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FOREWORD

Bangladesh Agricultural University Research System (BAURES) is coordinating, organizing and monitoring all non-degree oriented research programmes undertaken by the teachers of this university. At present 544 projects are being carried out by the teachers and researchers in different disciplines of agricultural sciences. The annual review workshop is a regular process to present, discuss and evaluate the progress of researches carried out in the preceding year. I am very happy to know that the publication of the 33 volume of the Bangladesh Agricultural University Research Progress in the form of proceedings of the workshop held on 18, 19 & 20 March 2023 (Published on May 2023). This volume contains 415 abstracts of on-going/completed research projects conducted in the fiscal year 2021–2022. I am confident that the research findings documented in this report would be much helpful to the researchers working in the field of agricultural sciences.

I am taking the opportunity to congratulate the Principal Investigators/Project Directors and all other investigators/researchers of different research projects for presenting their research findings to make the workshop a success. My heartfelt thanks are due to the Associate Director, BAURES, Dr. Paresh Kumar Sharma and Mr. Abul Hashem, Deputy Director, BAURES.

Special appreciation and thanks are expressed to the national and international donor agencies for funding and implementing the research projects under BAURES. Finally, the encouragement and supports extended by the honorable Vice-Chancellor of BAU are gratefully acknowledged.

Professor Dr. Md. Zainul Abedin
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EDITORIAL NOTE

Bangladesh Agricultural University Research System (BAURES) is responsible for providing necessary supports of overall administration, monitoring and implementation of research projects conducted by the teachers and researchers of different faculties of Bangladesh Agricultural University (BAU), Mymensingh. BAU itself provides grants for the research projects which have been increased by volume and number in the recent years. Through administrative and legal supports, BAURES has attracted many national and international donor agencies to provide research grants to the reseachers of BAU which is being steadily incleasing. The findings of these research projects are presented in the annual workshop which is held every year, and the progress of the projects are evaluated as part of the monitoring and evaluation process of BAURES. This Volume of the proceeding includes abstracts of 415 research projects presented in the workshop held on 18, 19 & 20 March 2023, where 272 projects were funded by BAURES, and the the remaining were funded by the domestic and and international donor agencies.

The aim of publishing this proceeding is to provide information generated through the project based research by the teachers, researchers and extension workers engaged in agricultural reseach and development. This proceeding is edited by an editorial board consisting of intellectual expert members from six different Faculties of BAU. We have tried our best for quality publication of the proceeding however, suggestions are always highly appreciated by BAURES regarding improvement the publication in the coming days and our best effort will be continued for improving the standard of future proceedings.

I would like to extend my sincere thanks and appreciation to the contributors and to the learned members of the editorial board for their sincere cooperation and help in preparing, improving and proof reading of the abstracts. I would also like to acknowledge and appreciate the valuable inputs of Prof. Dr. Md. Zainul Abedin, Director; Dr. Paresh Kumar Sarma, Senior Scientific Officer (SG); Mr. Md. Abul Hashem, Deputy Director and Mr. Md. Nazrul Islam, Computer Operator; BAURES in publishing this proceeding.

I wish you all the successes of respected reseachers of BAU as a whole.

Professor Dr. A K M Mominul Islam
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Bangladesh Agricultural University, Mymensingh, Bangladesh

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CHAPTER II
Faculty of Agriculture

CHAPTER III
Faculty of Animal Husbandry

CHAPTER IV

Faculty of Agricultural Economics and Rural Sociology

CHAPTER V

Faculty of Agricultural Engineering & Technology

CHAPTER VI
Faculty of Fisheries

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Insights into the Mucosa and Mucosa-associated Lymphoid Tissues in the Gastrointestinal Tract of Sonali and Indigenous Chicken

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Abstract
The experiment was conducted to the comparative study of mucosa and mucosa associated of lymphoid tissue (MALT) in the gastrointestinal tract of Sonali and indigenous chicken. A total of 20, 6-7 weeks old male sonali and indigenous chicken were used in the study and were divided into 2 equal groups (n=10). After ethically sacrifice, the samples were collected. The histomorphological study revealed that the lamina epithelium and tunica mucosa of the esophagus were thick in the Sonali than the indigenous chicken. The lamina epithelium of the proventriculus was highest in the indigenous chicken followed by sonali. The villi of duodenal, jejunal and ileum were higher in the sonali followed by indigenous chicken. The highest width of the villi of duodenum, jejunum and ileum were found in the indigenous chicken. Lymphocyte population in upper segments of gastrointestinal tract and small intestine were highest in indigenous chicken due to their scavenging. The lymphocyte population of Meckel's diverticulum were highest in sonali followed by indigenous chicken. The thickness of mucosa and depth of the crypts of Lieberkühn of caecum were highest in indigenous chicken. The lymphocyte population of cecal tonsil were higher in indigenous chicken. The thickness of tunica mucosa and depth of the crypts of Lieberkühn, the lymphocyte population of colo-rectum were higher in indigenous chicken than the sonali breed. In present study, the indigenous chicken was found more competent in perspective of mucosa associated lymphatic populations.

Enrichment of the Anatomy Museum for Enhancing Quality Veterinary Education and Research

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Abstract
The museum is a centre for learning new information or knowledge through visual observation. Anatomy museum explores the knowledge based on the shape and structure of living beings as a whole or part. This research study was aimed to enrich veterinary anatomy museum collecting samples and preparing the skeletons, preserve, interpret, and display items of artistic, cultural, or scientific significance for the education of the educators and public. In this research project, we also described a simple techniques for the preparing of skeleton, stuffing for the teaching of animal structures, organs or animal as a whole. For preservation of the skeletons, the animals were sedated, skinned then internal organs removed. The sample was boiled with lemon extract combined with baking soda and kept in bleaching agent. The bones were washed out with clean water and sun-dried. The bones were arranged and connected with glue and wire. Finally, the skeleton was fixed on a wooden stand to be stored easily the animal structure for teaching purposes. The stuffing process involves keeping the appearance of an animal intact using cotton, iron rod, wire and some chemicals after removing and processing the skin of a dead animals. In the mean time a good number of skeletons (Elephant, Giraffe, Goyal, Common Eland, Horse, Monkey, Cow, Goat, Dog, Cat, Chicken, Turkey etc.), stuffed birds/animals (Rabbit, Cock, Pigeon. Duck, Lizard etc.), and organs of animals (Liver, Kidney, Spleen,

Stomach, Heart) were preserved. Implementation of this technique for animal structure are teaching based on inquiry-discovery learning shown that students have good process skill (cognitive process, knowledge, creativity and innovation). The anatomy museum offered great promise to cope with anatomy practice in veterinary education and another science subjects as well. In conclusion such a museum will certainly have a more holistic approach to anatomy study and will be more educative and scientific.

Development of Antioxidants Based Antidote against Pesticide (Imidacloprid)-Induced Hepatotoxicity in Rats

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Abstract

Pesticide residues in food and food products are an essential public health problem. The present study was designed to develop a mitigation option against IMI-induced hepatotoxicity by supplementing antioxidants (vitamin E & Selenium and vitamin C) in IMI-exposed adult male rabbits. Twenty-five adult male rabbits were divided equally into 5 groups, namely: Group-1 (control), Group-2 (IMI-exposed), Group-3 (IMI + Vit E-Se), and Group-4 (IMI + Vit C). Rabbits of Group-1 received pesticide-free green grass, and Group-2 received IMI (Imidacloprid, Bildor® 0.5 ml (100 mg)/L water) contaminated green grass every alternative day once daily for up to 15 days. Rabbits of Group-3 and 4 received IMI-contaminated green grass, simultaneously Vit E-Se (Vit E @ 75 mg/L drinking water and Se @ 0.25 mg/L drinking water) and Vit C (100 mg/L drinking water) was given in the aqueous form in respective groups on every alternative day once daily up to 15 days. Blood serum analysis showed that the hepatic enzymes AST and ALT levels were significantly higher in IMI-exposed rabbits compared to the control and no changes in antioxidants-supplemented rabbits. Histopathology of the liver revealed coagulation necrosis with granulomatous inflammation and congestion in the parenchyma of periportal areas, Cholangitis was seen in the portal areas. Dilated and congested central veins were observed. No histopathological changes were seen in the liver of antioxidant-supplemented rabbits. Immunohistochemistry of the liver section showed that Iba 1-positive macrophage and CD8-positive T-lymphocyte were significantly increased in periportal areas of IMI-exposed rabbits, and interestingly their numbers remained normal antioxidants treated rabbits, indicating that antioxidant properties of Vit E-Se, Vit C have a protective role against IMI-induced hepatotoxicity in rabbits. The results suggest that the residue of IMI is responsible for hepatotoxicity which can be mitigated using different antioxidants like Vitamins C, E, and Selenium.

Expression and Molecular Sequence of GluN2B mRNA in the Brain of Pigeons (Columba livia)

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Abstract

Glutamatergic neurons are distributed widely in the avian brain, but their projection targets remain unknown. Our previous study showed localization of vesicular glutamate transporter 2 mRNA-

expressing glutamatergic neurons in the avian brain, suggesting many glutamatergic origins. Here, to know the expression of mRNA in the pigeon brain and to determine cDNA sequences of pigeon N-methyl-D-aspartate type glutamate receptor 2B (GluN2B). RT-PCR, clearly showed that the mRNA of GluN2B was expressed in the telencephalon, thalamus, optic tectum, and cerebellum of pigeon brain. From PCR products, a cDNA sequence of 4,576 bp containing 51 bp of 5' untranslated region (UTR), 4,512 bp of a single open reading frame (ORF), and 13 bp of 3' UTR was obtained for pigeon GluN2B. The obtained cDNA sequence of pigeon GluN2B showed 95% identity for chicken and 85% identity for human GluN2B. The encoded pigeon amino acids sequences showed 85% to 97% identity with human, rat, and mouse GluN2B amino acids. Pigeon GluN2B is closely related to GluN2B of other species as revealed in molecular phylogenetic trees inferred by a neighbour-joining (N-J) method. The obtained results indicate the regional differences of GluN2B mRNA-expressing neurons in the pigeon brain and suggest the existence of many glutamatergic projections and circuits in the avian brain.

Living with Pesticide in the Environment: Hazards, Awareness, Food Safety and Mitigation Options Against Pesticide Menace in Bangladesh

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Abstract

Imidacloprid (IMI) is the most well-known and commonly used broad-spectrum, systemic, neonicotinoids insecticide. Here, to evaluate the residual effects of IMI-contaminated feed exposure on the liver, lung, heart, and kidney of adult male rabbits (n=12) this study was performed. Pesticide-exposed rabbits (n=6) received IMI-contaminated green grass (Bildor® 0.5 ml (100 mg)/L water) every alternative day once daily for up to 15 days. The rest of the rabbits received a normal pesticide-free standard feed as control. No evident toxic symptom was found on regular monitoring of rabbits during the experiment. On day 16, after deep anesthesia blood and visceral organs were collected. The hepatic serum aspartate transaminase and alanine transaminase levels were significantly increased in IMI-exposed rabbits. Thin layer chromatography revealed that the residue of IMI was at a detectable level in the liver and stomach. Histopathologically, the liver revealed coagulation necrosis with granulomatous inflammation and congestion in portal areas with dilated and congested central veins. The lungs showed congestion of blood vessels and granulomatous inflammation around the terminal bronchiole. Accumulations of inflammatory cells were observed in the cortico-medullary junction in the kidney. The heart showed necrosis and infiltration of mononuclear cells within the cardiac muscles. The results of the present study emphasize that IMI-contaminated feed exposure causes toxicity into the cellular level of different visceral organs of adult male rabbits and it may also cause similar toxic effects the other mammals, especially the occupationally exposed person.

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Modulation of Growth Performance, Gut Morphometry and Cecal Microbiota in Broilers by Clove (Syzygium aromaticum) and Tulsi (*Ocimum sanctum*) Supplementation

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Abstract
In an epoch of the growing risk of antibiotic resistance, there is a dire need to establish an alternative feeding practice for broiler nutrition as an alternative to antibiotic growth promoters (AGPs). The aim of the current study was to evaluate the impact of clove powder and tulsi extract on the growth performance, gut morphology, and cecal microbial status of broiler. Sixty day-old chicks of Cobb-500 strain were randomly divided into 4 groups, each having 15 birds. Chicks of the control group (T0) were fed commercial broiler feed with no additional supplementation. The treatment groups were offered commercial broiler feed and received clove powder and tulsi extract with drinking water at the rate of 0.5% + 2% (T1), 1% + 3% (T2), and 1.5% + 4% (T3), respectively. Results showed a nonlinear relationship with the dosage of clove and tulsi. All the growth parameters substantially ($P < 0.05$) improved in T2 while T1 and T3 showed no significant improvement compared to T0. The final body weight was significantly ($P < 0.05$) higher in T2. Giblet and offal weights showed no noticeable differences except in the intestine and heart where intestine weight markedly ($P < 0.05$) decreased in T3 and heart weight significantly ($P < 0.05$) increased in T1 and T2. Clove and tulsi supplementation substantially improved the villus height and surface area of the small intestine in T2 while the large intestine remained mostly unaffected by the treatment. Cecal microbial status significantly improved in all the treatment groups having increased ($P < 0.05$) *Lactobacillus spp.* count and decreased ($P < 0.05$) *E. coli* count compared to T0. Based on these findings, it can be concluded that clove and tulsi can improve the growth performance and gut health of broilers and might be supplied as a potential alternative to AGPs.

Pathobiology of Edible Vegetable Oils on the Vital Organs of the Rabbit: A Health Perspective Study in Bangladesh

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Abstract
Consumption of heated cooking oil (HCO) has been a regular practice despite the serious health risks associated with it. Therefore, the current study was designed to investigate the consecutive effects of long-term dietary intake of heated vegetable oils on weight gain, blood pressure, pulse rate, and sero-biochemical indices in rabbits to assess their overall health status. A total of 42 male rabbits at six months of age were randomly divided into 7 equal groups (n=6): one control and six oil (i.e. soybean, palm, mustard, coconut, sunflower, and rice bran oil) fed groups. The oil-fed groups were supplemented with 3ml oil/kg body weight mixed with their diet for six months. The blood pressure and pulse rate of the rabbits were measured on a weekly basis while the blood samples were collected after six months of the experimental trial period. The results showed that the weight gain was substantially higher ($P < 0.05$) in oil-fed rabbits, especially in the soybean and palm oil groups. The

blood pressure was also increased markedly ($P < 0.05$) in the soybean and palm oil-fed rabbits followed by mustard, coconut, sunflower, and rice bran oil groups. Serum biochemical data showed no mentionable difference ($P > 0.05$) in the protein levels. However, total cholesterol and creatinine levels substantially ($P < 0.05$) rose in the soybean and palm oil groups. Levels of ALT and AST markedly dropped ($P < 0.05$) in all the oil-fed groups while the ALP levels notably increased in the soybean and sunflower oil groups. Levels of testosterone were noticeably lower ($P < 0.05$) in all the oil-fed groups except the soybean oil group which showed a significant rise. Cardiac troponin levels markedly increased in all the oil-fed rabbits. Based on these findings, it can be concluded that the consumption of heated vegetable oils might result in obesity and increased blood pressure while soybean and palm oil consumption might affect the hepato-renal, cardiac as well as reproductive functionality in male rabbits.

Dietary Chitosan Oligosaccharides for Improving Gut Health and Immunity in Broilers

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Abstract

Feed additives are routinely used for improving poultry health and production worldwide. Chitosan oligosaccharides (COS) is a relatively new feed additive that is a derivative of chitosan, a non-toxic linear polysaccharide with many biological functions. To investigate the efficacy of COS on gut morphology and serum biochemical profile (lipid, protein, glucose, creatinine and enzymes), a total of 180 day-old broiler chicks ($n = 45$) were allocated into allocated to 1 of 4 groups: control (T0) and treatment groups (T1, T2 and T3) fed basal diet supplemented with increasing amounts of COS for 35 days. Our findings showed that dietary COS supplementation had positive effects on the body weight and body weight gain in the treatment groups. Villus height and width, ratio of villus height and crypts depth, and tunica mucosa thickness of duodenum increased ($P > 0.05$) in the treatment groups (T1 and T2), whereas crypts depth of duodenum and cecum were decreased in the treatment groups (T1 and T2) compared to the control group; treatment group 3 (T3), however, was almost similar to the control group. In the case of cecum, tunica mucosa thickness, length and width of mucosal folds showed similar results as duodenum. The population and size of intestinal glands and lymphocytic infiltration in the mucosa were increased considerably in the treatment groups (T1 and T2) than control group. Total serum cholesterol, triglyceride, LDL and VLDL cholesterol levels were significantly lowered in the treatment group 2 (T2) than control group or other COS treated groups ($P < 0.05$), although HDL cholesterol level was significantly ($P < 0.05$) higher in all of the treatment groups, but substantially higher in the group treatment groups 1 and 3 (T1 and T3) compared to control group. Total serum protein, albumin, and globulin were gradually increased in all of the treatment groups along with the increasing dose rates. The liver and kidney functions (ALT, AST and creatinine) were not significantly ($P > 0.05$) affected due to COS supplementation. These results suggest that COS has a dose-dependent response to improve gut morphology and health physiology in broilers; low to medium doses are more favorable for safe poultry production as it enhances growth performance, increases villus surface area, reduces undesirable cholesterols and positively affects the blood glucose and protein levels. These results would be helpful in exploring the efficacy of COS as a potential feed additive for safe poultry meat production, which is a time-demanding issue for the poultry industry from the consumers' point of view.

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Effects of Non-nutritive Sweeteners on the Brain, Liver, Heart, Kidney, Pancreas and Blood Profile of Diabetic Mice

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Abstract
Diabetes mellitus (DM), is a group of metabolic disorders characterized by high blood sugar and if not treated properly diabetes can cause adverse disease leading to death. In order to reduce blood sugar, non-nutritive sweeteners or artificial sweeteners like aspartame, sucralose, saccharin, acesulfame potassium (AceK), and sodium cyclamate of in different brand names have been using which have adverse pathological effects. Therefore, this project has been designed to study the effects of aspartame, sucralose, saccharin, acesulfame potassium (AceK), and sodium cyclamate on the brain, liver, heart, kidney, and pancreas of artificially induced diabetic mice in comparison to the control. Our results showed that the average weight of the mice in between male and female varied. The male weight ranges from 30 g - 39 g and that of female 24 - 31 g. The random sugar of the control mice also varied in between male and female being higher in male. Different blood parameters also varied between male and female mice where most of the parameters were higher in female; NRBC, lymphocytes, neutrophils, eosinophils, and basophils are high in some groups while total WBC and PLT is low in most of the groups. The serum analysis revealed higher ranges of total bilirubin (TB), total bile acid (TBA), creatinine and glucose. In contrast, low level of amylase and phosphorus found in the treated diabetic mice in comparison to the control. Histological structures of the brain, heart, liver, pancreas and kidney of the control mice showed normal architectures, however, noticeable changes were recorded in the brain and pancreatic tissues. These results suggest some adverse effects of artificial sweeteners in mice. However, further study is required to explore the deep insights of pathobiology of artificial sweeteners.

Embalming: An Innovative and Cost-effective Technique for Fixation and Preservation of Carcasses in Bangladesh

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Abstract
Embalming is the art and science of preserving the body of an animal after death with the use of certain chemicals. During the renaissance period of Europe embalming techniques were primarily used to preserve the cadavers for dissection and study purposes (Saeed et al., 2001). In the present study, 10% neutral buffered formalin (NBF) and saturated salt solution were injected through the carotid artery of goats to preserve the gross structures, color, flexibility, textures, histoarchitectures, and histochemical components of the embalmed animals. The gross results showed that the structure, color, flexibility and textures of the skeletal muscles and viscera of the 10% NBF embalmed goats were well maintained and durable for the study in comparison to control and saturated salt solution. The joints were well moveable in 10% NBF embalmed goats and the skeletal muscle, intermuscular connective tissues and visceral organs showed standard histological architectures than others. These results suggest that 10% NBF would be more effective for embalming of tissues in Bangladesh.

RT-PCR Based Detection and Pathotypical Characterization of Newcastle Disease Virus Isolated from Layer Chickens in Some Regions of Bangladesh

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Abstract
Newcastle disease virus (NDV) is endemic in Bangladesh and is a major threat to commercial poultry operations. It is a contagious viral disease affecting birds throughout the world and causing economic losses in the poultry industry. The present research work was carried out to isolate and identify Newcastle disease virus (NDV) by using haemagglutination (HA) test and reverse transcription-polymerase chain reaction (RT-PCR) using primers of Fusion (F) and Matrix (M) genes. A total of 12 samples (Brain, trachea, proventiculus) were collected from 4 clinically ND suspected dead birds through post-mortem examination from Trishal and Mymensingh sadar. All the samples were inoculated onto 10-day-old embryonated chicken eggs through chorio-allantoic membrane route. The allantoic fluid (AF) of the dead embryos harvested at 48 and 96 hours of post-infection. Total 04 isolates were identified by HA and chicken embryo inoculation after obtaining samples through post mortem examination. Pathotypical characterization of all NDV field isolates revealed that all isolates were velogenic (MDT:<60, ICPI:1.5-2.0). RT-PCR have been performed using the primers for partial amplification of F (839bp) and M (970bp) genes through which all 04 isolates were confirmed as NDV. For PCR amplification of a 970 bp fragment spanning nt 1161 of the M gene through nt 889 of F gene, whereas for amplifying the 839 bp fragment covering nt 862 through 1700 of F gene, were used. Therefore, the molecular method (RT-PCR) can be applied for rapid and confirmatory detection of velogenic strains of NDV which is mostly prevalent in field level in Bangladesh.

Molecular Detection of Serovers, Virulence Factor Genes and Antibiogram Study of *Salmonella* sp. in Avian Salmonellosis in Bangladesh

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Abstract
Avian Salmonellosis is a devastating disease of commercial poultry and it has also zoonotic importance. The *inv*A and *inv*E genes play a crucial role in the pathogenicity of Salmonella infection. Virulence factors also encoded in the plasmid of a pathogenic bacteria and plasmid carrying virulence gene easily transmitted between different hosts. The study was aimed at characterization of virulence factor genes and plasmid typing of *Salmonella* sp. to reveal the mode of pathogenicity of Salmonellosis. A total 70 samples collected from avian Salmonellosis suspected chicken, among them 13 were positive for *Salmonella* sp. (18%) at PCR assay by genus specific primer. All the isolates considered as *Salmonella enterica* species among them 5 were serovars S. Gallinarum (2 were biovars Gallinarum and 3 were biovars Pullorum), 7 were serovars S. Typhimurium and 1 were untyped. All the isolates were virulent which carrying virulence factor *inv*A and *inv*E genes (100%) and showed very close genotypic relationship among the isolates through sequencing and phylogenetic analysis. Among the isolates 92.30% (12) *Salmonella* sp. were Amoxicillin resistant (*bla*TEM) gene positive and 84.61% (11) were Cephalosporin (*bla*CMY) gene positive respectively. The findings revealed that

all the isolates were virulent (*inv*A and *inv*E) genes carrying as well as Amoxicillin and Cephalosporin resistant *Salmonella* sp. is prevalent at the study area. Cephalexin, Cephotaxime and Cefoxitine may be the right choice antibiotics for therapeutic purpose at the study area.

Isolation and Identification of Enteric Bacteria From Different Water Sources At Mymensingh City and Their Antibiogram Study

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Abstract
The study was carried out to isolate and identify the enteric bacteria from water samples of different sources and locations of Mymensingh city. A total of 40 water samples were analyzed. Enteric bacteria were isolated and identified by culturing, staining and biochemical tests followed by polymerase chain reaction (PCR). Disk diffusion assay was employed to investigate antibiotic resistance phenotype. Among the 40 bacterial isolates, 3 (7.5%) were confirmed as *Salmonella* spp. 6(15%) *Shigella* spp., 14 (35%) *E. coli*, and 3(7.5%) *Vibrio* sp.. *Salmonella* sp. was confirmed by the detection of *bcfC* gene, *Shigella* spp. by *invC* gene, *E. coli* by *16SrRNA* gene and *Vibrio* spp. by *groEL* gene through PCR. Furthermore, PCR-confirmed isolates were subjected to antibiotic susceptibility test against 12 commonly used antibiotics. All the Salmonella isolates found 100% resistance against Amoxicillin whereas 100% sensitive to Azithromycin. However, variable sensitivity were also found against Cefepime (80%), Gentamycin (80%), Levofloxacin (75%), Cotrimoxazole (74%), Amikacin (70%). Resistance to Ceftazidime (70%) and Ceftriaxone (33%) were also observed. The isolates of *Shigella* sp. exhibited higher resistance patterns against Cefepime (83%) and Ceftazidime (67%). Additionally lower level of resistance were recorded against Amoxicillin (17%) and Colistin (10%). Highly susceptibility were observed against Azithromycin, Levofloxacin, Cotrimoxazole, Ceftriaxone, Amikacin and Gentamicin. The isolates of *E. coli* exhibited higher resistance patterns against Amoxicillin (100%), Colistin (93%). Cefepime (72%), Cotrimoxazole (72%), Azithromycin (72%). Additionally lower level of resistance was recorded against Ceftriaxone, Amikacin Ceftazidime, Levofloxacin, and Gentamicin. The isolated *Vibrio* sp. exhibited higher resistance patterns against Ampicillin (100%), Cefepime (81%), Cefixime (72%), Amoxicillin (70%), Erythromycin (67%), Ceftazidime (67%). Conversely, highly sensitive or intermediately sensitive isolates were exhibited against Gentamicin, Levofloxacin, Doxycycline, Cotrimoxazole, Amikacin. The findings of this study suggest recent and continuous contamination of water sources, thus exposing the resident dependent on the water for drinking to potential risks of gastrointestinal infections.

Genomic Diversity and Characteristics of *Streptococcus* spp. Isolated from Clinical Mastitis of Cattle in Some Selected Areas of Bangladesh

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Abstract
Streptococci are the major pathogen in clinical and environmental mastitis. *Streptococcus* (*S.*) *agalactiae*, *S. dysagalactiae* and *S. uberis* are mostly encountered in bovine mastitis; however, data on the diversity and characteristics of Streptococcus in clinical mastitis of cattle in Bangladesh is lacking.

Thus, the present study was aimed to determine the diversity and antimicrobial resistance of *Streptococcus* spp. isolated from clinical mastitis of cattle. A total of 105 milk samples comprising eighty (80) from clinical cases and twenty five (25) from apparently cattle were examined. Milk samples were enriched in Luria Bertani broth (LB) and *Streptococcus* spp. was isolated on Modified Edwards Medium and identified by 16S rRNA sequencing. Among eighty (80) clinical samples, eighteen (18) were positive for *Streptococcus* spp. While none of the milk samples from apparently cattle revealed Streptococcus by cultural and molecular examination. Sequencing and phylogenetic analysis revealed 55.56%, 33.33%, 5.56% and 5.56% of the isolates as *S. uberis*, *S. agalactiae*, *S. hyovaginalis* and *S. urinalis*, respectively. Antibiotic sensitivity testing elucidated 55.6% of the *Streptococcus* spp as multi-drug resistant (MDR). Molecular characterization through whole genome sequencing of three (3) *S. agalactiae* and five (5) *S. uberis* isolates explored them as a member of ST4 and two novel ST types, respectively. Pan-genome and phylogenetic analysis of the core gene sequences revealed *S. agalactiae* clustering with human isolates from France and UK, whereas *S. uberis* isolates clustered in two sub-clusters, one close to the pathogenic and other with the non-pathogenic strains previously described in the UK, respectively. Moreover, the isolates carried all the virulence factors related to intramammary infection and of zoonotic importance. In nutshell, Streptococcus present in bovine clinical mastitis in Bangladesh is diverse which need to be further evaluated with more number of samples from different part of the country.

Detection and Characterization of Fosfomycin Sensitivity and Resistance Pattern in E. coli Isolated from Livestock and Poultry

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Abstract

Antimicrobial resistance is a global health crisis. Fosfomycin is a reserve group of antibiotic used to treat MDR bacterial pathogens. In this study we screened total 78 fecal samples originating from cattle (n=32) and poultry (n=46). Isolation and identification of E. coli were based on culture and PCR. The sensitivity of the isolates was carried out by disk diffusion test. Among these 78 fecal samples, 32 (cattle=11, poultry=21) were found positive for E. coli. Overall occurrence of E. coli was 41.02%. In the antibiotic sensitivity test all the isolates were found sensitive to fosfomycin and also to carbapenem group of antibiotics e.g., imipenem, meropenem, doripenem and ertapenem. Among these isolates, about 18.57% isolates were resistant to streptomycin, 9.37% to ceftazidime, 21. 85% to tetracycline, 12.50% to ceftaxime and 21.85% to gentamicin. Further studies are required with more samples to know the actual status of sensitivity or resistance pattern of E. coli against fosfomycin in cattle and poultry in Bangladesh.

Serological Investigation of Avian Leukosis Virus (ALV) Infection in the Selected Poultry Farms in Bangladesh

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Abstract

Avian leukosis (AL) is one of the important viral diseases of poultry that is widespread and reported in Bangladesh as well. This disease is caused by a notorious retrovirus called the avian leukosis virus

(ALV). Immunosuppression by this virus due to various types of tumors and egg production of the layers bird significantly reduced which causes significant economic losses. However, there is limited information on the prevalence of ALV in Bangladesh. Therefore, the aim of this study is to investigate the prevalence of ALV infection in the different poultry farms of Bangladesh by serological assays. A total of 125 cloacal swabs were collected from chickens of 6 different layer farms in the Mymensingh (5) and Jamalpur (1) districts with their histories including age, egg production, egg quality, vaccination, etc. ELISA (BioCheck Immunoassays) was performed using antigen (Ag) detection kits from the samples according to the manufacturer's protocol and generated data were analyzed using various available statistical tools. ELISA results showed that the overall prevalence of ALV was 4.8%. The prevalence of ALV in farms A, B, C, D, and E of Mymensingh district were 3.13%, 0%, 0%, 28%, and 0% respectively. Whereas the prevalence of ALV infection in farm F of Jamalpur district was 7.31%. In addition, we found that birds aged 20 weeks, 25 weeks, and 51 weeks showed a prevalence of 3.31%, 7.31 and 28.0 and respectively. On the other hand, birds of age 22 weeks, 10 weeks, and 53 weeks showed no disease occurrence. The results suggested that ALV is circulating in Bangladesh and therefore it is strongly recommended to further investigate the molecular status and genetic characteristics of the ALV circulating in Bangladesh.

Molecular Investigation and Genetic Characterization of Bovine Viral Diarrhea Virus (BVDV) of Cattle in the Selected Regions of Bangladesh

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Abstract

Bovine viral diarrhea (BVD) caused by BVD virus (BVDV) is an economically important viral disease of cattle distributed throughout the world including Bangladesh. A report showed a high prevalence of BVDV (Around 50%) which is a great threat to the livestock sector in Bangladesh. Therefore, the current study is designed for the molecular investigation of BVD and the genetic characterization of BVDV in Bangladesh. However, a total of 38 samples among which 31 milk and 7 sera, were corrected from the cattle with histories either of diarrhea, fever, abortion, repeat breeding, retained placenta, etc. The samples were then subjected to ELISA followed by molecular identification by reverse transcriptase PCR and sequencing. ELISA results showed that BVDV occurrence is higher in serum samples (57%) compared to milk samples (29%). However, overall, 34% of cows are positive for BVDV infection. Then cDNA was synthesized from the extracted RNA from the ELISA-positive samples and PCR was conducted using three sets of BVDV gene-specific primers. However, we could not able to detect BVDV by RT-PCR from the samples. We are still trying to detect the BVDV by RT-PCR from the fresh samples. In conclusion, the high prevalence of BVDV infection in Bangladesh suggested that molecular detection and genomic characterization of BVDV should be continued.

Zoonotic *Salmonella* Serovars in Buffaloes: Occurrence, Molecular Detection and Characterization of Virulence and Antimicrobial Resistance Genes

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Abstract

There are only few reports of incidence of *Salmonella* in retail raw buffalo meat. There is only one report on bacteriological quality of buffalo meat samples in Bangladesh. However, there was no report

on molecular characterization of virulence and antimicrobial resistance genes of Zoonotic *Salmonella* serovars isolated from buffaloes in Bangladesh. Therefore, the aim of the present study is to isolate, identify and characterize virulence and antimicrobial resistance genes of Zoonotic *Salmonella* serovars from buffaloes. Altogether 200 raw buffalo meat and offals comprising of muscle, intestine, liver and lung (50 samples each) were collected into sterilized polyethylene bags from the different locations of Bagerhat, Bhola, Sherpur and Jamalpur districts. Isolation and molecular detection of zoonotic *Salmonella* serovars were done using standard procedures. Detection of five virulence genes viz. *invA, stn, fimA, spvR* and *spvC* were performed using PCR. All *Salmonella* serovars were tested against commonly used antibiotics using disk diffusion method. Antimicrobial resistance genes were detected using PCR. In this study, a total of 74 *Salmonella* isolates were obtained from 200 collected samples. Out of 74 *Salmonella* isolates, 14 isolates were identified as *Salmonella* Typhimurium by using culture, biochemical tests and PCR based techniques. The remaining 60 isolates were categorized as unclassified salmonellas. All the isolates of *Salmonella* Typhimurium revealed the presence of *invA*, *stn* and *fimA* genes. Ten (71.43%) of the isolates showed the presence of *spvR* gene and 5 (35.71%) had the *spvC* gene. The findings of the present study revealed the presence of multidrug resistant *Salmonella* Typhimurium in buffalo meat. All the isolates of *Salmonella* Typhimurium revealed the presence of *bla*TEM-1 genes. Seven (50%) of the isolates showed the presence of *tetA* gene.

Epidemiological Study on Campylobacteriosis in the Selected Sheep Farms at Mymensingh and Development of a Protocol for the Long-term Storage of Sheep Blood for Campylobacter Growth

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Abstract

This study was carried out to confirm the prevalence of *Campylobacter jejuni* by evalution of fecal samples (a single sample from each sheep) collected from randomly selected 408 sheep of 12 flocks of Mymensingh and Sherpur districts. The samples were tested by both basic (culture and biochemical tests) and molecular-based assays (initially 16S rRNA, and later virulence testing *cdt* gene-based multiplex PCR). Further, antimicrobial susceptibility status of *Campylobacter jejuni* were confirmed via a disk diffusion method. Flock and animal-level data were captured using semi-structured interviews with owner the farm under in bivariable and multivariable logistic regression analysis for confirming risk factors of Campylobacter-positive status. In this study an animal level prevalence of 8.82% (36/408) and a flock level prevalence of 66.70% (8/12) for *Camplylobacter jejuni* stains. The age of the sheep was identified as important risk factor. The sheep up to 1 year age have 3.78 times (95% CI: 1.0736-13.3146, p= 0.038) more likely to be infected with *C. jejuni.* Of 36 isolates of *C. jejuni,* all were found to be fully susceptible (100%) to gentamicin (GEN) and ciprofloxacin (CIP). Alarmingly, three antimicrobial agents such as oxytetracycline (OTE) and azithromycin (AZM) and ceftriaxone (CRO) were showed fully resistant (100%) in this study. Majority of isolates were found resistant to in combination of four to six antimicrobials agents. The study has highlighted predominant maintenance zoonotic C*ampylobacters* in sheep and their burden in human health is enormous.

Epidemiological Studies on Shiga Toxin-producing *Escherichia coli* O157:H7 and Cytolethal Distending Toxin-producing *Campylobacter jejuni* from Foods and Diarrhoeal Stools in Mymensingh

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Abstract
This study was designed with a view to collect different food samples and human diarrhoeal stools, isolation and identification of *E. coli* O157:H7, *E. coli* non-O157:H7 and *C. jejuni* by conventional and molecular methods, virulence characterization of the isolated bacterial strains. A total of 500 food samples (fresh vegetables, raw milk and milk products, poultry meat, sugar cane juice and betel leaves) were randomly purchased from different markets/traders/hawkers in Mymensingh district of Bangladesh. A total of 300 diarrhoeic stools were collected from patients with diarrhoea who present themselves in Surya Kanta (SK) Hospital of Mymensingh. Prevalence of *E. coli* O157:H7, *E. coli* non-O157:H7 and *C. jejuni* in foods and diarrhoeal patients has been recorded. Different virulence genes were identified in *E. coli* O157:H7, *E. coli* non-O157:H7 and *C. jejuni* isolates obtained from foods and diarrhoeal patients in this study. Majority of the *E. coli* isolates of milk origin were resistant to amoxicillin and erythromycin in this study. On the other hand, it was observed that majority of the *C. jejuni* isolates of fresh vegetables origin were resistant to tetracycline, erythromycin, amoxicillin and ciprofloxacin. Vendors/traders' knowledge, attitudes and practices towards food hygiene were assessed in this study.

Polyvalent Vaccine Development for Mastitis in Dairy Cow

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Abstract
Mastitis is frequently found in lactating cows worldwide including in Bangladesh. This study was conducted to develop a polyvalent mastitis vaccine to prevent mastitis in lactating cows and reduce the indiscriminate use of antibiotics in dairy farming. Mastitis-affected cow milk was collected from randomly selected cows after being confirmed by California Mastitis Test, then the samples were allowed to Somatic Cell Count (SCC) by LactoScan Combo. Afterward, SCC-positive milk samples were inoculated on selective growth media, incubated at 37 ^{0}C, sub-cultured and confirmed by PCR and MALDI-ToF MS. Next-generation sequencing of isolated primary mastitis-causing pathogens was done by NextSeq-550, analyzed and submitted to GeneBank. Polyvalent mastitis vaccine was prepared using the pathogenic bacteria by inactivation with formalin. The vaccine safety, potency and efficacy were tested according to OIE, BP and in-house protocols. A total of 423 cows were tested, and 44.68% of the tested cows found mastitis affected, where 17.49% (74/423) were clinical and 27.19% (115/423) sub-clinical mastitis. Subsequent, PCR and MALDI-ToF MS detection it was found that, 54.79% (103/189) of the mastitis-positive cows were infected by *Staphylococcus aureus*, 37.56% by *Escherichia coli*, 2.12% by *Streptococcus agalectiae* and 4.76% by *Streptococcus uberis*; the isolates are multidrug-resistant and zoonotic in nature. The WGS analysis found that the isolates carried many antibiotic efflux, antibiotic target alteration and virulent genes. Polyvalent mastitis vaccine was prepared using *S. aureus*, *E. coli*, *S. agaclactiae* and *S. uberis* in Water-in-Oil-in-Water adjuvant. The

vaccine was found safe in pregnant guinea pigs and mice; the vaccinated guinea pigs and mice survived after the challenge experiment with the live virulent pathogens. Clinical trial for the vaccine's safety, potency and efficacy is now in progress in experimental pregnant cows. The newly developed polyvalent mastitis vaccine will prevent mastitis in lactating cows, and would be beneficial to combat multidrug-resistant mastitis-causing pathogens, also minimize public health threats and would help economically dairy farmers of Bangladesh.

Molecular Detection and Characterization, Antibiogram and On-site Molecular Detection of *Riemerella anatipestifer* from Ducks (*Anas platyrhynchos domesticus*) of Different Areas of Bangladesh

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Abstract

This study was designed to detect *Riemerella anatipestifer* through polymerase chain reaction (PCR) from duck farming areas of the Mymensingh and Sylhet divisions and to determine the antibiogram profile of the PCR-positive isolates using the disc diffusion method. Fifty two samples were collected, comprising clinically sick (32 ducks) and dead ducks (20). PCR confirmation was accomplished, and consistent findings were observed, employing *R. anatipestifer gro*EL (271-bp) gene as appropriate molecular markers. For further clarification, see *R. anatipestifer* specific PCR assay (546-bp) and *gyr*B-based PCR (162-bp) were also done. The disc diffusion method was followed for the antibiotic susceptibility test of the isolates against commonly used antibiotics. A total of 21 samples, 8 from clinically sick birds and 13 from dead birds, showed positive results in both conventional and molecular assays out of 52 samples. High occurrences were found in oropharyngeal swabs from sick ducks and the liver and heart from dead ducks. Antibiotic susceptibility testing revealed that the isolates were 100% resistant to penicillin G, cefradine, streptomycin, neomycin, gentamycin, meropenem, and erythromycin, but 100% sensitive to cotrimoxazole, florfenicol, and levofloxacin. For diverse duck-populated areas in Bangladesh, this study shows the severity of *R. anatipestifer* infection among ducks.

Antibacterial Evaluation of Green Synthesized AgNPs against *E. coli* and *S. aureus* Isolated from Poultry

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Abstract

This study developed an ecofriendly, green synthesis protocol for the biocompatible Silver Nanoparticles (AgNPs) with broad spectrum antibacterial activity. This green AgNPs synthesis program employed Silver Nitrate ($AgNO_3$) solution as ion source and lemon extract as reducing agent as well as stabilizing agent. The particle yield was initially confirmed by UV-Vis spectroscopy while their morphological feature was revealed by the Atomic Force Microscopy (AFM). Both the physical characterizations tools revealed maximum AgNPs yield with a dimension of 34.5nm diameter by the reduction of 0.001M $AgNO_3$ (ion source) with lemon juice (reducing agent) at a ratio of 10:1 for 5h. The antibiogram assay revealed green synthesized AgNPs as an excellent antimicrobial against

Staphylococcus aureus and *E. coli* isolated from poultry. Moreover, the green synthesized AgNPs showed better antibacterial activity than the chemically synthesized one. Finally, the minimum inhibitory concentration (MIC) of the yielded AgNPs was 0.01mg/ml for *E. coli* and 0.02mg/ml for *S. aureus* while minimum bactericidal concentration (MBC) was 0.02mg/ml for *E. coli* and 0.04mg/ml for *S. aureus*. Considering this minimum doses, the AgNPs could be used as broad-spectrum antibacterial for inhibiting bacteria in a cost effective manner. Thus, the synthesized AgNPs holds promise to be an effective alternative of commercial antibiotic in poultry farming.

Molecular Detection and Genetic Characterization of Duck Viral Hepatitis Virus in Ducks of Some Selected Areas of Bangladesh

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Abstract
Duck Viral Hepatitis Virus (DVHV) is an acute, highly contagious virus often causes disease in ducklings and having high mortality of around 95%. Among the three serotypes, DHAV-1 is globally distributed, whereas DHAV-2 and DHAV-3 serotypes are predominantly restricted to Southeast Asia. Live duckling were showing nervous signs and opisthotonos and hemorrhagic lesion on liver of dead duckling. In this study, a total number of 52 liver samples were collected from suspected ducklings of less than six weeks of age. Samples were collected from Netrokona Sadar, Mohonganj and Mymensingh Sadar, Bangladesh. Samples were processed and RNA were extracted using Monarch® Total RNA Miniprep Kit following manufacturer's instruction. Reverse Transcription PCR (RT-PCR) were performed using primers pair F:5′-CCTCAGGAACTAGTCTGGA-3′, R:5′-GGAGGTGGTGCTGAAA-3 and F:5′ATCAGGGTGATTCTAACCAG-3′, R: 5′-CTTATTTCTAATTTGGTCAG-3′, targeting 5′UTR and VP1 gene respectively. Targeted amplicon size for 5'UTR and VP1 gene would be 250bp and 734bp respectively. Amplified segments were separated on 1% agarose gel along with 100bp DNA ladder and visualized under gel documentation system. No samples were found positive for DVHV.

An Investigation on the Presence of Bovine Viral Diarrhea Virus in Semen Used for Artificial Insemination in Bangladesh

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Abstract
Semen used for artificial insemination (AI) can lead to the spread of Bovine Viral Diarrhea Virus (BVDV) into inseminated heifers which may give birth of persistently infected calves. So, the aim of the study was to investigate the presence of BVDV in semen samples for safe insemination. To investigate the presence of Bovine Viral Diarrhea Virus in semen used for artificial insemination (AI) in Bangladesh a total number of 45 semen samples were collected from Department of livestock Services (DLS), artificial insemination center (AI center), and Animal Research farm of BAU. Reverse transcription PCR (RT-PCR) techniques were used to investigated the presence of BVDV in those semen samples. First, the semen samples were centrifuged to pellet the sperm cells. Sperms cells were then used to extract the RNA followed by RT-PCR according to the manufacturer's instruction. RT-

PCR were done by using 3 sets of primer namely BVDV-F/BVDV-R, BVDV-F1/BVDV-R1 and Pestivirus-F/Pestivirus-R. The first two primer was designed by targeting 5/-UTR region which results in a 201-bp and 230-bp fragments respectively and the third one was designed by targeting N-terminal end of E2 gene which results in a 106-bp fragments. None of the 45 samples were found to be positive for BVDV after Gel Electrophoresis. So, the semen samples that were collected and tested for our study are found to be safe from BVDV.

Molecular Detection and Biofilm Formation Ability of S. aureus Isolated from Bovine Milk in Some Selected Areas of Mymensingh Division

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Abstract
Staphylococcus aureus is one of the most common causal agents of mastitis in dairy and associated with biofilm formation in inanimate objects, animal and human body. The present study was designed to detect the biofilm producing *S. aureus* in bovine milk. by amplification of biofilm associated genes and biofilm formation assay in relation with antibiotic resistance profile. A total of 60 milk samples were collected from 60 milking cows of 4 different dairy farms in Mymensingh. Screening of *S. aureus* was done by culture in selective media, Gram's staining, biochemical tests, and amplification of thermonuclease gene (*nuc*). The biofilm associated *ica*A, *ica*B, *ica*C, and *ica*D adhesion genes were detected in *S. aureus* by PCR. The biofilm formation ability of *S. aureus* was determined by crystal violet staining of biofilm mass and culture onto Congo red agar plate. Antibiogram of each isolate was investigated by disc diffusion method and molecularly by detection of *blaZ*, *mec*A and *van*A genes. The occurrence of *S. aureus* in milk samples were 18.33% (n=11/60) and among the *S. aureus* isolates 18.18% (n=2/11) were biofilm producer. Only two isolates were found positive for biofilm associated genes of which one isolate harbors only *ica*A gene and another isolate harboring other three genes *ica*BCD. Each tested isolate able to form biofilm, of which 9.09% (1/11) and 91% were strong and moderate biofilm producer respectively. The isolates showed 100% resistance to Oxacillin and cefoxitin followed by 90.90% to penicillin and erythromycin. Highest 81.81% sensitivity was observed against gentamycin and vancomycin. There was no significant correlation between antibiotic resistance and absorbance value of biofilm production (P=0.12), but a moderate Pearson correlation (r=0.49) was observed between antibiotic resistance and biofilm production. The result of this study indicates that, biofilm harboring *S. aureus* are prevalent in cow milk which may lead to persistence of mastitis in cows or may transfer to human by consumption of milk.

Isolation, phenotypic and genotypic characterization of novel lytic bacteriophage BAU.Micro_ELP-22 against avian pathogenic *E. coli* O157:H7 strain for safe poultry production

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Abstract
Antimicrobial resistance is a concerning global public health threat for over years. Worldwide much attentions have been drawn for fighting this devastating crisis. Phage therapy is a new hope to combat

against antibiotic resistance. *E. coli* O157:H7 is a pathogenic bacterial strain associated with colibacillosis causes septicemia, perihepatitis, pericarditis and ultimately huge economic losses in poultry industries. Applying bacteriophage therapy as an alternative option of antibiotics is a prominent step to cope with the crisis. In this study a novel lytic bacteriophage BAU.Micro_ELP-22 was isolated from sewage water as a potential antibacterial bio agent against *E. coli* O157:H7 strain and was characterized by *in vivo* and *in vitro* approaches. The phage exhibited a broad host lytic activity, remarkable thermal stability from 0°C to 60°C and pH survivability from 4 to ≥ 9. According to one step growth curve analysis, the isolated phage has relatively shorter latent period of < 25 min and larger burst size of >250 PFU, which indicates it's strong lytic activity. The phage BAU.Micro_ELP-22 exhibited strong antibacterial activity against *E. coli* O157:H7 by *invitro* antibacterial activity investigation on the basis of OD value determination. No toxicity was observed in case of toxicity investigation test as the phage was injected into BALB/c mice model. More over in vivo efficacy test of the isolated phage revealed the successful recovery report of the *E. coli* O157:H7 infected experimental mice by the phage treatment. From Next generation sequencing (NGS) of the bacteriophage analysis data, the double stranded phage DNA length is 4,92,709 bp which contains 35.5% GC content and 858 coding sequences and does not contain any toxin producing or virulent gene. All the findings suggest that, BAU.Micro_ELP-22 is a potential candidate for phage therapy against *E. coli* O157:H7 strain to combat against colibacillosis as well as antibiotic resistance for safe poultry production.

Isolation and Molecular Detection of *Leptospira* spp. in the Rodent of Selected Areas of Mymensingh Division

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Abstract
Leptospira is one of the most important zoonotic bacteria which affects humans and animals, is known as leptospirosis in all over the world. Rats are the most important reservoir of Leptospira but domestic and wild mammals may also act as important maintenance or accidental hosts. It is endemic in many countries but this disease is not well recognized in Bangladesh. Socio-economically it is also very important threat to our livestock industry. This study was conducted to isolate and characterize Leptospira from rat population through cultural, dark field microscopy and molecular techniques. A total of 80 rat samples which includes rat kidney and urine samples were collected aseptically from urban and rural areas of Mymensingh district. Each sample was allowed to grow initially in the EMJH medium. Identification of the bacterial isolates was done by observing under dark field microscope followed by molecular detection by PCR. It was found that out of 40 rat samples of urban areas 16 were positive (40%) whereas in rural areas 10 rat samples were positive (25%) out of 40. From the both areas, female rat samples were found more positives than male rat samples but more Leptospira were found in adult rat samples than juvenile rat samples. We conclude that Leptospira is circulating among the rat populations of urban and rural areas of Bangladesh and despite the low infection rate reported, the high pathogenicity of some serovars of this organism raises concern of public health risks caused by rat transmission of leptospirosis.
Keywords: Leptospira, Rat, Isolation, Molecular detection

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Bacterial Diversity from Frequently Touched Objects of Toilets and Washrooms

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Abstract
This study was conducted to know the bacterial diversity from frequently touched surfaces of toilets and washrooms at BAU student residential halls using cultural, biochemical and molecular techniques and also to study their antibiogram. A total of 80 swab samples were collected aseptically from girl's and boy's halls of BAU followed by bacterial load determination by TVC, TCC and TSC. Isolation of bacteria was performed by giving culture of each sample in different bacteriological media. Identification of the bacterial isolates was done by staining, biochemical tests followed by molecular detection by PCR. Isolated organisms were then subjected to antibiotic sensitivity test using 13 commonly available antibiotics. The highest mean of TVC, TCC and TSC were log 5.91, log 5.75 and log 5.96 respectively in washroom samples and the lowest mean were log 5.39, log 5.13 and log 5.47 respectively in toilet samples, where the highest TVC, TCC and TSC were found in the floor surface samples. Out of 80 samples 57 (71%) were positive for *E. coli*, 70 (87.5%) for *Klebsiella* spp. and 75 (93.75%) for *Staphylococcus* spp. From the toilet and washroom samples *Staphylococcus* spp. were recovered in highest number (89.5%), (100%) followed by *Klebsiella* spp. (87.5%), (87.5%) and *E. coli* (75%), (65.6%). All the isolated organisms were found sensitive to gentamycin, chloramphenicol and resistant to amoxicillin, ampicillin. Methicillin Resistant *Staphylococcus aureus* was also found that bears a threat to the public health. This study will help to creating public awareness about the potential threat, thus prevent the spread of infectious diseases.

Sero-prevalence and Risk Factor of Brucellosis in Goats in Some Selected Districts of Bangladesh

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Abstract
Brucellosis is an emerging bacterial zoonotic disease of human and animal throughout the world including Bangladesh. It causes a huge economic losses in livestock industry due to abortion infertility. B. melitensis mainly causes infection in goat and *B. ovis* in sheep. To investigate sero-prevalence of brucellosis by screening serum samples of goat by rose Bengal plate test (RBPT) and indirect ELISA and to identify the risk factors associated with brucellosis in goats in the study areas. Blood samples (n=123) were collected from goat. Epidemiological information of animals including age, sex, breed, management practices of animals were recorded. Sera were tested for *Brucella abortus* specific antibody response by RBPT and i-ELISA. prevalence of brucellosis and identification of risk factors were determined.Overall prevalence of brucellosis in goats is 2.857 of the study areas. The prevalence of brucellosis in female goats was higher (6.451%) than the prevalence of brucellosis in male goats (0.00 %). Animal with abortion showed higher prevalence (22.22%). Prevalence of brucellosis was higher in cross bred goat (3.846%) and black Bengal goat (3.061%) compared to Jamunapari breed (0.00%). Prevalence of brucellosis in goat was higher in case of free ranging animals (3.528%) and semi intensive (2.380%) compared to intensive system(0.00%) Prevalence of brucellosis in older animals was higher (6.382%) compared to youngest animals. Household farm showed more

prevalence (4.878%) than commercial farm (0.00%) Prevalence of brucellosis goats at Veterinary hospital was 2.380% and in the slaughter houses was 2.857%. Data of this study suggest that brucellosis in goat is endemic in the study area.

Immunogenicity and Protective Efficacy of Oil Adjuvant Brucella Abortus Vaccine in BALB/c Mice

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Abstract
Bovine brucellosis caused by B. abortus is an economically important disease of cattle. The objective of this study was to evaluate immune response and protective efficacy of oil adjuvant B. abortus vaccine in BALB/c mice. BALB/c mice (n=30) at 6-8 weeks of age were immunized subcutaneously with *B. abortus* oil adjuvant vaccine. Booster vaccine was administered at 28 days post vaccination (DPV). Challenge infection of vaccinated and control mice was given at 42 DPV with virulent B. abortus biovar 3. Sera were collected from five randomly selected mice at 7, 14, 21, 28, 35 and 42 DPV for detection of antibody response by rose Bengal plate test (RBPT), Indirect ELISA. Bacterial load in the spleen of mice were determined at 7 days post challenge. Cell mediated immune response (CMI) in vaccinated mice was measured by delayed type hypersensitivity (DTH) reaction. B. abortus specific antibody response was detected in 80% vaccinated mice by RBPT. The ELISA OD value of sera of vaccinated mice were 0.244±0.001, 0.252±0.003, 0.546±0.030, 0.575±0.009, 0.684±0.005, 0.702±0.061 and 0.782±0.083 at 0, 7, 14, 21, 28, 35 and 42 DPV, respectively ($p<0.05$). Bacterial load of vaccinated mice (log 10 5.64±0.43 cfu/g) was significantly reduced as compared to unvaccinated control (log 10 6.45±0.78 cfu/g) ($p<0.05$). Swelling of footpad of mice was observed (1.16±0.13 mm, .14±0.16 mm and 0.96± 0.10 mm at 24hr, 48hr and 72hr, respectively). Data of this indicates that inactivated oil adjuvant B. abortus vaccine induces both humoral and CMI response and conferred protection in mice against virulent challenge infection.

Human–livestock contacts and their relationship in transmission of multidrug resistant zoonotic *Escherichia coli* in rural areas of Mymensingh

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Abstract
Livestock is regarded as the primary source of sustenance and income for the rural farmers of Bangladesh. In order to care for their livestock, farmers should come into close proximity to the animals, which elevates the risk of disease transmission. Transmission of *Escherichia coli* between livestock and human can be hazardous for both. Present study aims to the identification of *E. coli* from livestock, poultry and human at their phylogenetic and pathotypic levels with the determination of phenotypic and genotypic antibiotic resistance pattern. A total of 60 samples have been collected from Cattle (8), Goat (9), Sheep (2), Chicken (10), duck (5), pigeon (7), Children (8) and Human hand swab (11) of 11 rural households for the isolation of *E. coli* by culture, detection and differentiation by PCR, and antibiogram using 21 antibiotics with the detection of antibiotic resistant genes. Among the 49 culture positive *E. coli* isolates, 45 were confirmed by PCR and positive band was appeared at 401 bp

and 585 bp for 16SrRNA and *malB* genes, respectively. A higher degree antibiotic resistance was observed against amoxicillin, oxytetracycline, cefixime, amoxicillin-clavulanic acid and nalidixic acid whereas none of the isolates were resistant to imipenem and very few to meropenem, amikacin, gentamycin and Fosfomycin.

Identification of Chitosan Oligosaccharides as an Alternative to Antibiotic for Safe Poultry Meat Production in Bangladesh

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Abstract
Chitosan is a non-toxic polyglucosamine, widespread in nature, which is deacetylated to varying degrees form of chitin, a component of exoskeleton of shrimps, crabs and insects. Chitosan oligosaccharides (COS) is a new and less widely used feed additive. The present study was conducted to determine the effect of COS on growth performances of broilers. Five hundred Lohmann DOCs (day old chicken) meat broilers with initial body weight of 65.2-65.8 grams were equally divided into 5 dietary treatment groups. Presence of any antibiotic residues (ciprofloxacin, oxytetracycline and doxycycline) in feed was determined by thin layer chromatography (TLC) before supply to the birds. Dietary treatments were for group (A) basal diet (BD) without supplement, (B) BD + water soluble COS @ 300 mg L^{-1} of water, (C) BD + water soluble COS @ 400 mg L^{-1} of water, (D) BD + Antibiotic growth promoter @ 1g L^{-1} of water and (E) BD + Probiotics @ 1g L^{-1} of water. The diets were fed in a crumble form for starter phase (1-21 days) and pellet form for finisher (21-35 days) phase. Broiler chicken performances including body weight gain, hematological parameters, biochemical parameters of serum and intestinal bacterial loads were determined using standard methods. Body weight and bacterial load was determined every seven days interval. Whereas hematological and biochemical parameters were determined at day 0, day 21 and day 35 of age. No residue of ciprofloxacin, oxytetracycline and doxycycline was found in both starter and grower feed. The addition of COS @ 300 mg L^{-1} had a positive effect on increasing feed intake, BW, BWG, and decreasing FCR until end of maintenance compare to other treatment groups. Most of the hematological parameters in all treatments were not different except few. Variation in the biochemical parameters were observed during the study period. No growth of *Salmonella* observed in all groups during the whole period of study. Total viable count (TVC) and total *E. coli* count (TEC) was lower in birds of group B compare to other four groups.

Antimicrobial Resistance in Enterobacteriaceae Isolated from Food and Food-Producing Animals

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Abstract
Antimicrobial resistance (AMR) is a global health crisis. AMR particularly Carbapenems are a reserve group of antibiotics. Carbapenem-resistant Enterobacteriaceae (CRE) in food and food-producing animals are major public health concerns globally. In this study, we analyzed 275 samples of food and food-producing animal origin for the detection of resistance pattern of Enterobacteriaceae to

carbapenems and other antibiotics. Food samples analyzed included 16 fruits, 34 vegetables, and 102 seafood. Animal samples were fecal materials of cattle (51), broiler (36), and Sonali chicken (36). Isolation and identification of members of Enterobacteriaceae, *i.e., E. coli, Salmonella* spp. *Shigella* spp. and *Klebsiella* spp. were based on culture, staining, biochemical tests, and PCR. Antibiotic sensitivity test was performed by disk diffusion test. The double disk synergy test (DDST) was performed to detect extended-spectrum beta-lactamase (ESBL)-producing *E. coli*. Among all the samples, 149 were found positive for the presence of *E. coli,* three for *Salmonella* spp., four for *Shigella* spp., and three for *Klebsiella* spp. In disk diffusion test, all the isolates were found sensitive to the carbapenem group of antibiotics *i.e.,* imipenem, meropenem, doripenem, and ertapenem. On the sample basis, 20% of *E. coli* isolated from vegetables and 9.3% isolated from seafood were resistant to tetracycline. Eight (18.6%) *E. coli* of seafood origin were ESBL producers. Present findings suggest that food and samples from food-producing animal origin analyzed in this study are free of CRE. Further studies are ongoing to reveal the complete AMR patterns of these isolates, including analysis of more samples.

Sensitivity and Resistance Pattern in *E. coli* Isolated from Livestock and Poultry against Reserve Group of Antibiotics

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Abstract
Antimicrobial resistance is a global health crisis of the 21st century. Fosfomycin is a reserve group of antibiotics used to treat MDR bacterial pathogens. In this study we screened total 78 fecal samples originating from cattle (n=32) and poultry (n=46) to study the occurrence of fosfomycin resistance *E. coli.* Isolation and identification of *E. coli* were based on culture and PCR. Antibiotic sensitivity of the isolates was carried out by disk diffusion test. Among these 78 fecal samples, 32 (cattle=11, poultry=21) were found positive for *E. coli.* Overall occurrence of E. coli was 41.02%. In the antibiotic sensitivity test, all the *E. coli* isolates were found sensitive to fosfomycin. Sensitivity were also observed against other reserve group of antibiotics namely imipenem, meropenem, doripenem, and ertapenem. Among these isolates, about 18.57% isolates were resistant to streptomycin, 9.37% to ceftazidime, 21. 85% to tetracycline, 12.50% to ceftaxime and 21.85% to gentamicin. Further studies are required with more samples to know the actual status of sensitivity or resistance pattern of *E. coli* against fosfomycin in cattle and poultry in Bangladesh.

Prevalence and Antimicrobial Susceptibility Profile of Enterohaemorrhagic *Escherichia coli* O157:H7 in Foods of Animal Origin

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Abstract
An infection with enterohemorrhagic *Escherichia coli* (EHEC) causes bloody dysentery and raises the risk of hemolytic uremic syndrome (HUS). Global outbreaks of bloody diarrhea and HUS are brought

on by EHEC serotype O157:H7. The purpose of this study was to determine the prevalnce and antimicrobial susceptibility of *E. coli* O157:H7 in foods of animal origin. A total of 100 samples, including 20 samples of chicken, 20 samples of beef, 20 samples of raw milk, 20 samples of pasteurized milk, and 20 samples of egg washing, were collected and screened for the presence of *E. coli* using cultural, staining, and biochemical characteristics. Next, genus-specific 16SrRNA primers were used in a polymerase chain reaction to characterize the samples at the molecular level (PCR). The investigation found that 38 out of 100 samples contained E. coli. E. coli was present in 35% of the egg samples, 40% of the raw milk samples, 10% of the pasteurized milk samples, 60% of the chicken samples, and 20% of the beef samples. Again, PCR was used to check for the presence of the Stx-1, rfb O157:H7, eae, and hly genes in those 38 positive E. coli samples. Based on the findings, 2(5.26) isolate was determined to be positive for the Stx-1 gene and confirmed to be positive for the rfb O157:H7 gene. By using the disc diffusion method, the Enterohaemorrhagic *Escherichia coli* O157:H7 antimicrobial susceptibility pattern was identified against 10 widely used antimicrobial drugs. Among these, Ciprofloxacin, Gentamicin, Kanamycin, and Azithromycin displayed the highest sensitivity patterns, while Cefalexin and Nalidixic acid displayed intermediate sensitivity. The resistance to ampicillin, amoxicillin, cefixime, and erythromycin was discovered in all isolates. These results underline the importance of implementing reliable biosecurity practices all along the food supply chain.

Molecular Detection of Enterotoxin Producing Methicillin Resistant *staphylococcus aureus* (MRSA) from Phuchka of Different Locations in Mymensingh City Corporation

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Abstract

The present study was undertaken to investigate the presence of methicillin resistant enterotoxin producing *S. aureus* and their antimicrobial profile in most common Bangladeshi street food phuchka. For this purpose, a total of 140 phuchka samples were collected from 35 street vendors at different locations in Mymensingh. The samples include phuchka chips, its contents, water and hand washing of vendors. Isolation and identification of *S. aureus* was accomplished through cultural, morphological and biochemical characteristics and confirmed molecularly by detection of *nuc* gene by (PCR). To detect enterotoxin producing *S. aureus,* a series of primers were used to amplify *SEA, SEB, pvl* and *tst* genes. Antibiotic susceptibility profile was determined by disc diffusion method using ten commonly used antibiotics such as Penicillin G, Oxacillin, Vancomycin, Ciprofloxacin, Tetracycline, Norfloxacin, Sulphamethoxazole, Erythromycin, Neomycin and Amoxicillin on Muller Hinton agar plate followed by detection of MRSA by PCR to amplify *mecA* gene. Out of 140 samples, 11 *S. aureus* were recovered conventionally and molecularly. Off which only *SEB* gene was detected in two isolates of *S. aureus*. i.e, 18.18% were confirmed as enterotoxin gene (*SEB*) bearing *S. aureus.* On the basis of disc diffusion and PCR result among the 11 isolates 81.81% were confirmed as MRSA of which 11.42% in drinking water. The isolates found positive for *SEB* gene also resistant to methicillin. Phenotypically all *S. aureus* isolates showed resistance to penicillin, 81.81% to oxacillin and sulphamethoxazole. While 100% sensitive to norfloxacin followed by 82% to tetracycline, 63.63% to amoxicillin and 54.54% to ciprofloxacin. The increased frequency of MRSA and their extended resistant to several antibiotics might cause infection in human through ingestion of contaminated phuchka. Moreover, data of this study indicates that phuchka sold at BAU campus and Mymensingh

Town Hall harbor enterotoxigenic multidrug resistant food borne bacteria which could be the potential causes of food borne illness.

Prevalence of Antimicrobial Resistant Bacteria in Animal Originated Foods

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Abstract
Emergence of antimicrobial resistance (AMR) in food borne bacteria is a growing public health concern. In order to tackle the AMR it is important to know the role of animal originated foods in the transmission of AMR bacteria to the human. The present study was undertaken to determine antimicrobial susceptibility patterns of food borne bacteria in animal originated foods. Poultry meat (n=100), beef (n=100), milk (n=100) and egg (n=100) samples were collected. Routine bacteriological and molecular methods were performed for isolation and identification of food borne bacteria: *E. coli*, *Salmonella* spp. and *Staphylococcus aureus.* The antibiotic susceptibility test of food borne bacteria was performed by disc diffusion method against 17 different classes of antibiotics. Extended spectrum beta lactamase (ESBL) producing *E. coli* were determined by double disc synergy test (DDST) and methicillin resistant *Staphylococcus aureus* (MRSA) was detected by cefoxitin disc diffusion test. The prevalence of *E. coli*, *Salmonella* spp. and *Staphylococcus* spp. in chicken meat was 75%, 38% and 48% respectively. In beef prevalence of *E. coli*, *Salmonella* spp and *Staphylococcus* spp. in chicken meat was 55%, 25% and 28% respectively. In eggs prevalence of *E. coli*, *Salmonella* spp and *Staphylococcus* spp. was 60%, 15% and 36% respectively. In milk prevalence of *E. coli*, *Salmonella* spp and *Staphylococcus* spp. was 68%, 28% and 65% respectively. *E. coli* isolates (100%) were found to be resistant to Ceftazidime, Ampicillin and Mecillinam.. *E. coli* isolates 26 of 51 (50.98%) were found to be multidrug resistant (MDR). *Salmonella* spp. showed highest resistant profile against tetracycline (96.67%) followed by azithromycin (90.70%), colistin (69.76%) and ciprofloxacin (60.47%). Eight of 43 (18.28%) Salmonella isolates exhibited MDR profiles. *Staphylococcus aureus* were found highly resistant to benzyl penicillin (66%) followed by amoxicillin (62%), ciprofloxacin (56%). Eighteen of 50 *Staphylococcus aureus* isolates (36%) were found MDR since they were resistant to at least three different classes of antibiotics. The prevalence ESBL producing *E. coli* was 27.45% and MRSA was 16%. Data of this study indicate that animal originated foods were contaminated with MDR bacteria which might cause public health problem.

Exploring Migratory Birds as a Potential Source for Antibiotics *Escherichia coli* and *Salmonella* having Public Health Significance

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Abstract
Antimicrobial resistance (AMR) is a major health crisis globally. Migratory birds could be a potential source of antibiotic-resistant (ABR) bacteria. Not much is known about their role in the transmission of ABR in Bangladesh. In this study, a total of 66 fresh fecal materials from migratory birds were analyzed. Bacterial isolation and identification were based on cultural properties, biochemical tests, and polymerase chain reaction (PCR). The disk diffusion test (DDT) was employed to evaluate

antibiogram profiles. Extended-spectrum beta-lactamase (ESBL)-producing ability of *Escherichia coli* was determined by a double disk synergy test (DDST). ESBL genes were detected by PCR. In PCR, 83.33% (55/66) and 21.21% (14/66) of the samples were found to be positive for *E. coli* and *Salmonella* spp., respectively. In DDT, *E. coli* were frequently resistant (100-43%) to ampicillin, erythromycin, streptomycin, tetracycline, ciprofloxacin, and chloramphenicol; and *Salmonella* isolates were frequently resistant (72-43%) to chloramphenicol, tetracycline, ampicillin, streptomycin, and erythromycin. Interestingly, 100% of *E. coli* and 76.92% of *Salmonella* isolates were multidrug-resistant (MDR) in nature. In DDST, 21 (38.18%) *E. coli* isolates were ESBL producers. Moreover, ESBL genes, bla_{TEM}, bla_{CMY}, bla_{CTX-M}, and bla_{SHV} were detected in 95.24%, 90.48%, 85.71%, and 42.86% of *E. coli* isolates, respectively. Frequent detection of MDR bacteria from migratory birds traveling to Bangladesh suggests that these birds have the potential to carry and spread ABR bacteria and could implicate potential risks to public health. We recommend that these birds should be kept under an AMR surveillance program to minimize their consequences on health.

Investigation of the Sequel of Chia Seeds Supplementation on Growth Performance and Blood Biochemistry in Butter Fed Mice

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Abstract

Chia (*Salvia hispanica* L.) is a small seed that comes from an annual herbaceous plant that has protective, functional and antioxidant properties. The aim of this study was to investigate the effects of chia seeds on body weight, hematobiochemical parameters and liver histotexture in butter fed male mice. In this study, 1 month old 45 male Swiss Albino Mice with an average body weight of 29.5 ± 0.5 g were divided into 3 equal groups consisting 15 mice in each group. Group A act as control. Mice in the group B was fed with 20% butter; group C was fed with 20% butter and 10% chia seeds. The highest body weight gain was detected in group B which decreased significantly (P <0.001) in group C after addition of chia. In hematological parameters group C exhibited significant increase in TEC, Hb and PCV compare to group A. In lipid profile, group B showed highest level of serum TC, TG, LDL which reduced significantly (P<0.001) by addition of chia in group C. In serum HDL, group C was corrected significantly (P <0.01) which reduced by butter in group B. Serum AST, ALT and ALP of group B were reduced significantly (P <0.001) by addition of chia with butter in group C. Histotexture study of liver demonstrated that there was found fatty changes in the liver of butter treated group B, but there was found no fatty changes in group C (butter + chia) treated group. Based on present research it can be concluded that 20% butter supplementation causes arise in body weight, lipid profile, liver enzyme and would also produce fatty changes in liver but addition of 10% chia with butter reduces the adverse effect of butter.

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Evaluation of the Potency of Coral Fossil as a Toxin Binder in Blood Biochemistry and Different Organs in Heavy Metal Treated Broiler

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Abstract
Contaminated poultry feed can pose a risk to human health by biomagnifies and bioconcentrates toxic metals up the food chain, it may enter the poultry production system in a variety of ways. The experiment was carried out with 105 broilers and were divided into 07 groups randomly with 15 broilers in each group. Group A was served as vehicle control and received daily doses of the poultry feed. The birds in group B were received daily doses of lead (280 mg /kg b.w). Whereas, the birds in groups C were administered with daily doses of chromium（22.14 mg /kg b.w). The birds in group D were treated with daily doses of Cadmium（75 mg/kg b.w) respectively. Whereas group E was supplemented with lead (280 mg /kg b.w) ＋（2.5 gm/kg b.w ULKAL). Group F was received chromium（22.14 mg /kg b.w) ＋（2.5 gm/kg b.w ULKAL). Group G was administered with Cadmium（75 mg/kg b.w) ＋（2.5 gm/kg b.w ULKAL). Both the heavy metals and coral fossil were given with water. The experiment was carried out for a period of 30 days. Blood samples were collected and sera were separated for hematobiochemical analysis. Kidney, liver, heart, gizzard, proventriculus and brain samples were collected and processed for routine histopathological study. The results showed that there were variations in concentrations of liver, kidney enzymes as well as hematological parameters and histopathological alterations noticed in the selected organs of the treated boilers.

Role of Vitamin-C on Acrylamide Induced Reproductive Toxicity in Male Mice

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Abstract
Exposure to acrylamide, which is generated in various foods due to high-temperature cooking or processing; has triggered a *revived* interest in public health. Therefore, this study is aimed to investigate the effect of vitamin C against acrylamide (ACR) toxicity on testosterone level, sperm physiology, and gross and microscopic structures of testes and epididymis in mice. A total of fifty male Swiss Albino mice, aged 3-4 weeks were treated with different concentrations of ACR, vitamin C, ACR and vitamin C. After 90 days of treatment, the mice were sacrificed to analyze the effects of vitamin C against ACR toxicity. The results demonstrated that serum testosterone concentration was significantly decreased in ACR-treated mice which was improved by vitamin C treatment. Furthermore, ACR caused a significant reduction in sperm concentration, motility percentage, and a significant increase in sperm abnormality percentage. Whereas, vitamin C restored these physiological parameters of sperm. Similarly, the weight and length of both testes and epididymis were decreased by

ACR; whereas improved by vitamin C treatment. In histopathology, there was atrophy of seminiferous tubules of testes due to arrest of spermatogenesis, and disintegration of the tubular lining epithelium of epididymis. These changes were improved by supplementation of vitamin C. Therefore, it might be concluded that ACR has detrimental effects on reproduction which could be alleviated by the supplementation of vitamin C.

Comparative Study of Polymyxin B and Honey against Endotoxemia in Mice

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Abstract
The study was carried out to investigate the effect of polymyxin B and natural bee honey against bacterial lipopolysaccharide (LPS) induced toxicity in male mice. A total of fifty male Swiss Albino mice (*Mus musculus*), aged 25-28 days were randomly divided into 5 groups (n=10) such as the Control group, LPS treated group, pretreated polymyxin B sulfate plus LPS treated group, pretreated natural bee plus LPS treated group and pretreated polymyxin B plus honey plus LPS treated group. Results revealed that LPS caused significantly decreased hematological parameters such as TEC, Hb, PCV, erythrocyte indices and TLC; and altered the values of DLC of mice; whereas, supplementation of mice with Polymyxin B and honey with LPS declined the impact of LPS on hematological parameters. LPS induced a significant increase in AST, ALT, ALP urea, and creatinine levels. Whereas, Polymyxin B and honey decreased these parameters. On the other hand, serum glucose and insulin level were decreased in LPS-treated mice which were increased by polymyxin B and honey treatment. Histopathological analysis in the LPS-treated group demonstrated that there was disarrangement of hepatocytes along with pyknosis, and congestion in the central vein in the liver. Whereas in the kidney, numerous cellular infiltrations in the glomerulus. In the lung, alveolar congestion and peri-bronchiole inflammatory cellular infiltration was observed. And in the pancreas, degenerative changes were found along with lymphoid aggregation around the pancreatic islets. These are the major changes in the above-mentioned organs that were restored significantly and/or near to the normal histology of the control group by the additional supplementation of polymyxin B and honey with LPS. Therefore, it might be concluded that LPS has detrimental effects on hematology, biochemical, and histology which could be alleviated by the supplementation of polymyxin B and honey.

Mitigating Action of Coral Fossil Against Mycotoxin Infection in Broiler and Layer Birds

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Abstract
Mycotoxins are toxic secondary metabolites of fungi commonly found on grains, which cause severe impacts on animal health and performance. Coral fossil can remove toxic substances; it contains calcium, magnesium and more than 70 kinds of minerals and works for antibacterial, fungistatic, and

antioxidative action. So, the aim of the study is to evaluate the actions of coral fossil as a toxin binder for removing the harmful effects of aflatoxin in broiler. For this study, the 80 broilers were divided into 04 groups each containing 20 broilers. Group A was served as vehicle control and received daily doses of the poultry feed. Groups B was supplied with 1 gm coral fossil/kg body weight. The birds in Group C received 200 ppb of aflatoxin B_1. Groups D was administered with 200 ppb of aflatoxin B_1＋1 gm coral fossil/kg body weight. Both the aflatoxin and coral fossil were given with water. The experiment was carried out for 30 days. After sacrifice, blood was collected and serum was prepared. The results showed that total leukocyte count was decreased significantly ($p<0.05$) in mycotoxin treated broilers but increased significantly ($p<0.05$) after coral fossil treatment while there were no significant changes in total erythrocyte count and hemoglobin concentration after both treatments. Liver and kidney enzymes in mycotoxin treated broilers were increased significantly ($p<0.05$) but decreased significantly ($p<0.05$) after coral fossil supplementation. Therefore, it can be concluded that coral fossil supplementation has protective effects on mycotoxin treated broilers.

Transgenerational Effects of Environmentally Relevant Phthalate Plasticizer and Thymoquinone on Reproductive and Immunological Parameters in Mice

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Abstract
Phthalates (PHA) are environmental pollutants, widely used in the plastic industry. Exposure to PHA is known to have detrimental effects on human and animal health. Thymoquinone (TQ), a bioactive constituent of the black cumin seed, holds promising pharmacological properties against several diseases. The research work is carrying out to evaluate the effects of TQ on reproductive and immunological parameters in PHA treated Swiss albino mice at the multigenerational level. A total of thirty mice of 28-30 days of age were used and divided into three groups consisting of 10 mice (6 female and 4 male) in each. Group A (control) was fed normal mice pellet mixed with olive oil, group B was fed with PHA and group C was administered both TQ and PHA mixed with mice pellet. All mice were administered PHA and TQ at the later stages of pregnancy and reared at 26-30ºC until parturition. Blood, sera & organ were collected and processed from parental (F0) mice according to standard methods. F1 offspring mice were reared naturally. Results revealed that PHA caused an increase in body weight gain in F0 male mice. Receiving TQ with PHA normalized the body weight. Serum T4 and testosterone concentration were significantly ($p<0.01$) decreased in the PHA treated F0 male mice whereas TQ caused improvement of these two hormones. PHA caused a significant ($p<0.01$) reduction in the sperm count and sperm motility with increased abnormalities whereas TQ prevented these sperm parameters. There were degenerative and necrotic changes found in the seminiferous tubules in the testis of PHA treated F0 male mice only. Reproductive and Immunological parameters of subsequent generation F1, F2 mice are currently under investigation. It is concluded that PHA has harmful effects on reproductive parameters in F0 male mice. These harmful effects could be alleviated by the addition of TQ.

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Protective Actions of Vitamin E and Zinc on Nickel Induced Hematotoxicity and Hepatotoxicity in Swiss Albino Mice

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Abstract
Heavy metal toxicity is a universal problem for all livings with the generation of free radicals inside the biological system that are commonly used in a wide range of agricultural industries. Therefore, the study aimed to investigate the effect of vitamin E and zinc against nickel (Ni) toxicity on hematological parameters, and hepatic system in mice. At first, mice were randomly divided into five groups (n=10): Group A was treated with a normal diet whereas Group B received Ni @ 20mg/kg bw/day, Group C was administered Ni and vitamin E (20mg/kg bw/day + 400mg/kg bw/day), Group D received Ni and Zinc (20 mg/kg bw/day + 400 mg/kg bw/day), Group E was treated with Ni, Vitamin E and Zinc (20 mg/kg bw/day+400 mg/kg bw/day+ 400 mg/kg bw/day) respectively for 12 weeks. After 12 weeks of treatment, the mice were sacrificed to analyze the effect of vitamin E, and zinc against Ni toxicity on hematological parameters, and liver structure and function in mice. The results demonstrated that Ni caused a significant decrease in total erythrocyte count (TEC) ($p<0.01$), hemoglobin concentration (Hb) ($p<0.01$), packed cell volume (PCV) ($p<0.01$), and erythrocyte indices (MCV) ($p<0.01$). On the other hand, Ni significantly increased the level of liver enzymes such as AST ($p<0.05$), ALT($p<0.01$), and ALP ($p<0.01$). Histology of Ni-treated liver showed disarrangement of hepatocytes along with the presence of inflammatory cells in the central vein. Whereas, treatment with vitamin E and zinc restored all these parameters. Therefore, it might be concluded that Ni has detrimental effects on hematology, and the hepatic system which could be alleviated by the supplementation of vitamin E and zinc.

High Fat Diet: Metabolic Syndrome in Mouse Model

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Abstract
The coincidence of obesity, insulin resistance, hyperglycemia, hypertension, dyslipidemia and fatty liver disease are commonly referred to as the metabolic syndrome. This study was carried out to evaluate the impact of high fat diet induced metabolic syndrome in mouse model through investigate body weight, hemato-biochemical parameters, lipid profile and histopathological changes in liver. A total of forty-eight (48) male Swiss Albino mice aging five weeks with a body weight of 25-30 grams were divided into four groups (n=12). After acclimatization, the mice of group A was treated as control, and those of group B, C and D were fed with 10% mutton fat-based feed, 10% beef fat-based feed and 10% soyabean oil-based feed for 12 weeks respectively. The result indicated a significant increase in body weight ($p<0.05$) in groups treated with animal fat in comparison to control. There was an increase in TEC and Hb concentration in all treatment groups with a significant difference ($p<0.05$) in group C and D but TLC was decreased in all treatment groups. Glucose level was significantly ($p<0.05$) higher in all treatment groups and significantly ($p<0.05$) lower in group D. A significant ($p<0.05$) decrease in uric acid were observed in groups C and D compared to control. There was

significant ($p<0.05$) increase in TG and cholesterol level in all treatment groups in comparison to control. The HDL of animal fat groups were significantly lower ($p<0.05$) compared to control except group D ($p>0.05$). Variations were observed in LDL values among the groups but were insignificant ($p>0.05$). Histopathological study revealed cytoplasmic vacuolar infiltration in hepatocytes with hepatic necrosis and fatty infiltration in all treatment groups. It was concluded that high-fat diet can affect body weight, alter the hematological and biochemical parameters with pathological changes in hepatic parenchyma leading to induced metabolic syndrome.

Evaluation of the Effects of Spirulina Platensis on Various Organs of Sodium Selenite Induced Selenocosis in Mice

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Abstract

The study was undertaken to investigate the effects of Spirulina platensis on body weight, biochemical parameters (SGOT, SGPT) and histopathology of liver and brain on induced selenosis in mice. Twenty-four male mice having four weeks of age were used for the experiment. Selenosis was induced by sodium selenite @ 4 mg/kg and experiment was carried out for a period of four weeks. The study was conducted by dividing the animal into four groups (n=6 rats in each group) indicated as with Group-A (healthy control); Group-B (therapeutic group@ 0.2mg/kg selenium); Group-C (toxic group@ 4mg/kg selenium); Group-D (selenosis mice treated with Spirulina platensis @ 1000mg/kg). Spirulina platensis reduced SGOT significantly ($P<0.05$) but non-significantly SGPT and improved the body weight losses non-significantly ($P<0.05$) compared to control mice after four weeks treatment. The histopathological alteration was observed in the liver of selenosis mice which was characterized by congestions in portal vein and central vein, generalized oedema, congestions in portal vein with fatty degenerative changes and presence of sinusoidal hemorrhages and necrosis of hepatocytes and encephalomalacia, necrosis and proliferation of glial cell on brain in mice. Marked improvements in the histopathological change were noticed in the liver and brain of selenosis mice treated with Spirulina platensis. The collected samples were preserved for further analysis are ongoing and will be done in due course of time. Next year the remaining part of the project work will be done.

Development and Strengthening of *De Novo* Thin Layer Chromatography Analytical Technique to Analyze & Control Residues of Veterinary Antibiotic Drugs in Poultry Products and Byproducts: A Need Based Technology Development & Research Arena to Save Human Health

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Abstract

Technology plays a very important role in the modern era. Antibiotic therapy has great importance in human and veterinary medicine. But indiscriminate uses of antibiotics become a matter of concern for antimicrobial resistance and residues. The majority of the people in Bangladesh are still not aware of the health hazards of antibiotic residues. Now a day, medical science faces many questions, not for rational uses of antibiotics. To ensure consumer protection, this work is designed to develop a *de*

novo Thin Layer Chromatography (TLC) technique to detect the presence of different antibiotic residues in broiler chicken. We have done a lot of research on stationary phases, mobile phases, and retention factors (R_f) to establish a *de novo* TLC technique. Finally, we have established reliable mobile phases with the combination of different ratios of chemicals based on the nature of polarity & capillary action of the chemicals. In our study, we found acetone: acetic acid: methanol (1:1:1) mobile phase is the best choice for the detection of Amoxicillin in poultry edible tissues. Like Amoxicillin; acetone: methanol (1:1) was the best for Cephalexin, methanol: acetonitrile: acetic acid (1:1:1) for Oxytetracycline, methanol: toluene: acetic acid: acetone (2.5:2:2:2) for Chlortetracycline, acetone: methanol (1:1) for Ciprofloxacin, acetone: acetic acid: methanol (1:1:1) for Enrofloxacin and methanol: acetonitrile: acetic acid (1:1:1) for Levofloxacin antibiotics. Then the question arises, is TLC a qualitative, semi-quantitative, or quantitative analytical technique? We have found that TLC is either qualitative or semi-quantitative/or quantitative. Finally, we have done a validity and efficacy analysis of our TLC. We examined hundreds of samples both from outdoor and indoor sources and received excellent findings and reliability. Therefore, the established *de novo* TLC technique could be an excellent technology to investigate the drug residues in any samples. Further research is needed for more precise conclusion.

Knowledge, Attitudes and Practices of Farmers Regarding Pesticides Usage and Analysis of Pesticides Residue in Vegetables

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Abstract
Vegetable farming is developing day by day in order to meet the increasing demands in Bangladesh. This research has been designed to investigate the presence of pesticide residue in vegetables, fruits, dry fish, and tea leaves and assess the knowledge of farmers about pesticide use and its harmful effect on human health to ensure food safety and security. This study is conducting research in Mymensingh Sadar, Muktagacha, Fulbaria, and Trishal upazila. A prescribed questionnaire-based survey was performed to assess the knowledge of farmers about pesticide application, use, residual period and harmful effect in humans. Pesticide residues were detected by using thin-layer chromatography (TLC). Most of the farmers and vegetable sellers have primary education or are illiterate. 80% of farmers denied that they used pesticides in their fields. However, farmers used pesticides up to three times in their vegetable fields (47%). Among them, only 20% of the farmers have knowledge about the withdrawal period of pesticides. A total of 20% of samples were found positive for cypermethrin and chlorpyrifos and 10% of samples were found positive for abamectin. We will conduct quantitative detection of pesticides using HPLC for the TLC-positive samples.

Anti-inflammatory, Wound Healing and Hepatoprotective Effects of Ethanol Extract of Rice Bran in Rodent Models

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Abstract
Rice bran is an essential co-product in rice meals with many biological activities. This study was aimed to evaluate the anti-inflammatory, wound healing, and hepatoprotective effects of ethanol extract of rice bran in vivo. The anti-inflammatory and hepatoprotective studies were performed in

rats, and the wound healing study was conducted in mice. Carrageenan and carbon tetrachloride were used to induce inflammation and hepatotoxicity, respectively. The wound healing activity of rice bran extract (RBE) was tested by creating a circular wound using a biopsy punch. For all the studies, animals were treated with RBE at a dose rate of 100 mg and 200 mg/kg body weight (bwt). It was observed that RBE dose-dependently reduced the carrageenan-induced paw edema and wound closing time(9-10 days) compared to that of control (12 days) rats. Histological examination of the inflamed rat paw tissue showed massive infiltration of inflammatory cells, which was significantly reduced by RBE treatment. Intra-peritoneal injection of CCl_4 increased the serum AST and ALT levels, which were significantly ($p<0.05$) decreased by RBE treatment in a dose-dependent manner. The histological section of the liver tissue showed severe hepatic cell damage in CCl_4 injected animals which were distinctly regenerated by RBE treatment (200 mg/kg bwt). These results demonstrated that RBE has potent anti-inflammatory, wound healing and hepatoprotective effects in the experimental animal.

Chronic Exposure of Drugs Residues to Human Health Through Meat, Milk, Egg and Poultry Products & Byproducts: A Long Term Exposure of Drugs Residues Study in Laboratory Animals to Establish the Legislation on Drug Residues to Save the Human Health

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Abstract
Uses of drugs in our life are not a problem but indiscriminate uses of drugs and long term exposure of residues is a great matter of deal in the recent years. 8 weeks old Swiss Albino male mice have been used in this research. After acclimatization, mice were randomly grouped namely Control, Ciprofloxacin and Amoxicillin groups respectively. Treated group were supplied Ciprofloxacin 50ppm and Amoxicillin 10ppm in drinking water *ad libitum* for a consecutive period of one year. Body weight of both Ciprofloxacin and Amoxicillin residue exposure mice were found significantly increased ($P<0.05$~0.01) from 3rd month onwards. Physically antibiotics treated mice were found robust in size and lazy in character. Blood parameter analysis demonstrated decreased number of lymphocyte, neutrophil & monocyte; increased number of eosinophil and unchanged basophils between treated and control mice. Both ALT and AST enzymes up-regulated in antibiotics exposure mice but was statistically insignificant. Treated mice demonstrated steatosis, enlarged central vein, infiltration of inflammatory cells in liver; glomerular atrophy, fragmentation of glomeruli, degeneration & necrosis in proximal tubule and inflammatory cells infiltration in kidney; diffuse white pulp and distorted lymphoid architecture in spleen, however, no remarkable change was found in the colon histology. TLC analysis revealed that long term exposure of Ciprofloxacin as well as Amoxicillin residues further produced residue in liver, kidney, spleen, intestine, breast muscle and thigh muscle. This research gives a clue that long term exposure of residual level of antibiotics could be harmful and hazardous to the human health.

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Anti-inflammatory and Hepatoprotective Effects of Chia Seed (*Salvia hispanica* L.) Extract in Rats

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Abstract

The current study was carried out to evaluate the possible protective effects of *Salvia hispanica* L. (chia) seed extract on CCl_4 induced hepatotoxicity and carrageenan-induced inflammation in experimental rats. Chia seeds were dried in an incubator, levigated as dry powder and macerated in ethanol-acetone mixture for extraction. Anti-inflammatory and hepatoprotective actions were investigated on male Wistar rats (130-170 g) by using two different doses (200 and 400 mg/kg body weight/day) of the extracts mixed with basal diet. 1% carrageenan (100 µL, sub-plantar) and CCl_4 in olive oil (50% v/v, 2 ml/kg body weight, intraperitoneal) were injected to induce inflammatory paw edema and hepatotoxicity, respectively. Dexamethasone (3 mg/kg body weight, intraperitoneally) and silymarin (50 mg/kg body weight/day, orally) were used as standard drugs for inhibition of inflammation and hepatotoxicity, respectively. Paw thickness was measured at 0, 1, 3, 5, and 24 hours after carrageenan injection to evaluate the degree of inhibition of paw edema at percentages. The extent of hepatotoxicity was assessed by measuring the serum level of the enzymes alanine transaminase (ALT) and aspartate transaminase (AST), and serum bilirubin. The data were analyzed by one-way analysis of variance (ANOVA) followed by Post-Hoc test (Duncan's test) and expressed as mean ± SEM. Although both doses reduced inflammatory edema significantly ($p < 0.05$), 400 mg/kg/day was found to be more effective for inhibiting paw edema by 39.82 ± 0.69%. The higher dose (400 mg/kg/day) significantly lowered ($p<0.05$) the elevating effect of CCl_4 on serum ALT, AST, and bilirubin to 87.89±1.20 U/L, 196.41±7.75 U/L, and 0.96±0.08 mg/dL, respectively. CCl_4 induced liver injury and carrageenan induced inflammation were markedly alleviated with the dose of 400 mg/kg/day as evident by histopathological studies. The results of this study suggests that the dietary supplementation of chia seed extract possess anti-inflammatory and hepatoprotective activity in dose dependent manner.

Genetic Characterization of Blood Feeding Haemonchus Contortus Populations Isolated from Sheep and Goats Based on β-tubulin Gene Analysis

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Abstract

Anthelmintic resistance against gastro-intestinal nematodes especially *H. contortus* of sheep and goat is a global issue. To address the gravity and extension of AR in Bangladesh, genotyping of 160 adult

H. contortus parasites were performed to confirm benzimidazole resistance allele from different geographic zones of Bangladesh based on allele specific PCR (AS-PCR). The genotype frequencies were 9.4% for homozygous resistant (rr), 61.2% for heterozygous (rS) and 29.4% for homozygous susceptible (SS) among the selected areas. The allelic frequency of the mutation conferring resistance (r) ranged from 27.5% to 52.5% indicating substantial existence of benzimidazole resistance in *H. contortus* in small ruminant nematodes. Therefore, it can be concluded that genotyping the F200Y polymorphism can be used to monitor the resistance and thereby to enhance the control on the development of anthelmintic resistance against *H. contortus* in small ruminant nematodes.the control on the development of AR against *H. contortus* in small ruminant nematodes.

In Vitro Drug Efficacy Against Blood Feeding Stomach Worms of Ruminants

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Abstract

Haemonchus contortus is the most prevalent and pathogenic gastrointestinal nematodes (GINs) in ruminants causing extensive economic losses. It is essential to estimate the efficacy of common commercially available anthelmintics against *H. contortus* parasite. Here, we standardized an *ex-vivo* culture platform for *H. contortus* and evaluated the efficacy of commonly used anthelmintics namely, albendazole (ABZ), levamisole (LVM), ivermectin (IVM), closantel (CLS) and rafoxanide (RFX). Adult worms were collected from abomasa of slaughtered animals, cultured in MEM, DMEM, M199 or RPMI with or without 20% FBS for up to 72 h. Cultured worms were incubated with ABZ, LVM, IVM, RFX or CLS in DMEM supplemented with 20% FBS at different concentrations (0.5-50 µg/ml) in triplicates and examined at 0, 3, 6, 12, 24, 36 and 48 h post treatment. Of the culture conditions, DMEM supplemented with 20% FBS supported the survival of *H. contortus* for ($P<0.001$) longer period of time which was used in the evaluation of anthelmintics. The efficacy of CLS and RFX were significantly ($P<0.001$) higher than other drugs and 100% mortality was observed at 2 µg/ml of CLS and RFX within 12 h post treatment. However, ABZ, LVM, and IVM showed significant effect at the concentration of 50 µg/ml with 48, 36, and 24 h, respectively. Morphological changes included severe cuticle disruption around the buccal cavity, posterior region and vulva as well as loss of cuticle structure integrity coupled with expulsion and fragmentation of digestive components of parasites when treated with 50 µg/ml of ABZ, LVM, and IVM and 2 µg/ml of RFX and CLS. Collectively, DMEM supplemented with 20% FBS can be used as *ex-vivo* culture platform for maintenance of *H. contortus*, and RFX and CLS can be used as the promising drugs for the prevention, control and treatment of *H. contortus* infections.

Prevalence, Damage Severity and Bio-rational Control of Pigeon Canker and Concurrent Infections

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Abstract

Pigeon trichomoniasis is a highly prevalent protozoan disease caused by Trichomonas gallinae and infest the upper digestive tract, mainly crop and esophagus of columbiformes birds. This study investigated the overall prevalence, host factors, effects on host, concurrent infections and their control

using neem, papaya and ananas leaf extract. A total number of 150 pigeons of various ages will be purchased from local markets of Mymensingh division, the birds were physically examined for any clinical signs of sickness and data on area, age, sex, weight, clinical signs and gross lesions were recorded. Swabs were taken from crop of pigeons to be evaluated under light microscope. In positive cases, swabs were processed for culture and microbial co-infection detection. Gastrointestinal tract were examined for helminth co-infection detection. Overall 46.67% prevalence of pigeon trichomoniasis was recorded in Mymensingh Pigeons of female sex (53.57%) and birds aged between 3 to 6 months were more susceptible. Coinfection with *A. columbae, Echinostoma* and *Raillietina* of helminth species, and *Klebsiella, Staphylococcus, Pseudomonas* and *E. coli* of bacterial infection were observed. This study will help to ensure improved disease management, more rational use of natural plants and prolong the life of many pigeons.

Optimization of Culture Media of Poultry Cestode, *Raillietina* for in Vitro Drug Testing

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Abstract

Raillietina is the most prevalent and pathogenic, particularly in domestic fowl throughout the world. Therefore, the present study was performed to establish a highly standardized culture media and to assess the efficacy of anthelmintics at different concentration against adult *Raillietina.* To do this, adult parasites were isolated, cultured in different culture media at 37 ºC in CO_2 incubator, scored according to scoring criteria upto 8 days. Different concentration of albendazole, mebendazole, piperazine, ivermectin and niclosamide were used to evaluate the efficacy against *Raillietina*. The result revealed that DMEM was the best medium for the survival of *Raillietina*. The adult parasites were again cultured in best culture media (DMEM) with 200 U/ml penicillin and 200µg/ml streptomycin with additional supplementation of 5%, 10% and 20% FBS. Results revealed that DMEM with supplementation of 5% and 10% FBS slightly enhances the viability of *Raillietina* but it was not statistically significant, although the viability drastically reduced in 20% supplementation of FBS. To standardize the efficacy of anthelmintics against *Raillitina* spp., five drugs were selected such as albendazole (ABZ), mebendazole (MBZ), pierazine (PPZ), ivermectin (IVM) and niclosamide (NSM). Three concentrations were used for each drug (1µg/ml, 10µg/ml and 100µg/ml) except NSM where we used low concentration such as 0.05, 0.1, 0.2 and 0.5µg/ml. The viability of parasites was examined at 3hrs, 6hrs, 12hrs, 24hrs and 48hrs of post treatment (p.t.). From this experiment, it was found that NSM was the most effective against *Raillietina* among the studied drugs. The structural changes of *Raillietina* at the highest concentration of ABZ, MBZ, PPZ, IVM and NSM were also observed. Structural deformities of scolex, swelling, frazilness and distortion of segment were observed in treated group compared to control group. The present study will help to select appropriate chemotherapeutics for *Raillietina* infections in domestic chickens.

The Immune Effect of Caprine Peripheral Blood Mononuclear Cells on the Larvae of *Haemonchus contortus*

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Abstract

Trichostrongylid nematode parasitism is the greatest problem facing small ruminant livestock, largely due to development of anthelmintic resistance. *Haemonchus contortus*, a hematophagous trichostrongylid that can lead to death in goats. This study was planned to determine the viability or

infectivity of larvae *in vitro* after exposure to PBMC obtained from parasite infected goats and to understand the cellular interaction with larvae using immune cells from goats. The infective stage (L3) of *H. contortus* larvae were harvested through coproculture. PBMC were separated using Ficoll Histopaque -1077 from caprine blood, viability test and counting were done by Hemocytometer. To test *in vitro* immune effects on larval motility, larvae was incubated with various concentration of PBMC as treated groups in 10 % FBS and 200 U/ml penicillin and 200 µg/ml streptomycin containing RPMI-1640 culture medium at 37 °C in 5% CO_2 and the mortality rate were calculated. To determine *in vivo* cellular interaction, oral dosing L_3 to goat, deworming and CBC, animal sacrificing, histopathology of lymph node and fundic region of abomasum and mRNA for cytokine and interleukin expression analysis are in progress. Over a period of 24 hours, scoring of the larvae was performed following defined criteria. Phase contrast microscopic analysis demonstrated greater cellular adherence of PBMC to larvae. A large number of immune cells such as eosinophil and neutrophil were shown to forming cellular trap around the larvae. This study revealed that PBMC trapping larvae lost their motility gradually as the test time progressed. One-way ANOVA test revealed a statistically significant difference in larval motility between control and treatment group ($p \leq .001$, df=3, F=21.969). Larval viability reduction might be due to direct adherence and degranulation of eosinophils, mast cells, cytokines release and signaling of interleukin that triggers macrophages, neutrophils, and phagocytic activity on L3 of *H. contortus*.

Genetic Diversity and Vector Biology of Paramphistomes in Livestock in Bangladesh

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Abstract

Paramphistomiasis caused by the different species of the paramphistomes (Trematoda: Paramphistomatidae) seriously affect health and production of ruminants leading to colossal economic losses for the farmers throughout the world including Bangladesh. The paramphistomes are transmitted by different fresh-water snails where the lymaneid and *Indoplanorbis exustus* play the major roles. This study was conducted to determine the genetic diversity and phylogeny of the parasites and also to study the biology of the vector snails. Viscera examination and morphometric identification of the parasites collected from cattle, buffaloes, goats and sheep revealed 5 different species of paramphistomes namely, *Paramphistomum cervi, Gartrothylux crumenifer, Gigantocotyle explanatum, Homalogaster paloniae* and *Cotylophoron cotylophorum.* Molecular identification of the parasites using primers specific for ITS1, ITS2 and 18SrRNA confirmed the species. To study the biology (feeding biology and life cycle) of the established snail vectors, the *Lymanea aurucularia*, *L. luteola* and *I. exustus* were collected from fields and reared in the laboratory to obtain the pure culture. The feeding biology of the snails revealed that both the lymnaeid and *I. exustus* take boiled mango leaves, khudipana (Minute duckweed, *Lemna perpusilla*), spinach, lettuce and cucumber as feed where the cucumber and lettuce are the most preferred feed to the snails. The snails laid eggs in clusters/batches on the supplied mango leaves, submerged sticks and on the wall of the concrete vats in which the snails were cultured. The average number of eggs in clusters was 46 (4-77) eggs. The average size of the cluster was 1.7 cm in length (L) and 0.45cm in width (W) (0.3-2.9 cm L and 0.2-0.6 cm W). The eggs hatched by 7 days (6-8 days) and it took 34 days (28-38 days) for one generation (egg to egg) was. The detailed studies on sequence analyses, phylogeny as well as genetic diversity of paramphistomes are on progress.

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In vitro Anthelmintic Sensitivity of Paramphistomes Affecting Ruminants in Bangladesh

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Abstract
The control of paramphistomiasis, the most common and economically important parasitic disease of ruminants is almost entirely dependent on anthelmintic therapy. However, now-a-days the commonly used anthelmintics are not found so effective against paramphistomiasis. The objective of this study was to investigate the sensitivity of the paramphistomes against the commonly used anthelmintics viz. Praziquental (PZQ), Triclabendazole (TBZ), Nitroxynil (NTN), Oxyclozanide (OCZ), Levamisole (LVM) and Albendazole (ABZ) *in vitro*. The parasites were cultured in RPMI 1640, M199 and DMEM media supplemented with 20% heat activated Fetal Bovine Serum, 200 µg/ml penicillin and 200 µg/ml streptomycin in a 12-well/6 well flat bottom cell culture plates. The culture plates were incubated at 37 °C and 5% CO_2 in a humidified atmosphere with (treated) or without (control) different concentrations of anthelmintics. The paramphistomes were the most sensitive to PZQ at lower concentrations (5 µg/ml) in 1 hour of treatment. However, the parasites did not die before 48 h of treatment at higher concentrations (10 µg/ml or more). Death of parasites occurred at 24 h of treatment with 10 and 20 µg/ml concentrations of TBZ. NTN did not have effects before 12 h of treatment. It was found that 1 µg/ml concentration of OCN had pronounced effects at 3 h of treatment and parasites died at a concentration of 5µg/ml at 6 hour of treatment. Levamisole at 5 µg/ml concentration was highly effective and at a concentration of 10 µg/ml or more promptly killed paramphistomes at 1 h of treatment. However, albendazole, was not found effective even at higher concentrations (200 µg/ml). Taken together, the results indicated that levamisole and oxyclozanide are the first choice of anthelmintics followed by triclabendzole and praziquental for treating paramphistomiasis in ruminants. *In vivo* tests of sensitivity of the paramphistomes against the anthelmintics through experimental infection in animals are needed.

Molecular Detection and Characterization of Tick and Tick-borne Pathogens (TBPs) Affecting Cattle of Lalmonirhat and Netrakona District of Bangladesh

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Abstract
Ticks and tick-borne pathogens (TBPs) impose a significant constraint to livestock production in the tropical and subtropical countries. They cause the substantial losses to the livestock industry that impact on the livelihood of resource-poor farming communities including Bangladesh. Therefore, the present project was designed to investigate the present status and associated risk factors of ticks and tick-borne pathogens (TBPs) of cattle in different areas of Lalmonirhat and Netrokona district and to characterize the detected tick-borne pathogens specially the *Anaplasma* spp. by molecular tools. Ticks and blood samples were collected from 218 apparently healthy cattle from Lalmonirhat and Netrokona district. A total of 439 ticks were collected from 103 infected cattle (47.25%, 103/218) and identified

morphologically as *Rhipicephalus microplus* (93.4%, 410/439) and *Haemaphysalis bispinosa* (6.8%, 29/439). Prevalence of ticks co-infection was 5.04%. According to the univariate analysis, sex, breed, poor body condition, grazing, floor condition, animal rearing purpose and keeping status were found significantly ($p< 0.05$) associated with tick infestation of cattle. By multiple logistic regression model, sex, breed, poor body condition, grazing and floor condition were identified as risk factors for tick infection in cattle. Thin smear blood slides (n=124) reveals 8.0% prevalence of *Anaplasma* spp. No slides were found to be positive for *Babesia* and *Theileria* pathogens. DNA extracted from blood samples was subsequently screened by multiplex PCR for the presence of tick-borne pathogens. Multiplex PCR reveals an overall prevalence of tick-borne pathogens 41% (41/100). The PCR results demonstrated high prevalence 25% (25/100) of *Anaplasma* spp. followed by *Theileria* spp. (6.0%). The present findings give a detail insights regarding the prevalence of ticks and tick borne pathogens. So, it is concluded that *Rhipicephalus microplus* are highly prevalent and *Anaplasma* spp. is very endemic in the study area.

Molecular Detection of Dengue Virus in Natural Populations of Aedes Mosquitoes in Mymensingh City

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Abstract

Dengue is a major emerging and constantly evolving mosquito borne disease represent significant warning to human health in Bangladesh. Dengue virus (DENV) is mosquito borne arbovirus transmitted by *Ae. aegypti* and *Ae. albopictus*. *Aedes aegypti* is considered as the primary vector and *Ae. albopictus* is identified as a second major vector of the virus. Active surveillance for DENV in natural infected mosquito populations would be of great value to minimize risk of this disease in an area. Therefore, this project was planned to identify dengue virus from naturally infected Aedes mosquitoes in Mymensingh city using RT-PCR (reverse transcriptase-PCR) and semi-nested PCR. Mosquito larvae and pupae were collected from different breeding sites of Mymensingh city manually or using dipper, ladle spoon, pipette and dropper. Adult mosquitoes were collected using aspirators, insect net and insect spray from indoor and outdoor. Adult collection was conducted from 8 am to 3 pm and 4 pm to 7 pm. After collection, larvae, pupae and adults were transported to the laboratory and identified using the published keys under stereomicroscope. A total of 2426 artificial containers and natural water lodged areas were identified among 965 houses examined (mean 2.5 container/house), among which 218 (8.9%) containers were found positive. Among 19 different varieties of wet containers were identified, 14 types of containers were positive in Mymensingh city. Artificial containers were the main breeding places of Mymensingh city. Breeding containers were categorized into three, disposable, controllable and uncontrollable, where disposable containers (58.5%) were more available in Mymensingh followed by controllable (39.8%) and uncontrollable (1.7%) containers. Among the positive containers, coconut shell (28.6%) was the most available breeding place for Aedes followed by flower tubs (22.2%) and discarded car tires (14.6%). Identified container breeders are *Aedes aegypti, Ae. albopictus, Culex. quinquefasciatus* and *Armegeres subalbatus.* A total of 5336 adult mosquitoes were collected from different households of Mymensingh city, among which 83.3% were *Culex* followed by *Anopheles* (12.5%) and *Aedes* (5.2%). Out of 277 *Aedes* mosquitoes, *Ae. aegypti* were more prevalent (67.2%) than that of *Ae. albopictus* (32.8%). Adult *Aedes* females were pooled by species and area of collection and stored at -80°C for RNA extraction, cDNA synthesis, RT-PCR and semi-nested PCR. After completion, this study will help to develop an effective control of vector mosquitoes as well as control of dengue outbreak in Mymensingh city.

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Detection of Parasitic Contamination of Medical, Veterinary and Zoonotic Importance in Commonly Consumed Raw Vegetables and Fruits in Mymensingh

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Abstract
Parasitism claims to be one of the main obstacles in public health and livestock in Bangladesh. Many outbreaks of parasitic infections in humans have been linked to raw fruits and vegetables. This study was designed to determine the parasitic contamination of selected fruits and raw vegetables in Mymensingh and to identify the associated risk factors. A total of 16 types of raw vegetables and fruits (12 types of vegetable and 4 types of fruits) were selected and collected from local markets of Mymensingh and were brought to the Parasitology laboratory of BAU. Then parasitological examinations were done to identify the ova and larvae of helminths, trophozoites, cysts/oocysts of protozoa. A questionnaire was prepared and then data were analyzed to identify the risk factors. Among a total of 192 fruit and vegetable samples purchased from 4 local markets of Mymensingh, among which 84.3% were contaminated with at least one species of parasite. Green chilli was the highest contaminated (98.4%) vegetable with average 7 types of parasite species, followed by coriander leaf (97.9%) and apple was the least contaminated (9.3%). Among protozoa, the cysts of *Entamoeba, Giardia, Balantidium coli* and oocyst of *Eimeria* sp. were identified. The larvae of *Strongyloides stercoralis*, ova of helminth parasites *Ascaris sp,* hook worm, stomach worm, *Taenia sp., Trichuris trichiura*, *Strogyloides sp., Enterobius vermicularis, Hymenolepis sp, Schistosoma indicum. Paramphistomum sp., Facsiola sp. Catatropis verrucosa, Moniezia* sp., were identified in this study. *Strongyloides* species (Ova and Larva, (73.79%) was the most frequently detected parasite followed by *Entamoeba histolytica/E. dispar* (cysts and trophozoites, 69.7%) and *Giardia* sp. (cysts and trophozoites, 65.1%). Contamination was more common in vegetables (93.0%) than fruits (58.3%). Fruits and vegetables purchased from farmers using unclean tape/pond water to keep the vegetable and fruits fresh were significantly associated with parasitic contamination. The information from this study will help to control the parasitic infection in human and animals, and will help to develop a guideline to supply parasite free vegetable and fruits to the public and animals which ultimately will contribute to the development of sustainable technology in health sector.

Development of an *Ex vivo* Culture Method and Optimization of Chemotherapy against *Ascaridia galli*, a Devastating Nematode Affecting Chickens

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Abstract
Ascairdia galli is the largest and the commonest nematode in chickens (70- 80% data), especially in indigenous semi-scavenging chickens in Bangladesh. Anthelmintic vaccines are yet to be discovered, therefore, control of the devastating worm in poultry mainly depends on the prophylactic chemotherapy by anthelmintics. Treatment of specific cases as well as prophylactic mass drug administrations (MDA) are recently giving equivocal results, warranting optimization of chemotherapy

against *A. galli.* Here, we develop a standard, long term *ex vitro* culture method for *A. galli*, and evaluated the efficacy of different commercially available anthelmintics available in Bangladesh. Our results showed that RPMI supplemented with egg white supported the survival of the worm for long time and supports their biological activities such as movements and egg production. Then we used this cultural condition for the screening of efficacy of commercially available anthelmintics such as albendazole (ABZ), mebendazole (MBZ), levamisole (LVM), ivermectin (IVM) and piperazin (PPZ). Of the drug used, LVM rapidly killed the worms within 6 h and IVM also killed the parasites within 12 h. Other two drugs such as ABZ and MBZ affected the worms very slowly but PPZ failed to kill the worm. Taken together, chickens serum and egg white almost equally support the survival of *A. galli*. LVM and IVM are almost equally effective against *A. galli*, therefore these two drugs can be used to treat the affected chickens.

Detection of Infective Stages of Echinostomes, Food-borne Zoonotic Worms, from Some Wild Fishes of Bangladesh

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Abstract
Metacercariae (MC), the infective stage, of fish-borne zoonotic trematodes have been reported from fishes in Bangladesh. Here, we collected and examined tengra (*Mystus* spp.), pabda (*Ompok* spp.), gutum (*Lepidocephalus guntea*), tara baim (*Macrognathus aculeatus*), and veda/meni (gangetic leaffish; *Nandus nandus*) fishes from different markets of Mymensigh. During examination, we recovered MC of fish-borne trematodes and on the basis of morphologic and morphometrical analysis, they were tentatively identified as the MC of echistomes. We recovered MC of echistomes from pabda and veda. To validate tentative identifications, we extracted total genomic DNA from the harvested MC. PCR was performed by employing specific primers and PCR products were electrophoresed. By PCR, presence of MC of *Echinostoma revulotum*, was confirmed. Our findings will help to assess safety wild fishes cought from different water bodies.

Analyses of Innate and Adaptive Immune Responses in Cattle against Fascioliasis

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Abstract
Fascioliasis is a food borne zoonotic disease caused by *Fasciola gigantica* and *F. hepatica*, popularly known as liver flukes. Here, we studied prevalence and economic impact of the flukes in terms of condemnation of livers along with pathological changes by collecting 154 liver samples from different slaughter houses located at Madhupure and Mymensingh. In this study, we found that 74 (48.1%) samples were infected with liver flukes. We recovered two distinct types of liver flukes such as spermic *F. gigantica* (sFg) and parthenogentic *Fasciola* (prF). Spermic *F. gigantica* is relatively longer (4-4.5 cm) than prF (2.3-2.7 cm) but uterus of both types of the fluke contained fully developed eggs. Microscopically, sFg is characterized by the presence of sperm in the cirus sac but asF did not have any sperm. Of the sample examined, 73.8% and 18.6% were found to be infected from Mymensingh and Madhupure, respectively. Our analysis showed that >40% of liver were condemned due to

fascioliasis, resulting huge economic losses. Condemnation of liver was significantly ($p<0.01$) higher in Mymensingh than Madhupure. The livers of the severely affected animals, there were heavy calcification of the bile ducts, bile ducts became thick, prominent and lumen was almost obliterated. The normal architecture of the liver was almost replaced by the extensive fibrosis in case of heavy infection. There was massive infiltration of inflammatory cells (765±38 cells/foci), predominantly eosinophils and there were massive proliferations of fibrous connective tissues. Taken together, fascioliasis is a big problem in the profitable livestock rearing.

Screening of Haemoprotozoan Parasites in Indigenous and Crossbred Cattle of Bangladesh Using Microscopic and Molecular Biological Tools

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Abstract

Haemoprotozoan diseases, especially babesiosis, theileriosis and anaplasmosis are considered among the economically most important protozoan diseases. These tick-borne diseases (TBDs) are widely distributed throughout the world especially in tropical and subtropical countries including India, Pakistan and Bangladesh. Babesiosis in cattle is caused mainly by *Babesia* (*B.*) *bovis* and *B. bigemina*, theileriosis is caused by the protozoan parasite *Theileria (T.) annulata* and bovine anaplasmosis is caused by *Anaplasma* (*A.*) *marginale*. Animals suffering from acute babesiosis or anaplasmosis can have a variety of symptoms such as fever, oculo-nasal discharge, increased heart rate, increased respiratory rate, abnormal mucous membrane color, and low PCV values. Theileriosis is characterized by anorexia, fever, anaemia and lymph node enlargement. These diseases cause devastating losses to livestock industry throughout the world. There are limited studies in Bangladesh on the application of specific molecular diagnostics for detecting the bovine blood protozoan diseases in cattle and genetic characterization of these species is also scarce. In view of providing detailed and accurate information on the detection of haemoprotozoan species, till now, a total of ~200 blood samples were immediately collected in EDTA-vacutainer tubes from randomly selected indigenous and crossbred cattle from different Upazilas of Mymensingh and Sirajgonj districts. Thin blood smears were prepared and examined under a binocular microscope (×100) to detect the haemoprotozoan species. Genomic DNA extraction is on going from cattle blood samples. PCR amplification of the extracted DNA will be performed for the detection of *B. bovis*, *T. annulata and A. marginale* using the specific primers reported in previous studies. In microscopic examination, a total of 30 % of cattle blood were found to be infected with *A. marginale* and *A. central* till now. Only 2 samples were detected for *Theileria* species. We could not find any samples yet infected with *Babesia* species microscopically. Three samples were found to be positive with mixed infections *A. marginale*, *A. centrale and Theileria* sp. The outcome of this research project will enhance our knowledge about the molecular epidemiology of haemoprotozoan diseases and thus will be helpful to design the efficient monitoring and control strategies of TBDs in Bangladesh.

Prevalence of *Neospora caninum* in Aborted Foetus of Sheep, Goat Cattle and Buffalo and Assessment of Risk Factor in Bangladesh

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Abstract
Neospora caninum is one of the most important pathogenic protozoan parasites causing abortion in cattle (intermediate host) and neurological disorder in dog (definitive host). *N. caninum* has also been implicated in causing sporadic disease in other livestock species including sheep goats, horses and other carnivores. The aim of this study was to identify *N. caninum* in aborted fetuses of cattle, goats, sheep and buffaloes using PCR and assessment of risk in Bangladesh. Methods: In total, 157 aborted fetuses (50 Cattle, 46 Buffalo, 34 Goat and 27 Sheep) were randomly collected from various regions of Bangladesh. The brain tissue was excised from each aborted foetus and the DNA was extracted for nested PCR and sequencing of ITS1 rDNA gene of *N. caninum.* A total of 20 aborted fetuses out of 157 were positive for *N. caninum* infection. Higher prevalence was observed in cattle (16.0%) followed by sheep (14.8%), goat (11.8%) and buffalo (8.7%). There is a little difference in prevalence considering the study area. Highest prevalence (21.51%) was found in animals during second trimester. The prevalence of *N. caninum* was high 15.8% (9/57) in animals aged 2 to 4 years irrespective of animal species and breed. Sequences from representative positive samples showed similarity between 99%–100% for *N. caninum* ITS1 rDNA gene with other sequences stored at GenBank. Abortion in pregnancy (p=0.000), abortion history of the animals (p=0.001), presence of dog in animals farm or premises (p=0.001) and management practices (p=0.001) were found as significant risk factors associated with the occurrences of *N. caninum* infection. Multivariate logistic regression demonstrated that animals that were in contact with dog feces or presence of dog in animal premises or farms, animals having previous history of abortion, animals reared in free range system, animals that had history of abortion during second trimester had higher risk of getting infection with *N. caninum*. The obtained data of the present study indicated that *N. caninum* infection is one of the major causes of abortion and economic loss in livestock farming in the study areas.

Molecular Detection of *Babesia* in Vector Ticks in Mymensingh, A Continued Threat in Cattle Farming

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Abstract
Babesiosis is distributed globally and responsible for higher rate of morbidity and mortality. Babesiosis is caused by infection with intra-erythrocytic protozoan parasite transmitted by tick vectors. With the changing climate, the epidemiology of tick infestations has changed in everywhere in the world. This parasite mainly transmitted by *Boophilus (Rhipicephalus) microplus* ticks, although other tick species can also transmit infection. So, in this changing climate it is necessary to determine whether tick vectors other than *Boophilus (Rhipicephalus) microplus* is involved in transmission of babesiosis or not in Bangladesh. So far, little research has been done on to the detection of *Babesia* organism in tick vectors in Bangladesh. So, this study is designed to molecular detection of the *Babesia* species and screening of vectors ticks in Mymensingh. A total of 505 ticks were collected from Mymensingh

Sadar. Three species of ticks were identified. Among them, *Rhipicephalus* (*Boophilus) microplus* was the predominant species (60.2%) followed by *Haemaphysalis bispinosa* (21.5%) and *Rhipicephalus* sp. (18.3%). During the 1 year study, the abundance of ticks were highest in summer (*73.9%)* followed by Monsoon (48.7%) and winter (22%). DNA was extracted from the ticks and was stored in -20ºC for PCR. This study will help to proper diagnosis and control of the clinical and subclinical bovine babesisosis in Bangladesh.

Pathogenicity of Low Pathogenic Avian Influenza (LPAI) H9N2 Infection in Sonali Chickens in Bangladesh

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Abstract
Low pathogenic avian influenza (LPAI) H9N2 virus has been endemic in Bangladesh since 2006 and causes economic losses in the poultry industry. Despite the fact that a considerable number of Bangladeshi LPAI H9N2 viruses have been molecularly characterized, there is inadequate information on the pathogenicity of H9N2 viruses in commercial poultry. Therefore, the study is designed to assess the pathogenicity of a Bangladeshi LPAI H9N2 isolate in experimentally infected Sonali chickens. Forty 6-weeks old Sonali chickens were divided randomly into two groups; thirty chickens in the infected group and ten chickens in the control group. Experimental Sonali chickens (n=30) were inoculated intranasally-intraorally with A/Layer/Bangladesh/LT2/2021 (H9N2) virus with a dose of 10^4 EID_{50}/ml. Birds were monitored for clinical and pathological changes, and virus shedding at different time points. No mortality and clinical signs were observed in the infected and controlled chickens. At necropsy, lung and trachea of infected birds displayed mild to moderate hemorrhage and congestion at different time points. Histopathologically, infected chickens showed mild tracheitis at 3-4 dpi followed by severe tracheitis at 7, 10, and 21 dpi. Lung showed mild to severe congestion, hemorrhage, and edema at 4 dpi followed by resolving of lung tissue at 7dpi. On RT-qPCR, the viral shedding was detected in the trachea and cloacal swabs up to 10 dpi, whereas lung and intestinal viral shedding was observed until 4 dpi. This study demonstrated the low pathogenic phenotype of H9N2 infection in Sonali chickens in Bangladesh.

Poultry *Salmonella* Vaccine Protocol and Efficacy Determination up to Last Stage of Laying Along with Molecular Characterization, Sequencing and Phylogenetic Analysis of Isolates of Poultry *Salmonella*

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Abstract
The present investigation was designed to develop a protocol for rearing of *Salmonella* -free poultry flock. Biosecurity and vaccination with potent *Salmonella*-vaccines is one of the important tools for *Salmonella* infections control and prevention. A total forty birds (N=40) were collected from Tangail district kept in Departmental Poultry Shed with commercial pellet feeds and supply of sufficient clean

water. Birds were divided into two groups, one group (n=20) as vaccinated challenged and another group (n=20) as unvaccinated challenged. Vaccination was performed with fowl typhoid live lyophilized (Korea) vaccine (0.2 ml, s/c) containing 2×10^7 CFU of bacteria at 16 and 18 (booster dose) weeks after 6 months interval at 42, 66 and 90 weeks. Both groups of birds were also infected with challenged oral dose containing $2\times2\times10^7$ CFU of bacteria at 21 weeks and after 6 months interval at 42, 66 and 90 weeks of age in both vaccinated and unvaccinated challenged groups of birds. Cloacal swabs were collected at 16, 18 weeks, after 6 months interval at 42, 66 and 90 weeks of age to know the shedding of *Salmonella.* Sera were collected for ELISA test at 16, 18 weeks, after 6 months up to 90 weeks of age to detect antibody response. Cultural test from cloacal swabs detected the shedding of *Salmonella* positivity 95%(n=19/20) at 16 weeks in unvaccinated challenged birds while vaccinated challenged birds showed positivity 90%(n=18/20) at 16 weeks. Cultural test from cloacal swabs detected the shedding of *Salmonella* positivity 95%(n=19/20) at 18 weeks in unvaccinated challenged birds while vaccinated challenged birds showed positivity 80%(n=16/20) at 18 weeks. Cultural test from cloacal swabs detected the shedding of *Salmonella* positivity 95%(n=19/20) at 42 weeks in unvaccinated challenged birds while vaccinated challenged birds showed positivity 80%(n=16/20) at 42 weeks. The study is in progress.

Preparation of an Organic Sanitizer and Its Antibacterial and Antiviral Efficacy

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Abstract
Sanitizers play important role in reducing risks of infection in man and animals, which are mostly aqueous or alcohol based chemical agents. Due to inconsistent uses microorganisms often get resistance to common sanitizers, particularly occurs in animal farms. Organic antimicrobials can be an alternative. We prepared an organic sanitizer from household ashes and tested its efficacy against Salmonella sp. and Newcastle disease viruses. Household ashes derived from different sources were collected and obtained filtrates in water by layering charcoal, stone, sand, cotton, or gauze in a handmade filtration system. Salmonella was isolated and incubated 10 µl ($2.58\text{x}10^8$ CFU/ml) culture either with graded ash filtrate or with 100% washing soda or with distilled water only and inoculated in BG agar plates. The number of colonies was counted and compared. 100µl Newcastle disease virus viruses ($2.5\ \text{x}10^6$ EID50) on Petri dishes were sprayed with 250 µl of different dilutions of ash filtrate and incubated for 30 minutes at room temperature. Swabs from the respective treated petri dishes were inoculated in 1 ml MEM. For each dilution of ash filtrate, 200 µl was inoculated into embryonated eggs. After 4 days of infection, allantoic fluid (AF) was harvested, the hemagglutination test was performed, and titer was calculated. Using our handmade filtration system, we obtained a clear ash filtrate with pH ranging from 8.5 to 10.5. Ash filtrates showed pH dependent antibacterial activity against a pure culture of Salmonella sp. Spraying ash filtrate on infected eggs or dipping infected eggs in ash filtrates reduced bacterial loads significantly. Ash filtrates showed pH dependent antiviral activity against Newcastle disease viruses in embryonated chicken eggs. Since ash filtrates showed antimicrobial efficacy, can be used as organic sanitizer to reduce infection risk in man and animals and could reduce antimicrobial resistance.

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Pathological Investigation and Molecular Detection of Caseous lymphadenitis in Small ruminants at Slaughter

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Abstract
Caseous lymphadenitis (CLA) is a chronic debilitating as well as subclinical disease of small ruminants with a worldwide distribution. The disease is caused by *Corynebacterium pseudotuberculosis,* which can infect a wide range of animals, including humans. Data is limited about the occurrence of CLA in Bangladesh. This research was aimed at to detect CLA in slaughtered ruminants (goats and sheep) in Bangladesh. Tissue samples (mesenteric lymph nodes, lungs, liver, spleen, and kidney) of goats (102) and sheep (16) were collected from different slaughterhouses in Mymensingh district. The diagnosis was made based on gross pathological lesions, impression smear staining, and histopathology. The confirmatory diagnosis was made by polymerase chain reaction (PCR) using disease specific primers. Grossly, multiple abscesses containing greenish-cheesy caseous materials in the mesenteric lymph nodes, suppurative bronchopneumonia, onion skin appearance of growth of caseous materials (pathognomonic lesions of CLA) in the spleen, caseous nodule formation in the liver and kidney were seen. Histopathologically, the lesions revealed caseous necrosis mixed with Chinese letter-shaped arrangement of gram-positive coccobacilli surrounded by a pyogenic membrane and fibrous connective tissues in the mesenteric lymph nodes of goats and sheep. Similar lesions were also seen in the lungs, liver, spleen, and kidneys of infected goats. The results of PCR demonstrated that 30 goats and 01 sheep were positive for *C. psueudotuberculosis* infection. The diagnostic techniques used in this study can be routinely used to detect the disease at its early onset and manage the disease properly.

Ameliorator Property of Vitamin C, E and Selenium Against Acetaminophen-induced Hepatotoxicity

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Abstract
Drug-induced liver injury is becoming a major concern in public health globally. Acetaminophen (paracetamol) is extensively used as a non-prescribed drug for antipyretic and analgesic drugs both in human and veterinary medicine. Here, we investigate the protective property of antioxidants against acetaminophen-induced hepatotoxicity in mice. A total of 20 mice were randomly divided into four groups as control, the acetaminophen-treated group, the acetaminophen+Vit C group, and acetaminophen+Vit E & Se group. Vit C (100mg/L) and Vit E (@75mg/L +Se@0.25mg/L) were mixed in drinking water from day 1 to 4. Acetaminophen was given by a single intraperitoneal injection @50mg/kg body weight on day 4 and sacrificed at 24 hours of post-injection. There were no clinical signs developed after the acetaminophen injection. At necropsy, no gross lesions were seen in the liver and other visceral organs in mice of any group. Interestingly, the level of serum hepatic enzymes such as aspartate transferase (AST) and alanine transaminase (ALT) was significantly increased in acetaminophen-exposed mice as compared to treatment-free control mice and no significant differences were seen with APAP-exposed with Vit E-Se and Vit C supplemented mice.

Microscopically normal histoarchitecture of the liver was seen in the control liver. Hepatic lesions characterized by coagulation necrosis along with marked infiltration of inflammatory cells and mild congestion were seen mainly in the centrilobular area of the liver in acetaminophen-treated mice. However, liver lesions become less or almost no in acetaminophen-exposed mice where supplemented Vit. C or Vit. E+Se. In immunohistochemistry, huge hepatic macrophage populations were seen after paracetamol administration but did not show any significant difference in mice of Vit C or Vit. E-Se group. Therefore, it can be concluded that acetaminophen may lead to acute liver dysfunction and Vit. E-Se and Vit C have a cryoprotective role against acetaminophen-induced liver toxicity.

Patho-surveillance and Pathology of Spontaneously Occurring Neoplasms of Animals in Bangladesh

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Abstract
Neoplasms are silent killer and the incidence rate has increased and becomes a leading cause of death both in humans and animals globally. Therefore, the present study is undertaken to investigate the pathoepidemiology study of various spontaneously occurring neoplasms with their histopathological features in animals of Bangladesh. A total of 50 tumor like masses suspected as neoplasms were collected from three slaughter houses of Mymensingh. The nodular mass after the surgical correction was also collected from Veterinary Teaching Hospital (BAU), and Upazila Livestock Offices in Mymensingh. The collected tissue was fixed in 10% neutral buffered formalin for histopathology. Grossly, there were enlargement, swelling, hemorrhages, necrosis, and color change observed in different visceral organs. Microscopically, there were no neoplastic lesions found in the suspected samples of cattle, sheep, and goats at slaughter. The common histopathological findings were granuloma, necrosis, and others (including hemorrhages, fibrosis, hyperplasia etc). Among the all collected samples, the percentage of granuloma was the highest followed by necrosis and others. However, there was one case of nodular mass in dogs collected after surgical removal. Microscopically diagnosed as mast cell tumor (Grade-II) and characterized by neoplastic proliferation of mast cells (round or ovoid cells with well-defined cytoplasmic borders) in the skin. Focal areas of collagen degeneration and a high number of eosinophils are also found (fairly characteristics feature of canine mast cell tumor). Few mitotic figures are seen. The presence of neoplastic cells within the blood vessels is also seen and indicates metastasis of the tumor. Therefore, it can be concluded that the spontaneously occurring neoplasm in domestic animals is not commonly found. However, an extended survey with a large number of samples is needed to get a real scenario about the incidence of naturally occurring neoplasms in animals in Bangladesh.

Comparative Efficacy of Intra-cloacal Route over Intraocular Route of Infectious Bursal Disease Vaccination

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Abstract
Infectious bursal disease is an existing threat to the poultry industry in Bangladesh. A novel intra-cloacal route of vaccination was applied to compare the efficacy over intraocular route. A total of 100 broiler chicks were raised from day-old. At day 10, ten serum samples were taken randomly to detect

MDA level and birds were divided into five groups (A, B, C, D, E). Birds from group A and B were vaccinated with an intermediate type vaccine via intraocular and intra-cloacal routes respectively. Whereas, birds in group D and E received intermediate plus type via intraocular and intra-cloacal route. Group C was control. At day 17, birds from group A, B, D and E received booster vaccination accordingly. Sera were collected at 25 days from five birds of each group and half of the birds were housed separately and challenged with a very virulent IBD virus. Birds were sacrificed at 7 days post-infection (dpi) to measure bursa/body weight (B/Bw) ratio. Clinical signs appeared at 4 dpi in unvaccinated challenged group showing depression, closed eyelids, ruffled feathers which increased in severity later on. None of the vaccination strategies protected 100% of the birds from clinical signs and death. Vaccination with intermediate plus intra-cloacal route provided greater protection of 70%. Result of ELISA showed that higher level of MDA present at 10 days which became negative at 25 days in control birds. 60% sera samples were found to be positive for IBDV antibodies in intermediate plus intra-cloacal group whereas other groups had negative or very negligible positivity. For B/Bw ratio, intermediate intraocular challenged group had significantly higher ratio than other groups. In conclusion, novel intra-cloacal route using intermediate plus vaccine has the potential to bypass MDA and provided greater protection but its efficacy is masked by the presence of higher level of MDA.

Black Bengal Goats: A Gross and Histopathological Investigation on Female Reproductive Systems

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Abstract

Pathological investigation with bacterial isolation of genital diseases in Black Bengal goats *(Capra hircus)* was done using slaughter house materials. A total of 56 female genitalia were collected from slaughter houses of Kishorganj District during January to March 2022. The gross pathological changes were recorded and tissues from the affected organs were collected for histopathology. The prevalence of reproductive diseases increased with age and the highest number of lesions (34) was recorded in animals aged 19-24 months. The uterus showed the highest number of pathological lesions (44) followed by ovary (31), Fallopian tube (5), cervix (2) and vagina (2). Major pathological changes were luteal cyst (7.4%), endometritis (6.3%) and pyometra (7.0%). The histopathological lesions of each condition were described. Nine uteri of Block Bengal goats *(Capra hircus)* affected with pyometra were collected for bacteriological study. Six different bacterial species were identified and confirmed by Polymerase Chain Reaction (PCR). There are five *Escherichia coli*, six *Streptococcus* sp., five *Staphylococcus* sp., one *Salmonella* sp., one *Pasteurell*a sp. and one *Bacillus* sp. All had mixed infections containing two or three types of bacterial pathogens. The gross and histopathological lesions, isolated bacteria that have been recorded in this study are almost similar to the lesions of other breeds of goats.

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Hazard Identification of *Campylobacter* spp. in Ready-to-eat Foods in Mymensingh Sadar

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Abstract

Campylobacter spp., a foodborne pathogens, are survives well in modified atmosphere and vacuum packaging and also under refrigerated temperatures, that have gone through poor handling and processing. The consumption of contaminated ready-to-eat foods is the major cause of human campylobacteriosis throughout the world including Bangladesh. Therefore, the objectives were to isolate and identify *Campylobacter* spp. in ready-to-eat foods sold in different markets of Mymensingh district. A total of 30 samples of ready-to-eat foods (chicken sandwich, chicken toast, chicken sausages, and hot dog) were collected from two markets of Mymensingh sadar. Isolation and identification of *Campylobacter* spp. was done by cultural and biochemical assays. The antimicrobial susceptibility test of the isolates was done with 14 antimicrobial agents using disk diffusion assay. The overall prevalence of *Campylobacter* spp. was 43.3%. The contamination of chicken sandwich was found highest (80%), and the lowest contamination was in chicken toast (10%). The highest resistance was observed to cefotaxime and clindamycin (66.7%) followed by tetracycline and amoxycillin-clavulanic acid (50%). The low resistance was observed to streptomycin, imipenem and cefepime (16.7%). All the isolates of *Campylobacter* spp. were sensitive to gentamicin. Findings of the present study would be useful to evaluate the risk posed by ready-to-eat foods, and to the concerned authorities for eventual future food regulations.

Antimicrobial Resistance Profile of Common Foodborne Bacteria from Wholesale Chicken Markets in Bangladesh

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Abstract

Antimicrobial resistance (AMR) among foodborne bacteria is a well-known public health problem. A sink survey was conducted to determine the AMR pattern of common foodborne bacteria in cloacal swab of broiler chickens and sewage samples from five wholesale chicken markets of Dhaka city in Bangladesh. Bacteria were identified by standard culture-based and molecular methods, and subjected to antimicrobial susceptibility testing. ESBL-producing bacteria and MRSA were screened by double-disk synergy test and cefoxitin disk diffusion test, respectively. Resistance genes were identified by multiplex PCR and sequencing. The prevalence of ESBL-*E. coli* was higher in cloacal swab (97.7%) and sewage samples (100%) than ESBL-*Salmonella* (76.3% and 60%, respectively). Furthermore, the prevalence of MRSA was 47.2% in cloacal swab and 50% in sewage samples. Moreover, 93.2% of *E. coli*, 100% of *Salmonella* spp., and 97.2% of *S. aureus* from cloacal swab samples exhibited multidrug resistance (MDR). For sewage samples, MDR was observed in 80% of *E. coli*, and 100% of *Salmonella* spp. and *S. aureus*. Noteworthy, 8.3% of *S. aureus* from cloacal swab samples showed possible extensively drug resistance. Screening of β-lactamase encoding genes revealed that all isolates of *E. coli* and *Salmonella* spp. were positive for *bla*TEM gene. The *bla*SHV gene was detected in 20%

of *E. coli* isolates from sewage samples. In case of plasmid mediated quinolone resistance genes in *E. coli* from cloacal swab, 9.1% were positive for *qnrA* and 70.5% for *qnrS*. The *qnrS* gene was also present in 80% of *E. coli* isolates from sewage samples. For *Salmonella* spp., only one isolate from cloacal swab harbored the *qnrS* gene. For *S. aureus*, the prevalence of *mecA* gene was 47.2% and 25% in cloacal swab and sewage samples, respectively. The findings envisage the potential public health risk and environmental health hazard through spillover of common foodborne MDR bacteria.

Molecular Epidemiology of Mobile Colistin Resistance (mcr) Gene Carrying *Klebsiella pneumoniae* Isolated from Retail Foods and Environment in Mymensingh District

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Abstract

Emergence of mobile colistin resistance (mcr) carrying *Klebsiella sp* (mcr-Kleb) in retail food is alarming for public health as colistin is the last resort of antibiotic to combat multidrug resistant bacterial infections. *Klebsiella sp* is associated with severe pneumonia both in human and animal. Moreover, this pathogen is associated with mastitis in dairy cow which results in economic loss to dairy industry. The spread of antimicrobial resistant bacteria like mcr-Kleb has been occurred to public community via food chain. Prevalence of *mcr* carrying *Klebsiella sp* from different sources like retail food (beef, vegetables) and environment (soil, water) together has not yet been well investigated in Bangladesh. The objective of this study is to determine the prevalence of *mcr* carrying *Klebsiella sp* isolated from retail foods and environment in Mymensigh district. During the study period of February, 2022-June 2022, a total of 200 samples including beef (50), fish/shrimp (50), vegetables (50), soil (25) and irrigation water (25) samples were collected from randomly selected 4 upazilas of Mymensingh district including Mymensingh Sadar, Muktagachha, Fulpur and Tarakanda. *Klebsiella sp* was isolated from collected samples as per standard methods and identified by selective biochemical test. Detection of *mcr* gene in some of the isolated *Klebsiella sp* was done by PCR. In this study, *Klebsiella sp* was isolated from beef (36%), fish (70%), vegetables (30%), soil (60%) and irrigation water (72%). The *mcr* gene was detected in some of the *Klebsiella sp* isolates. High prevalence of *Klebsiella sp* was found in all the collected samples of all upazillas. Moreover, some of the isolated *Klebsiella sp* carried *mcr* gene indicated the risk for public health.

Detection and Quantification of Melamine in Milk, By-products and Dairy Products by High-Performance Liquid Chromatography (HPLC) and Observation of Toxic Effects of Melamine in Mice in a Dose-dependent Manner Detected in the Analyzed Samples

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Abstract

Milk is a naturally nutritious food for humans, especially children solely dependent on milk and can be supplied commercially. Non-protein nitrogenous substances can alter the percentage of protein content

in milk. Melamine, a nitrogenous substance, can be used as an adulterant in milk to show an increase in protein content in milk. This study focused on detecting melamine levels in commercially available different types of milk, dairy products, and by-products and estimating the risk caused by it adopting a mice model. The quantification of melamine in milk was performed by The High-Performance Liquid Chromatography (HPLC). The presence of melamine was detected above TDI (Tolerable Daily Intake) among most of the categories. All eight brands of commercial powder baby milk contained melamine above TDI (1 ppm) that ranges 30-1100 times higher than the acceptable level ranging 30-1100 ppm. In adults brands, all eleven commercial milk samples (powder and liquid) showed the presence of melamine above TDI (0.2 ppm) that range from 40-5000 times higher than TDI ranging 8.5-1028 ppm. Among dairy products (ice-cream, yogurt, condensed milk and whey), melamine was detected at a varying degree of levels (1- 31 times above TDI) and in some cases, melamine was not detected. In animal experiment, the effect of melamine was obsereved in a dose dependent manner (control/0, 250, 500, 1000, 1500 ppm). In mice, it was observed that melamine toxicity significantly increased Hb%, creatinine, TEC levels that indicated renal toxicity and polyuria in a dose-dependent manner. The significant increase of SGOT and SGPT indicated the liver damage caused by melamine. The weight and length of the testis and epididymis were observed the highest in the 250 ppm treated group and lowest in the 1500 ppm treated group which were significantly different from the control. The rest of the treated groups showed a gradual reduction of weight and length of the testis and epididymis from the higher to the lower melamine-treated group in a dose-dependent manner. Sperm motility and concentration decreased in a dose-dependent manner from higher to lower concentration treated groups except 250 ppm treated groups. The percentage of abnormal sperm had significantly increased in the melamine-treated groups in a dose-dependent manner from higher to lower with neck torsion, detached head, bent tail, coiled tail etc. From this study, it was revealed that the concentration of melamine detected in commercial milk was severly harmful for the liver, kindney, hemapoietic system and male reproductive system. A strict monitoring and food safety law should be implemented to control melamine adulteration in milk and dairy products for the public health issue.

Antimicrobial Resistance and Virulence Profiles of Extended-Spectrum Beta-Lactamase Producing *Eschericia coli* Isolates in Milk Samples of Dairy Cows in Bangladesh

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Abstract
Emergence of extended-spectrum beta-lactamase-producing *Escherechia coli* (ESBL-Ec) in milk is serious public health concern as milk is considered as complete food and important part of daily human diet worldwide including Bangladesh. Molecular characterization and antimicrobial resistance profile of ESB-Ec from milking healthy cows have not yet been reported in Bangladesh. The study aimed to detect and characterize ESBL-Ec from milk samples of healthy cow in small holder dairy farms of Mymensingh district, Bangladesh. A total of 100 milk samples were collected from apparently healthy cows. *E. coli* was isolated and screened for ESBL production by double disk synergy test. ESBL gene grouping of the isolates was done by multiplex PCR. In this study, 41 (82%) *E. coli* were detected as ESBL-Ec which carried ^{bla}CTX-M, ^{bla}TEM and ^{bla}SHV individually or combinedly (^{bla}CTX-M plus ^{bla}TEM, ^{bla}TEM plus ^{bla}SHV). Antibiogram study revealed that these ESBL-Ec were highly resistant against ampicillin, cefotaxime, gentamicin (100%), and azithromycin (88%). In conclusion, our study showed wide dissemination of ESBL-Ec in raw milk of healthy cow and most of the ESBL-Ec were

multidrug resistant which may be alarming for human health. This is the first study on ESBL-Ec isolated from raw milk of healthy cow in Bangladesh.

Prevalence and Risk Factors of Brucellosis in Dairy Cattle

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Abstract
Brucellosis is the most widespread bacterial zoonotic disease throughout the world. In animals: mainly affects reproduction and fertility, with abortion and reduced milk yield. In humans: the clinical picture resembles many other febrile diseases, but sacroiliitis and hepato-splenomegaly are the most prominent. The brucellosis has been reported to be associated with bovine infertility for the first time in 1967 from Bangladesh. Recently the reviewed reports showed that the 3.7% sero-prevalence of brucellosis in cattle, 4.0% in buffaloes, 3.6% in goats and 7.3% in sheep and 4.8% in pigs and 4.0% in dogs in Bangladesh. The objectives of this study are molecular characterization of *Brucella* strain from placentas of aborted dairy cows of Central Cattle Breeding and Dairy Farm (CCBDF) and Military Dairy Farms (MDF) of Bangladesh; identification of risk factors for positivity of brucellosis in dairy cattle and efficacy of conventional antibiotics and changes of haemato-biochemical constituents of *Brucella* infected dairy cattle. Serum samples of 460 (290 from Central Cattle Breeding and Dairy Farm, 170 from Military Dairy Farm) lactating cows along with their milk samples were collected randomly. Serum samples were screened for brucellosis with Rapid Antigen Kit Test and Rose Bengal Test (RBT), whereas milk samples were tested with Milk Ring Test (MRT). Farm and animal level demographic and risk factor data were collected using a questionnaire and analyzed using univariable and multivariable logistic regression. The overall sero-prevalence was found to be 3.9% (95% CI 2.4-6.2) using RBT and Rapid Antigen Kit Test and 2.8% (CI 1.5-4.9) using Milk Ring Test, respectively. The odds of brucellosis was 7.4 times (95% CI: 2.5-21.5) higher in cows with repeat breeding that without repeat breeding. Moreover, the sero-prevalence of brucellosis was significantly higher (Odds ratio: 15.7; 95% CI: 5.2-47.4) in cows with retention of fetal membranes than without retention of fetal membranes. The study is still in progress.

Cytokine mRNA Expression Dynamics in the Peripheral Blood Mononuclear Cells following Foot-And-Mouth Disease Vaccination in Cattle

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Abstract
The innate immune response is the first line of body defense developed within hours of infection or vaccination. Innate immunity launches through the recognition of conserved microbial structure by the receptors of host immune cells and subsequent secretion of cytokines and inflammatory mediators. The temporal patterns of cytokine mRNA expression in the systemic circulation are one of the major indicators of the innate immune status of the host. Foot and mouth disease (FMD) is a highly

economically important viral disease of cattle, and vaccination is considered an effective FMD prevention strategy in endemic areas. This study aimed to evaluate the innate immunity developed in peripheral blood mononuclear cells (PBMCs) after foot and mouth disease (FMD) vaccination in cattle. For this, three female calves of crossbred cattle were immunized with an FMD vaccine manufactured by the Department of Livestock Services, Bangladesh as per the recommended dose and route. The whole blood sampling was performed immediately before, and 6, 24, and 72 h after vaccination, PBMCs were isolated from whole blood followed by extraction of RNA and synthesis of cDNA. The mRNA expressions of six selected cytokines such as interleukin 1 alpha (IL-1α), IL-1β, IL-6, tumor necrosis factor-alpha (TNF-α), and interferon-gamma (IFNγ) were quantified by using the quantitative real-time PCR. Results demonstrated that mRNA expression levels of IL-1α, IL-1β, IL-6, and TNF-α in PBMCs were significantly increased following the vaccination suggesting that the FMD vaccine used was able to induce sufficient immune responses. The mRNA expression of IFNγ was also increased after vaccination indicating the type II interferon response was developed after FMD vaccination. The findings of this study suggest that the FMD vaccine triggered innate immune responses in the systemic circulation after vaccination.

Knowledge, Attitude and Practices of Veterinarians Regarding Lumpy Skin Disease in Cattle in Bangladesh

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Abstract

The Lumpy skin disease (LSD) is a highly contagious, transboundary, and notifiable emerging viral disease of cattle worldwide, and the very first LSD outbreak in Bangladesh was reported in August 2019. The LSD has shown substantial economic impact causing decreased milk yield, abortion and infertility in cows, reduced growth rate in beef cattle, and permanent damage to the skin of affected animals. Since an emerging disease, the veterinarians working in the field have come across LSD as new cases, and front liners to provide services related to the treatment and management of clinical cases. Thus, the experience, knowledge, attitude, and practices of veterinarians related to LSD in cattle would provide a better understanding and design of the prevention and control strategy. For this purpose, a country-wide, cross-sectional, online questionnaire survey will be conducted among the Government, non-government, and private veterinary practitioners to gather existing field-side knowledge on the predisposing factors, clinical manifestations, control measures, and management practices associated with LSD outbreaks. The questionnaire has been sent via email or social media to the responders. The number of targeted responders is about 500 throughout the country. The inclusion criteria of responders are he/she should be registered/licensed veterinarians who have been practicing in Bangladesh and have gone through at least three LSD cases in cattle. The data from the responses will be filtered and analyzed with appropriate statistical tests. In conclusion, this proposed survey would contribute to a better understanding of veterinary clinical aspects of the LSD outbreak, and thereby design effective strategies for the preparedness and control of LSD outbreaks at the regional and the national level.

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Work-related Musculoskeletal Discomfort and Injury of Dairy Farm Workers in Baghabarighat Milk Pocket Areas of Bangladesh

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Abstract
Dairy farming is physically demanding and associated with a high frequency of musculoskeletal disorders (MSD) where operating their routine activities manually. Though MSDs are one of the crucial occupational health hazards in the livestock sector of Bangladesh but this issue always becomes ignored by dairy farm workers. This study investigated the work-related MSDs in nine different parts of the body concerning ergonomic work factors and cattle-related injuries of dairy farmers. A community-based cross-sectional study was conducted among 350 manual dairy farm workers from March to August 2022 in the Sirajganj district. For this purpose, a modified version of the Nordic questionnaire was used for data collection. The data were analyzed using descriptive statistics and the chi-square test in SPSS software version. As per the results, the most frequently reported MSD in farm workers were located in the lower back pain (65.46%), shoulders (57.0%), neck region (46.45%), and hands/wrist (41.28%) among farm workers. Age was significantly associated with MSDs in the shoulders, lower back area wrist, and knees. Female farm workers reported significantly higher frequencies of MSD in the upper and lower back (67%) neck (48%) and hands/wrists (61%) than male farmers/workers (24%, 21%, and 26%, respectively). Lower back pain mostly affected workers engaged in fodder cutting (62.24%), manual milking (74.45%), and working in cowsheds (68.26%). Lifting heavy objects, fodder collection/cutting, daily cleaning, and manual milking were reported as important discomforts from repetitive and monotonous work in dairy houses. Overall, female workers (57.60%) reported significantly more MSDs than their male counterparts (16.26%). The most strenuous task in dairy work is the manual milking of cows which was significantly associated with neck disorders compared to other tasks. The leg region of workers was more prone to physical injuries at 55.0% than the hand at 17.34%. Proper ergonomic intervention, quality training of workers, use of proper hand tools and aids as well as modification in house design are needed to provide a more comfortable work life to dairy farm workers, particularly female workers in Bangladesh.

Lameness in Dairy Cattle: Prevalence, Risk Factors and Impact on Milk Production in Baghabarighat Milk Shed Areas of Bangladesh

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Abstract
Lameness is one of the most pressing health, production, and welfare problems on intensive dairy farms. A cross-sectional study was conducted to determine the prevalence of lameness, identify the associated risk factors and assess the impact of lameness on milk production. This study was carried out on randomly selected 643 cows from 30 dairy herds in the Sirajgonj district. A pretested structured questionnaire and direct observation were the main tools for collecting information from respondents and determining risk factors regarding different aspects of lameness. Data were collected from farmers, with inclusion criteria of having at least 5 cows with farming experience of more than 6 months.

Animals were observed during in motion for detection of any kind of abnormalities in locomotion. Milking and pregnancy status, milk yield before and after disease, feeding, body condition score, parity, floor type, frequency of floor cleaning, bedding type, and herd size were hypothesized to be risk factors for lameness and statistically tested. Out of 643 dairy cattle examined, 107 (16.64%) showed lameness in different grades, with 58.0% mild, 29% moderate,11% lame, and 2% severe lame. Lameness was significantly associated with floor type, concentrate feed, parity, pregnancy, and milking status (P>0.05). The study revealed that lameness mainly occurred due to hoof disorders like overgrowth/lesions/crack (20.56%) and carpal/tarsal joint lesions (14.95%). Lameness was significantly higher in the hind limbs (13.0%) than in the forelimbs (3.5%). In milking dairy cows, the mean daily milk yield (av. 12.36 L/day/cow) was significantly reduced (av. 10.34 L/day/cow) after the onset of lameness. The study showed that lameness is associated with milk yield and is an economically important welfare problem in studied dairy units. Therefore, farmers should give attention to lactating cows for early detection and prevalence of lameness to minimize economic loss.

Bangladeshi Farmers' Awareness and Attitudes Towards Lameness in Relation to Cow Welfare and Milk Yield in Dairy Farms

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Abstract

Lameness is a painful disease, which negatively impacts dairy cow production and welfare. Control is impeded because farmers often underestimate the number of lame cows in Bangladesh. A cross-sectional study was conducted using a questionnaire and face-to-face interviews to assess Bangladeshi farmers' awareness and knowledge about lameness and to analyze farmers' perspectives and approaches to management and prevention. A total of 60 farms located in the Sirajganj district was visited twice by Veterinarian. On the first visit, the farmers were requested to answer a questionnaire on lameness knowledge and their farms' management. All lactating cows (n = 643) on each farm were scored for locomotion by a Veterinarian and farmers were asked to estimate the number of lame cows present on their farms at each visit. The ratio of farmers' estimated prevalence and the veterinarians' observed prevalence (Farmer's Detection Index; FDI) was calculated. On average, farmers underestimated lameness prevalence during both visits except for severe lameness. The median prevalence of lame cows assessed by veterinarians and farmers was 21.82% and 14.25%, respectively. Farmers (100%) agreed that lameness induces pain and cows feel it, but interestingly 64.48% of farmers don't think that lameness can reduce milk production. Most of the farmers (78.5%) supported the requirement for alleviating unnecessary pain and but they do not call Veterinarians immediately. Farmers (82.48%) used anti-inflammatories/analgesics and antiseptic hoof wash as treatment remedies by themself and no one mentioned the adoption of regular preventative measures and records for lameness in their herds. 100% of farmers reported having no training on lameness management and cited an overall lack of veterinary support to control lameness on their farms. The results indicate that lameness exists in studied areas due to a lack of farmers' knowledge and awareness.

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Impact of Water Salinity on Health, Productivity and Reproduction Performance of Indigenous Cattle in the Coastal Areas of Bangladesh

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Abstract
Salinity intrusion is one of the major environmental issues in the coastal areas of Bangladesh which has a significant effect on the livestock production. This study was undertaken to assess how salinity in drinking water affects the health, production, and reproduction of indigenous cattle in selected coastal areas of Bangladesh. A total of 60 native cattle (male and female) age ranging from 1 to 12 years were randomly selected from one upazila as control area (Mymensingh – group 1) and two upazilas in the coastal belt (Koyra – group 2 and Shubarnachar – group 3). In order to account age effects, all cattle were categorized as young (less than 1 year) and adults (older than 1 year). Blood samples were collected from the selected cattle and blood parameters such as alanine aminotransferase (ALT), aspertate aminotransferase (AST), urea, uric acid, creatinine, and blood electrolytes (potassium, sodium and chloride) were measured. Water and feed samples from the selected study areas were collected randomly for chemical analysis. Uric acid, serum aspartate aminotransferase (AST), potassium were significantly higher ($P<0.05$) in group 2 compared with group 1 and 3. Whereas serum creatinine, urea, alanine aminotransferase (ALT), chloride and sodium were significantly higher ($P<0.05$) in group 3 compared with group 1 and 2. Interestingly, there was no significant difference in uric acid, potassium, sodium and chloride between group 1 and 3. All measured blood parameters except uric acid were higher in young male cattle. Blood electrolytes and enzymes related to liver and kidney functions differed between young and old as well as male and female animals, indicate different salt tolerance capacities of cattle towards increased drinking water salinity.

Physiological Adaptation of Indigenous Sheep to Increased Water Salinity at the Coastal Areas of Bangladesh

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Abstract
Bangladesh is one of the countries most susceptible to climate change's effects and is most likely to experience its negative repercussions. Due to water salinity, it is important to understand the animals' physiological capacity for salinity tolerance. As a result, the study investigated the adaption mechanisms or methods for preserving salt-water balance in sheep when drinking saline water for an extended period of time in Bangladesh's coastal districts. A total of 150 sheep (both male and female), ages ranging from 1 to 6 years were randomly selected and divided into 5 groups (30 sheep from each group). Sheep were chosen from Mymensingh as control (group 1), and sheep were picked from the coastal areas (Dacope, Koyra, Subarnochar, and Hatia) in group 2, 3, 4, and 5, respectively. To account for age effects, all sheep were divided into two groups: young (under 2 years) and adults (over 2 years). The blood parameters were measured. Serum potassium, chloride, AST, urea, uric acid, and creatinine were significantly ($P<0.05$) differed among the groups. In group 3 where animals drank higher concentration of saline water, significantly higher ($P<0.05$) values were observed in serum

creatinine, uric acid, urea and potassium, whereas sodium and chloride were significantly ($P < 0.05$) higher in group 5 than other four groups. No significant differences were observed between the young and adult as well as male and female sheep. However, in group 2, 3 and 5, adult sheep had higher serum sodium and chloride than young sheep. Urea, uric acid, and creatinine were higher in young sheep of all groups except group 2. It is concluded that sheep in coastal regions may adapt to higher saline levels by altering their kidney function and have varying salt tolerance capacities depending on their age and sex.

Medial Patellar Desmotomy in Stringhalt affected cattle: Ultrasonographic Evaluation and Assessment of Serum Minerals

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Abstract
Changes in the serum mineral concentration and ultrasonographic appearance of the patellar ligaments were studied in the cattle with upward patellar fixation (UPF) before and after medial patellar desmotomy (MPD). The incidence of UPF in respect to age, breed, sex and season was retrospectively recorded (2019-2022) from the patient register of Veterinary Teaching Hospital (VTH), Bangladesh Agricultural University (BAU), Mymensingh. Eight clinically affected cattle with UPF and two healthy animals as control were used in this experiment. Blood samples were collected from the animals before and after MPD to assess serum level of Na, K, Cl, Ca, P, Mg, Fe, Cu, and Zn. The thickness of patellar ligaments was assessed ultrasonographically before and after MPD. The retrospective data revealed that a total of 37 cases were brought to the VTH with UPF among which 38% (n= 14) were below 4 years old, 51% (n= 19) were between 4 to 7 years and 11% (n= 4) of affected cattle were older than 7 years. The occurrence was higher in indigenous cattle (73%, n= 27). Females were more prone to the disease (n= 31, 84%). The occurrence was recorded higher in winter (n= 17, 46%) in comparison to the summer and rainy seasons. Serum electrolytes and minerals concentrations were within the normal range. The thickness of middle and lateral patellar ligaments were significantly increased ($P< 0.05$) after MPD. There is no correlation between the serum mineral concentrations and clinical affection of UPF in cattle. Ultrasonography may be an important complementary technique for postoperative assessment of patellar ligaments.

Blood and Plasma Transfusion for the Treatment of Critically Ill Goats

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Abstract
Now-a-days transfusion of blood and plasma become a very essential and life-saving tool in veterinary critical care and emergency medicine throughout the world. This study investigated the clinical and hematobiochemical responses of blood and plasma transfusion in severe anemic goats. From January 2020 to December 2022, a total of 23 anemic goats were admitted in the Veterinary Teaching Hospital (VTH), Bangladesh Agricultural University (BAU), Mymensingh. Among them, 12 clinical anemic goats (group A) received fresh whole blood transfusion and 11 (group B) received plasma transfusion. The recipients were selected depending on the clinical and hematological parameters and containing

less than 18% PCV with clinical sign of weakness and pale or whitish mucous membrane (anemic). Five healthy goats were used as donors. Desired amount of CPDA-1 (1 ml/7 ml blood) was taken into a 50 ml disposable syringe and blood was collected from the donor through jugular venipuncture. The blood was then transfused @10-12 ml/kg body weight afresh to the recipient or centrifuged for separation of plasma for transfusion. Clinical (heart rate, respiratory rate and rectal temperature), Hematological (TEC, TLC, HB, PCV, Neutrophil, Eosinophil, Lymphocyte, Monocyte), Electrolytes (Na^+, K^+, Cl^-) and Biochemical (ALT, AST, Creatinine, TP) parameters were evaluated before and after at 1st, 7th, 14th, 21th, 28th days post-transfusion. In both the group, total erythrocyte counts (TEC), packed cell volume (PCV), hemoglobin (Hb) and total protein (TP) were increased significantly ($p<0.05$) at 1st, 7th, 14th, 21th, 28th days of post-transfusion in comparison to pre-transfusion values. However, the hematological parameters were found superior in the animals received blood transfusion. All the animals recovered successfully except one received blood transfusion that was critically ill, emaciated, lateral recumbent and cannot stand, eat or drink. The blood and plasma transfusion was found to upgrade the hematological and biochemical parameters in anemic goats. The transfusion of blood and plasma can be an effective tool for the clinical management of anemic goats.

Adaptive Capability of Indigenous Versus Exotic Goats as Indicated by Dynamics of Heat Shock Proteins and Endocrine, Biochemical, Immune Responses Under High Environmental Temperature in Summer

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Abstract
Goats are most adapted species to all type agro-climatic conditions although they experience stress due to thermal challenges. Environmental stressors such as hypothermia or hyperthermia affect behavioral, physiological and molecular mechanisms. This study was conducted to evaluate the impact of high and low ambient temperature on physiological, biochemical, hormonal changes as well as heat resistant gene responses in indigenous and exotic breeds of goats. Black Bengal and boar goats were used as indigenous and exotic species respectively. The study was conducted in summer (May – August) and winter (December – February). The daily temperature and relative humidity were recorded by digital hygrometer and thermometer installed in the animal shed to calculate the temperature-humidity index (THI). Physiological parameters were recorded once a week during the experimental periods. Blood samples and skeletal muscle samples were collected at 15 days interval in each season. Blood samples were analyzed for haematobiochemical and endocrine changes. Skeletal muscle samples were used to perform real-time PCR to investigate the relative expression of Heat Shock Protein (HSP)60, HSP70 and HSP90. In this study, the temperature humidity index (THI) was 30.5± 0.51 and 16.37 ± 1.51 in summer and winter season respectively indicating that all the animals were in very high heat and cold stress under summer and winter season. The haematobiochemical and endocrine analysis of this study revealed that heat and cold stress in Black Bengal and Boar goats exerted significant alterations in some hematological, serum biochemical and hormonal parameters. There were abundant expression of HSP90 in the skeletal muscle of BB goats in both season but the expression was significantly ($P<0.05$) higher in the summer. Thus, it can be concluded that both heat and cold stress are associated with certain systemic effects in goats and HSP especially HSP90 may have protective effect of thermal stress so as to maintain cellular integrity and homeostasis in goats.

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The Role of Platelet Rich Plasma on Induced Third-degree Burn Wound Healing in Rabbits

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Abstract

This study was designed to find out the effectiveness of heterologous platelet-rich plasma (hPRP) against burn wound in rabbits. A total of 24 3rd degree burn wounds of 8 mm in diameter were made. The animals were then divided into two groups: group A or hPRP group- freshly prepared hPRP was applied topically on the wound twice a week, group B or control group- wounds received sterile saline only. Post-therapeutic morphology, morphometry, the histological architecture of wounds were evaluated and in vitro and in vivo antibacterial potentials of hPRP were assessed. In this study, hPRP-treated rabbits had faster rates of wound contraction and shorter days of complete wound closure. Histological examination revealed the existence of less inflammation and more organized fibroblast in the samples of day 7 in the hPRP group than those of control wounds. On day 21 of histological examination, remarkable thickening of the epidermis was observed in hPRP group. Serum biochemical examination revealed no toxic effects of hPRP on the liver and kidney. Based on the results of wound morphology, histological characteristics and antibacterial effect, it can be concluded that hPRP gel can be a promising substitute for antibiotics or other topical ointment in the treatment of infected wounds.

A Comprehensive Approach for the Diagnosis and Therapeutics of the Retained Foetal Membrane (RFM) in Dairy Cattle: A Perspective to Reduce the Antibiotic Use and Increase Economic Turnover

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Abstract

The health of the mother and the placenta are critically important to the success of a pregnancy. The retention of the foetal membranes (RFM)/placenta is a common disease/condition in cattle which directly and indirectly interfere with pregnancy outcomes. The purpose of this study was to assess how veterinarians currently handle cases of retained fetal membranes. To get the actual scenario, an e-survey was conducted across the entire country. To conduct the survey, we used a Google form and direct interviewing methods. Retained fetal membranes were treated following standard protocols. There were 105 vets who filled out the survey. Eighty percent of respondents have bachelor's degrees or higher; most have worked in their field for at least five years; and 76 percent have advanced degrees. When we inquired about retained fetal membrane in cattle, responses varied on whether or not the placenta is normally expelled after birth. However, most participants disagree on the typical time for the placenta to be expelled, with estimates ranging from 0-6 hours (30%) to 7-12 hours (23%), and 13-24 hours (47%). However, more than half of the participants (54%), identified a retention time of more than 24 hours for the placenta. It was heartwarming to learn that only 5% of veterinarians used antibiotics for retained fetal membrane management, with 55% instead opting to use hormones and/or hormonal products. Oxytocin, metherspan, utokil, and antibiotics were frequently prescribed for the

treatment of retained foetal membranes. According to the veterinarian, crossbred cattle are especially at risk for developing retained foetal membrane. Our results indicate, there is room for advancement in the management and treatment of retained foetal membrane, and thus in the overall reproductive health of cattle.

Chilled Preservation of Boer-cross Buck Semen in Bangladesh

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Abstract
Goats are regarded as the poor men's cows in Bangladesh. Compared to black Bengal (BB) goats, Boer is popular breed of meat goat in the world. Improvement of BB goats by cross breeding with Boer bucks through artificial insemination may contribute a lot to meat production from goats in Bangladesh. Considering the mentioned facts, the objective of this investigation was to preserve the Boer cross buck semen to optimize the semen preservation technique in Bangladesh. Semen was collected from two adult Boer cross bucks using artificial vagina following standard procedure. After performing routine evaluation with respect to volume, progressive motility, concentration and spermatozoa with normal acrosome, mid-piece and tail, semen was diluted using a TRIS-based diluent supplemented with 10% egg yolk. After dilution, the semen was stored at 4^{0}C at refrigerator for 72 hours. The stored semen was evaluated with respect to progressive motility and spermatozoa with normal acrosome, mid-piece and tail at 24 hours interval up to 72 hours. The volume, progressive motility, concentration and spermatozoa with normal acrosome, mid-piece and tail of fresh semen varied from 380.0125.5 to 410.054.8 µl, 74.013.9 to 76.06.5 %, 2584.0470.1 to 3542.01961.1 x 10^{6}/ml and 94.32.3 to 94.90.4 %, respectively. The progressive motility of stored semen decreased gradually (57.215.7 to 60.66.4 % after 24 hours and 34.013.9 to 39.25.4 % after 72 hours) with increased duration of storage at chilled condition. The ingredients of semen extender should be optimized to improve the storage quality of preserved semen of Boer cross buck semen. The work is in progress.

Application of Genomic Tools for Genetic Improvement of Crossbred Friesian Cattle in Bangladesh

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Abstract
The genotypes play a vital role in performance of dairy cows. The objectives of the study were to determine the admixture of genetics followed by evaluation of performances of crossbred Friesian cows in Bangladesh. Data on performance were collected from crossbred Friesian cows using questionnaire. The genomic DNA was extracted from blood samples of 1007 crossbred cows. The DNA was analyzed for genomic admixture by using Axiom bovine (BOVMDv3) 60K SNP array in Animal Production and Health Laboratory, IAEA, Vienna, Austria. Based on DNA analysis, cows were classified into <25.0%, 25.0-<50.0%, 50.0-<62.5%, 62.5-<75.0%, 75.0-<87.5% and ≥87.5% Taurine groups. Among 944 genotyped cows, the highest proportion (31.9%) had 50.0-<62.5% and the 2nd highest proportion (29.3%) had 62.5-<75.0% Taurine genetics. Higher proportion of cows (53.4%)

with 50.0-<62.5% Taurine genetics were reared in public farms than in private farms (24.6%) (P<0.05). In all lactations, 305 days milk yield increased in cows with rise of Taurine genetics from 25.0-<50.0% (1521.5 to 2278.2 L) up to 62.5-<75.0% (1723.7 to 2798.2 L). The milk yield decreased with increasing Taurine genetics from 75.0-<87.5% up to ≥87.5% (P<0.05). Higher first service conception rate (47.3%) was observed in cows with 62.5-<75.0% Taurine genetics than in ≥87.5% counterpart (38.8%) (P<0.05). The cows with 50.0-<75.0% Taurine genetics required lower service per conception (1.7) than in ≥87.5% counterpart (2.1) (P>0.05). The cows with ≥87.5% Taurine genetics had shorter calving to first service interval (134.9 days) than in 50.0-<62.5% counterpart (153.9 days) (P<0.05). The cows with 62.5-<75.0% Taurine genetics had the shorter days open (154.4 days) than in 50.0-<62.5% counterpart (181.1 days) (P<0.05). The cows with ≥87.5% Taurine genetics had shorter calving interval (462.9 days) than in 50.0-<62.5% counterpart (495.2 days) (P<0.05). This study will help in developing a national AI program for genetic improvement of non-descript zebu cows in Bangladesh.

The Pregnancy and Lambing Rates Following AI in Field Sheep and Selection of Resource Lambs for Nucleus Flock Development Through ARTS Under Public Private Partnership

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Abstract

The work was conducted in the sheep farm of the Surgery and Obstetrics Department and Government sheep farms of Bogura and Rajshahi and Gaibandha districts. The objectives were to i) observe the pregnancy and lambing rate in the field with AI using produced chilled and frozen ram semen and ii) production of resource lambs to be used in AI and MOET program for nucleus flock development. In the field, a total of 116 and 75 ewes were induced using $PGF_2\alpha$ (Ovuprost®, Bayers, New Zealand) for induction of estrus. TCAI was performed in 89 and 47 ewes using chilled and frozen semen, respectively. In the research station, natural service was given to the naturally heated ewes to produce the resource lambs. The semen was evaluated for the determination of puberty and the selection of the best male lambs. In the field, the percentage of ewes responded to induction with $PGF_2\alpha$ varied from 62.7- 76.7%. The pregnancy and lambing rates with chilled and frozen semen were 73.03 and 95.4%, and 76.7 and 62.5%, respectively. There was no significant difference between chilled and frozen semen in pregnancy rates. However, lambing and lamb survival rates were significantly higher (P<0.01) with chilled semen compared with frozen semen (88.7 vs 83.3%). Similar birth weight was observed with chilled and frozen semen 0.5-3.3kg. The lamb weight at 6 months was 17.3±0.35kg. In the research station, A total of 42 lambs (23 ram and 19 ewe lambs) were produced. The age and weight at puberty of male and female lambs were 6.9±0.21 and 7.0±0.27months and 10.52±4.51 and 9.33±1.2kg, respectively. Seven rams were selected as best from 12 puberty lambs for semen collection and preservation. The duration of oestrus in puberty lambs was 28.66 ±1.7hrs. Four synchronized ewes lambs underwent for LAP-AI using chilled semen. The selection of lambs is continuing to be used in LAP-AI and MOET programs to produce quality lambs for the nucleus flock.

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Determination of Factors Affecting the Postpartum Onset of Estrus in Local Ewes

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Abstract
The research was conducted at Sheep Research Farm and Reproduction Laboratory under the Department of Surgery and Obstetrics, Bangladesh Agricultural University, Mymensingh. The objective of the study was to elucidate the factors affecting the early onset of postpartum estrus in local ewes. The effects of body weight and breed, the season, presence of males following delivery, suckling, and biochemical properties, and progesterone at day 10 of delivery on days postpartum onset of estrus were observed. Seventeen ewes (12 Indigenous and 5 Garole) were used following delivery. The pregnancy and delivery were monitored. The blood was collected (7ml) from the jugular vein immediately after delivery and on day 10 of delivery and serum was prepared and stored at -20℃ until analyzed. The ewes of the higher body weight (14.87±0.27 and 28.3±2.65kg) group showed earlier postpartum onset of estrus (28.8±5.48 and 28.5±8.5 days) compared with lower body weight (12.89±0.48 and 24.42±0.22kg) (46±8.96 and 37±9.0 days) within both breeds of ewes. No significant difference was observed between the breeds on days postpartum onset of estrus, although Garole breed having higher body exhibited estrus earlier. The postpartum onset of estrus was earlier in the breeding season group than in the non-breeding season groups in the indigenous ewes (27±7.56 vs 44.57±7.47 days). The ewes in presence of males showed significantly ($P<0.05$) earlier onset of estrus (21.5±0.5 vs 41.88±6.6 days) in indigenous ewes compared with ewes in the group in absence of males. Similarly, earlier onset of estrus was observed in Garole ewes however, the difference was not significant. The suckling significantly ($P<.01$) delayed the postpartum onset of estrus in the indigenous ewes group compared with ewes in the non-suckling group (49.85±5.18 vs 17.75±2.3 days). A similar trend was the group of Garole ewe; however, the difference was not significant (37±9.0 vs 28.5±8.5 days). There were no significant differences between the biochemical values immediately after parturition and during the onset of estrus (Glucose, Total protein, Total cholesterol) except triglyceride ($p<0.05$). The Progesterone effect on the days postpartum onset of estrus is yet to be observed following analysis. The work is in progress.

Efficacy of Different Treatment Regimens in True Anoestrus Dairy Cows of Bangladesh

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Abstract
The study was carried out to evaluate the effect of different therapeutic interventions on estrus induction response and conception rate in true anoestrus dairy cows of Bangladesh. Forty two crossbred dairy cows having ≥90 days postpartum period were allocated to 4 groups viz. GI, GII, GIII and GIV. All cows were dewormed with bolus Tetranid @ 1 bolus/150 kg orally. Vitamin-mineral mixture was administered GI, GIII, GIV for 15 days, while cows of GIII and GIV additionally received a single injection of 500 µg GnRH analogue intramuscularly and Sepia 30 @ 10 drops orally daily for 10 days, respectively. Whereas, GII cows were only administered 500 µg GnRH analogue. Following confirmation of estrus, cows were inseminated trans-cervically within 14-20 hours of the onset of

estrus using good-quality frozen semen. Pregnancy was confirmed by rectal palpation and using fetal Doppler. Vaginal discharge, moderate to good uterine tone and the presence of palpable follicles in the ovary were considered as the genital changes indicative of oestrus in the study animals. Overall estrus induction response in GI, GII, GIII and GIV is 50, 45.45, 83.33 and 72.72% respectively, and the response in GIII was significantly higher (P>0.05) compared to GII. The post treatment estrus intervals in cows under the 4 treatment groups were 31.25 ±2.11, 26.80 ± 4.31, 23.60 ± 3.05, 28.13 ± 4.77 days, respectively. Overall conception rate in GI, GII, GIII and GIV were 50%, 60, 90 and 75%; whereas, service per conception was 3.5, 3.6, 1.89 and 2.83, respectively. However, there was no significant difference. It can be concluded that nutritional, hormonal and homeopathic intervention can be used to manage true anoestrus in cows. Homeopathic treatment was found to be effective as GnRH with nutritional support in addressing true anoestrus in dairy cows.

Clinical and Haemato-biochemical Changes Upon Administration of Atropine-Xylazine and Atropine-Diazepam Combinations During Herniorrhaphy to Repair Umbilical Hernias in Calves

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Abstract

This study was conducted to evaluate certain clinical and haemato-biochemical changes during herniorrhaphy in bovine calves with Atropine-Xylazine (A-X) and Atropine-Diazepam (A-D) combinations. Ten calves of 34−42 kg BW having umbilical hernias were randomly categorized into two groups: group I (A-X, n=5) and group II (A-D, n=5). Firstly, all calves were premedicated with Atropine Sulfate @ 0.04 mg/kg BW. Later, Xylazine HCl @ 0.1 mg/kg BW and Diazepam @ 0.2 mg/kg BW were administered to the group I and group II calves, respectively, for sedation. Clinical indices (temperature, respiratory rate, heart rate, and SpO_2) of calves were monitored 10 minutes prior to administration of injectable agents (control), and thereafter on 10, 20, 30, 40, 50, and 60 minutes (post-administration) over the surgical period, and postoperatively just at recovery from sedation. Additionally, blood samples were collected from calves at the aforementioned intervals to determine hematological (TEC, TLC, PCV, and Hb) and biochemical (TSP, BUN, creatinine, ALT, AST, Na, K, and Cl) changes. In both groups, all clinical indices got altered throughout the experiment but returned near baseline (control) after recovery from sedation. However, a significant (P<0.05) increase in heart rate was found in group I during the experiment. In addition, there were significant (P<0.05) decreases in TEC, TLC, PCV, and Hb, along with considerable fluctuations in TSP, BUN, creatinine, ALT, and AST in both groups. Mild alterations in Na, K, and Cl were also found throughout the experiment in both groups until recovery. Overall, a single dose of Xylazine was enough for surgery followed by smooth recovery in group I, whereas maintenance doses of Diazepam were required for the same in group II. These findings revealed that both combinations had definite effects on clinical and haemato-biochemical properties in calves over the experiment, including few differences in the convenience of clinical uses.

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Therapeutic Efficacies of Different Wound Healing Materials Traditionally Used by Rural Farmers in Bangladesh

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Abstract
All over the Indian subcontinent, herbal plants and other natural medicines are widely accessible to treat farm animals. The study was conducted to compare the therapeutic efficacies of different wound healing materials traditionally used by rural farmers in Bangladesh. Thirty-six incised wounds (3 in each animal) were made in twelve Blank Bengal goats. The goats were divided into three groups; wounds treated with normal saline which was considered as control group (Group A), Group B was treated with turmeric paste and wounds treated with cotton ash in Group C. Follow-up information was recorded from day 0 to day 21 postoperatively. Morphological characteristics such the swelling of the wound, the width of the sutured area, wound contractions and duration of wound healing were also recorded. Blood samples and biopsy of tissues were collected at day 1, day 4 and day 8 for haematological and histopathological studies, respectively. Wound contraction (0.27±0.01 mm), swelling of suture area (0.37±0.03 mm) and elevation line of suture (1.43±0.05 mm) were lowest in wound treated with cotton ash compare to other groups. No significant changes were observed in RBC and WBC of all animals. In histopathological studies, epithelial regeneration and healthy collagen fiber appear in the subcutis at day 8 in group B, whereas the keratin layer of epidermis appear thick and huge accumulation of carbon particles beneath the muscularis layer in the wound treated with cotton ash. It can be concluded that cotton cloth ash, in addition to other herbal remedies, is used for the treatment of skin wounds in goats. Both turmeric paste and ash ointment are equally effective, but turmeric paste is more effective to speed up the healing process.

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Development of Agronomic Package for Some Hilly Black Rice Cultivars for Plain Land Ecosystem

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Abstract
Black rice contains many vitamins and minerals, including iron, vitamin A and vitamin B, which are beneficial for human health with the prevention of heart disease and cancer. Black rice is a type of the rice species *Oryza sativa* L. which is glutinous, packed with high level of nutrients and mainly cultivated in Asia. In Bangladesh, the black rice is being cultivating in the remote hilly areas including Bandarban district as shifting cultivation without any agronomic management practices and hence giving very low yield. However, the overall cultivation procedure of this black rice under plain land condition is still unknown in Bangladesh. Therefore, this study intends to develop an agronomic package for few hilly black rice cultivars in plain land environment of Bangladesh. Two experiments were performed. In the first experiment, two black rice (Indonesian and Bangladeshi) and seven levels of fertilizers (0%, 60%, 70%, 80%, 90%, 100% and 110% recommended dose of fertilizers of a HYV BRRI rice cultivar) were selected as treatments. In the second experiment, the same black rice cultivars as first experiment along with 9 (nine) weed management methods (i. no weeding, ii. two hand weeding at 20 and 40 days after transplanting, iii. three hand weeding at 20,40, and 60 DAT, iv. application of early post-emergence herbicide, v. application of pre-emergence herbicide, vi. application of early post-emergence herbicide + one hand weeding at 40 DAT, vii. application of pre-emergence herbicide + one hand weeding at 40 DAT, viii. application of pre-emergence herbicide + early post-emergence herbicide and ix. weed free) were selected as treatments. In both the experiments, split plot design was followed with three replications. Fertilizer and weed management both were allocated in main plots and cultivars in subplots. It has been found that Indonesian black rice was better performer than that of Bangladeshi black rice. Considering the fertilizer dose, to get highest grain yield 100% recommended fertilizer dose for BRRI developed HYV rice variety (BRRI dhan 28) can be applied for black rice. For weed management, though weed free condition produced highest grain yield (6.1 t/ha) but considering BCR, application of early Post-emergence herbicide with one hand weeding at 40 DAT would be best weed management system to get maximum yield (5.6 t/ha) having a BCR of 2.28.

Efficacy and Economics of Integrated Nutrient Management in Baby Corn- Legume Intercropping Systems

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Abstract
The main advantage of intercropping is the more efficient utilization of the available resources and the increased productivity compared with each sole crop of the mixture. Charland areas are sometimes deficit of different plant nutrients and legume cultivation as intercrop is an important aspect of maintaining the nutrient status of soil. However, soil fertility varies spatially and temporally from field to regional scale, influenced by land use and soil management practices. Keeping this view in mind an experiment was set to find out the effect of integrated nutrient management and intercropping of baby corn legumes on the performance of baby corn and legumes. The experiment comprises two factors

viz. intercropping system (baby corn with chick pea in 2:1 ratio, baby corn with pea in 2:1 ratio, baby corn with chick pea in 2:3 ratio and baby corn with lentil in a 2:3 ratio) and seven integrated nutrient management (i. 100% NPKS from Chemical fertilizer, ii. Cow dung @ 2.5 ton/ha + remaining NPKS from Chemical fertilizer iii. Cow dung @ 5 ton/ha + remaining NPKS from Chemical fertilizer iv. Poultry manure @2.5 ton/ha + remaining NPKS from Chemical fertilizer v. Poultry manure @ 5 ton + remaining NPKS from Chemical fertilizer vi. Vermicompost @ 2.5 ton/ha + remaining NPKS from Chemical fertilizer and vii. Vermicompost @ 5 ton/ha + remaining NPKS from Chemical fertilizer). It has been found that the maximum gross return obtained when Poultry manure @ 5 ton/ha was used and remaining NPKS was supplied from Chemical fertilizer which was slightly higher than the treatment when vermicompost was used @ 5t/ha. But net profit and BCR were vastly higher in poultry manure treatment @ 5t/ha. It can be said that the poultry manure is relatively a cheap source of both macro nutrients (N, P, K, Ca, Mg, S) and micronutrients (Cu,Fe, Mn, B) and can increase soil carbon and N content, soil porosity and enhance soil microbial activity.

Development of Cultivation Technology of Nutrient Enriched Hilly Black Rice in Charland Areas of Bangladesh

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Abstract

Black rice, is a type of rice that belongs to the *Oryza sativa* L. species. In ancient China, it's said that black rice was considered so unique and nutritious that it was forbidden for all but royal family. In Bangladesh, the black rice is being cultivating in the remote hilly areas including Bandarban district as jhum cultivation crop without any agronomic management practices and hence giving very low yield. Two experiments were conducted where first experiment composed of three black rice cultivars with five spacing viz. 15 cm× 15 cm, 20 cm× 15 cm, 25 cm× 15 cm, 20 cm× 20 cm and 25 cm× 25 cm. The experiment two consisted of two black rice (Indonesian and Bangladeshi) and seven levels of fertilizers (0%, 60%, 70%, 80%, 90%, 100% and 110% recommended dose of fertilizers of a HYV BRRI rice cultivar). In the first experiment it has been found that all the parameters were significantly affected by both cultivars and geometry and with their interaction. However, black rice cultivar Gelong ni can be transplanted with 20 cm × 20 cm spacing in order to get maximum grain yield (4.0 t/ha). In case of second experiment, it has been found that Indonesian black rice was better performer than that of Bangladeshi black rice. Considering the fertilizer dose, 100% recommended fertilizer dose for BRRI developed HYV rice variety (BRRI dhan 28) can be applied along with Indonesian black rice to get highest grain yield (4.93 t/ha).

Influence of Planting Density and Weeding Regimes on Varietal Performance of French Bean (*Phaseolus vulgaris L.)*

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Abstract

Planting density influences French bean growth and yield due to increased competition for soil moisture and nutrients with increased plant population. Variation of plant population affects total bean yields. Maximizing the yield of French beans requires a review of the current used plant population

density to determine a population that could produce the highest seed yield of good quality, maximize the use of the land and help solve problems on weed management, disease and pest incidence and low yield. With this backdrop, BARI released three French varieties were evaluated with seven levels of planting densities and four stages of weed management to maximize yield. The results revealed that yield and yield attributes differed with different variety and planting density. The highest seed yield (1.84 t ha^{-1}) was produced from BARI Jharsheem-3 × (25cm×15cm) treatment. The results obtained in the experiment also indicated that there is scope to increase the yield of French bean by applying proper weeding regime and having good variety in French bean (*Phaseolus vulgaris* L). The highest seed yield (1.76 t ha^{-1}) was produced from BARI Jharsheem-3 × (three hand weeding at 15, 30, 45 DAS) treatment. The objective of the present study was therefore to evaluate different varietal effect with plant spacing and weed control/management of French beans and ultimately give the appropriate package of recommendation to French bean growers in the country. In conclusion planting density and variety play a vital role in growth and yield of French bean. BARI Jharsheem-3 at (25cm×15cm) planting density with three hand weeding (at 15, 30 and 45 days after sowing) can be recommended best cultivation practices to obtain higher yield.

Response of French Bean to Water and Weed Management

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Abstract

Soil moisture deficiency/insufficiency in winter of Bangladesh reduce the growth and development of French bean, due to having adventitious roots has a shallow rooting depth and responds favorably to irrigation/water supply. The critical water stress during flowering and pod development seriously lowers bean yields. On the other hand, initial heavy infestation weeds hinder its overall growth and productivity since initial growth rate of French bean is slow compared to weeds and the interspaces covered by weeds severely affected growth and yield. Growth stages of French bean such as emergence, flowering and pod setting are greatly hampered by weed. Weeds above critical population thresholds can significantly reduce crop yield quality. In this context, the present study was therefore undertaken to estimate the effect of water management and weeding regime on the performance of French bean ((*Phaseolus vulgaris* L.) cv. BARI Jharsheem-3). The results revealed that the highest plant height (50.62) , number of pods $plant^{-1}$ (7.29), number of seed $plant^{-1}$ (41.56), weight of seed $plant^{-1}$ (23.60 g), 1000-seeds weight (438.56 g), seed yield (2.55 t ha^{-1}), stover yield (3.62 t ha^{-1}) and biological yield (6.18 t ha^{-1}) were obtained from two irrigation (25 and 40 DAS) and two hand weeding (25 and 40 DAS) treatment while lowest all yield characters were obtained from no irrigation and no weeding treatment. The greatest sensitivity to indicate water supply is during period when irrigation is reported to give maximum increase in yield. The time of weeding has an important effort on the growth and yield of French bean. Weeding at wrong time and at wrong stage of the crop during growing season may not be beneficial. Finally, the results suggest that two irrigations with two hand weeding (at 25 and 40 DAS) treatment is better practice to get higher growth and yield of French bean.

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Effect of Nitrogenous Fertilizer Management on the Growth of Weed and Yield of Rice

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Abstract

An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University (BAU), Mymensingh during the period from November 2021 to May 2022 to study the effect of nitrogenous fertilizer on the growth of weed and yield of *boro* rice cultivars. The experiment comprised of five *boro* rice varieties viz., BRRI dhan28 (V_1), BRRI dhan29 (V_2), BRRI dhan71 (V_3), BRRI dhan100 (V_4) and BRRI Hybrid dhan5 (V_5) and five different levels of nitrogenous fertilizers viz. No N (control) (N_0), 100% of RD of N from urea (N_1), 100% of RD of N from poultry manure (N_2), 50% of RD of N from urea + 50% of RD of N from poultry manure (N_3) and 100% of RD of N from USG (2.7 g per 4 hills) (N_4). The experiment was laid out in a randomized complete block design with three replications. Experimental results reveal that BRRI dhan29 was highly infested with weeds and showed maximum weed density and dry weight at both sampling dates. On the other hand, the lowest weed density and dry weight was found in BRRI Hybrid dhan5 and BRRI dhan71, respectively. The 100% of RD of N from urea exhibited the maximum weed density and dry weight but with the application of USG showed minimum weed density and dry weight. The results also reveal that variety exerted significant influence on yield and yield components and plant characters of *boro* rice. The highest plant height (100.6 cm) was found in BRRI dhan71 and the highest number of total (10.53) and effective tillers hill^{-1} (9.59) was obtained from BRRI dhan29 and BRRI dhan100, respectively. The highest panicle length (23.81 cm), highest number of grains panicle^{-1}(138), highest number of sterile spikelets panicle^{-1}(14.41), highest 1000-grain weight (30.22 g), highest grain yield (7.50 t ha^{-1}), highest straw yield (8.32 t ha^{-1}) and harvest index (47.26%) were obtained from BRRI Hybrid dhan5. Different levels of N also exerted significant influence on the yield and yield contributing characters of *boro* rice. The highest plant height (97.64 cm), highest number of effective tillers hill^{-1} (10.07), highest number of grains panicle^{-1} (117.9), highest 1000-grain weight (23.71 g), highest grain yield (5.951 t ha^{-1}) and highest straw yield (6.851 t ha^{-1}) were obtained from 100% of RD of N from USG (N_4). In case of interaction highest plant height (102.6 cm) was found in the interaction of BRRI dhan71 × 50% of RD of N from urea and 50% of RD of N from poultry manure. The highest number sterile spikelets panicle^{-1} (17.54), 1000-grain weight (30.65 g) and harvest index (48.02%) were obtained from BRRI Hybrid dhan5 with 100% of RD of N from urea. The highest number of effective tillers hill^{-1} (11.47), grains panicle^{-1}(161), straw yield (9.67 t ha^{-1}) and highest grain yield (8.88 t ha^{-1}) were obtained from BRRI Hybrid dhan5 with the application of 100% of RD of N from USG. From the results of the study, it may be concluded that BRRI Hybrid dhan5 with the application of USG might be recommended for obtaining highest grain yield as well as to control weed more effectively in *boro* season.

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Increasing Cropping Intensity of Existing T. Aman Rice-Fallow-Boro Rice Based Cropping Systems through Agronomic Management

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Abstract
In order to produce more food within a limited area, it is necessary to increase cropping intensity producing three or more crops in the same piece of land round the year. The objective of the study was to observe the feasibility of growing T. *aman* rice- Mustard- *Patshak* - T. *aus* rice in existing T. *aman* rice- Fallow- *Boro* rice based cropping pattern. To fulfill the objective four crops were grown viz., short duration T. *aman* rice- Short duration mustard, Patshak and T. aus rice were grown in the same filed in a year. The highest grain yield (5.21 t ha^{-1}) was produced from the interaction of Binadhan-7 × application of duration mustard varieties, USG. Binasarisha-4 fertilized with 100% of RD of N produced the highest seed yield (1.44 t ha^{-1}). Biomass yield was varied significantly due to the interaction effect of variety and nitrogen management. It was found that Binapatshak-1 fertilized with 100% of RD of N produced the highest yield (0.87 t ha^{-1}). Gross income from different varieties of *Patshak* was significantly varied due to varietal effect. Table 7 indicates that Binapatshak-1 produced the highest gross income (15450 Tk. ha^{-1}) than the other varieties. The highest grain yield (5.08 t ha^{-1}) was produced from the interaction of V_2N_2 (BRRI hybrid dhan7 × application of 2.5 t ha^{-1} poultry manure + 75% of recommended dose of prilled urea) which was statistically similar with V_2N_1 (BRRI hybrid dhan7 × 100% of recommended dose of prilled urea) (4.69 t ha^{-1}) and V_2N_3 (BRRI hybrid dhan7 × application of USG) (4.97 t ha^{-1}). Therefore, farmers can maximize their crop production as well as economic return by producing four crops in a year instead of two crops.

Productivity and Economics of Puddled and Zero Till Non-puddled Transplanted Rice Under Varying Weed Management Practices

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Abstract
Weed management is a great challenge for crop production. Despite some undesirable side-effects no viable alternative is presently available to shift the chemical dependence for weed management in rice. Migration of labour away from agriculture to industries or other countries for employment further aggravated this reliance. Moreover, puddled transplanted rice (PTR) is the most common cultivation methods practice by the farmers of Bangladesh that consume huge labour, water and fuel. Zero-till non puddled rice (ZT NPTR) could be great option to face the problem related to PTR. In this backdrop, an experiment was carried out at the Agronomy Field Laboratory of Bangladesh Agricultural University to compare the PTR and ZT NPTR method of rice cultivation in terms of productivity and economics under varying weed management practices. The experiments comprised 5 weed management practices viz. (i) season-long weedy, (ii) season-long weed free, (iii) farmers' practices, (iv) pre-emergence herbicide Commit 500EC and (v) post-emergence herbicide Granite 240SC. The experiments were conducted under randomized complete block design with three replications. The results showed that the herbicide performance in terms of weed suppression varied significantly depending on the type weed management practice and rice cultivation methods. Post-emergence herbicide Granite 240SC

application to control weeds is more beneficial than pre-emergence herbicide Commit 50EC and farmers practice in terms of percent weed control efficiency, grain yield, percent yield increase over control and benefit cost ratio (BCR). Compare to the cultivation methods zero-till non-puddled condition (ZT NPTR) is more beneficial than puddled transplanted condition (PTR) in terms of percent yield increase over control and benefit cost ratio (BCR).

Tank-mix Combination of Available Herbicides for Better Weed Management in no Till Non-puddled Transplanted Boro Rice

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Abstract
Strategies of weed management may vary among the countries, but mostly rely on the use of synthetic herbicides because of outmigration of agricultural labor, escalating labor wages and drudgery involved. Although some proprietary herbicides are available in the market, their numbers are very limited. Tank-mixture of two or more chemical groups of either pre- or post-emergence herbicide might play a vital role to manage weeds of a diversified community more effectively. In case of tank mixture of more than one herbicide there are two possibilities, (i) might not be compatible (antagonistic effect), (ii) might be compatible (synergistic effect). In case of synergistic effect, weed control efficacy will be higher than their single application. Although reports related to tank-mix herbicide application on some dryland crop fields have been found in literatures, in rice field it is very meagre especially in Bangladesh context. Considering all these issues, the proposed research was conducted to evaluate the performance of tank-mix combination of 06 pre- / post- emergence herbicides along with their 13 (either pre- or post-) tank-mix combinations to control weeds in no till non-puddled transplanted boro rice. One proprietary (either pre- or post; commercially ready mix) and one weedy plot was included as control. The selected herbicides and their tank-mixer performed significantly in terms of weed suppression. In case of pre-emergence herbicide, the tank mixer of Pendimethalin+Tryafemon, Pretilachlor+Tryafemon, Tryafemon+ Trisalfuran 75WG, Oxadiazon+ Tryafemon, and the proprietary herbicide Acetachlor 14% + Bensulfuron methyl 4% performed very well interms of weed control. In case of post-emergence herbicide, the tank mixer of Penoxsulam + Pyrazosulfuron-ethyl, Penoxsulam + 2, 4-D Amine, Penoxsulam + Bispyribac sodium, Penoxsulam + Ethoxysulfuron, and the proprietary herbicide Triafamone 20% + Ethoxysulfuron 10%WG performed very well interms of weed control. However, the tank mixture combination of Pendimethalin+Tryafemon as pre-emergence, and Penoxsulam + Pyrazosulfuron-ethyl as post-emergence performed as highest in terms of weed suppression and rice yield.

Effect of Arbuscular Mycorrhizal Fungi and Foliar Supplementation of N and P on the Performance of Maize

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Abstract
The effect of arbuscular mycorrhizal fungi (AMF) and foliar supplementation of nitrogen and phosphorus on the performance of hybrid maize (Zea mays L.) under rainfed and irrigated condition

was studied in a field experiment at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, during December 2021 to April 2022. The treatments were included two level of AMF inoculation (inoculated and non-inoculated) and four level of foliar nitrogen and phosphorus supplementation (no nitrogen and phosphorus, only nitrogen, only phosphorus and both nitrogen and phosphorus) in randomized complete block design (RCBD) with 3 replication both in rainfed and irrigated condition. Commercially available mycorrhizal inoculum (*Gigaspora margarita*) was used to inoculate the respective experimental plots. Results showed that AMF inoculation helped in growth of maize plant and produce higher yield though other yield contributing parameters were not significantly affected. Yield contributing characters like cob length, grains per line of cob, grains per cob, weight of 1000 seeds were higher in the plots treated with foliar supplementation of both nitrogen and phosphorus at the early silking and tasseling stage compared to no supplement. Maximum highest values of all parameters including grain yield and stover yield were obtained from the AMF interacted plots with foliar supplement of both nitrogen and phosphorus than the controlled one in both rainfed and irrigated condition. It was observed that the obtained values of the crop parameters were higher in irrigated plots than rainfed. However, results indicate that maize can be grown in drought prone areas with better performance by using AMF and foliar supplement of nitrogen and phosphorus in both rainfed and irrigated condition.

Assessment of Allelopathy of Four Agriculture Land Associated Trees on Weed Growth and Yield Performance of Rice

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Abstract
Allelopathy plays an important role in weed control and crop productivity. An experiment was conducted at the Agronomy Field Laboratory, BAU to evaluate the allelopathic effect *of Mangifera indica, Artocarpus heterophyllus, Albizia lebbeck* and *Shorea robusta* on the weed growth and yield performance of *boro* rice. The experiment consisted BRRI dhan29 as test cultivar and five leaf extract's treatments such as no leaf extracts, *M. indica* extracts, *A. heterophyllus* extracts, *A. lebbeck* extracts and *S. robusta* extracts@ 20:200 (*w/v*) ratio concentration. The experiment was laid out in a Completely Randomized Design with four replications. Weed population, weed dry weight were significantly affected by different treatments. The highest weed population and dry weight for all weed species were found in no tree leaf extracts treatments and *S. robusta* leaf extracts respectively. The lowest weed population and weed dry weight were recorded in *A. heterophyllus* leaf extracts. The highest grain yield as well as the yield contributing characters was recorded in *A. lebbeck* leaf extracts. The highest reduction of grain yield was observed in no tree leaf extracts treatment. The longest plant height, highest number of total tiller hill^{-1}, highest number of effective tillers hill^{-1}, number of grains panicle^{-1}, 1000-grain weight, grain and straw yields were observed in *A. lebbeck* leaf extracts treatment. The plant height, number of total tillers hill^{-1}, number of effective tillers hill^{-1}, number of grains panicle^{-1}, 1000-grain weight, grain and straw yields were recorded lowest in no tree leaf extracts treatment. Results of this study indicates that *A. heterophyllus* and *A. lebbeck* leaf extracts showed potentiality to suppress the weed growth and in yield contributing characters, *A. lebbeck* leaf extracts (T_4) has significant positive effect on the yield performance of *boro* rice.

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Integrated Effect of Manures and Fertilizers with the Allelopathy of *Fimbristylis dichotoma* (L.) on the Yield Performance of Rice

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Abstract
We conducted an experiment to assess the combined effect of *Fimbristylis dichotoma* residues with manures and fertilizers on rice yield performance in *boro* season. The experiment consisted two rice varieties *viz*., BRRI dhan29 and BRRI dhan29; and six treatments of the combination of residues with manures and fertilizers *viz.*, Control; Residues @ 3 t ha^{-1} + Recommended doses of inorganic fertilizers; Residues @ 3 t ha^{-1} + Tricho-compost @5 t ha^{-1}; Residues @ 3 t ha^{-1} + Tricho-compost @1.5 t ha^{-1} + 25% less than recommended doses of inorganic fertilizers; Residues @ 3 t ha^{-1} + Tricho-compost @2.5 t ha^{-1} + 50% less than recommended doses of inorganic fertilizers; Residues @ 3 t ha^{-1} + Tricho-compost @3.75 t ha^{-1} + 75% less than recommended doses of inorganic fertilizers. Four weeds belong to four families were identified in the field such as Shama, Shusni Shak, Panikachu, and Sabuj nakful. Among the weed species two were broad leaf, one was sedge and another one was grass type morphology. Variety had no significant effect on most of the yield and yields contributing characters except number of grains spikelet^{-1} and 1000-grain weight. BRRI dhan29 produced highest grain and straw yield. On the other hand, *F. dichotoma* residues and combination of manures and fertilizers had significant effect on yield and yield contributing characters except number total tillers $hill^{-1}$, number of effective tillers and number of non-effective tillers $hill^{-1}$ and 1000-gain weight. The highest grain yield was produced when applied residues @3 t ha^{-1} and trichocompost @1.5 t ha^{-1} + 25% less than recommended fertilizers treatment. The lowest grain yield was found in control. From the above results it was found that BRRI dhan29 and residues @3 t ha^{-1} and trichocompost @1.5 t ha^{-1} + 25% less than recommended fertilizers treatment exhibited the superior effect.

Impact of Reduced Tillage on Soil Carbon and Crop Productivity

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Abstract
Tillage has been and will always be integral to crop production, and can affect soil health and crop productivity. This study aimed to evaluate effect of tillage systems on soil organic carbon (OC) and crop productivity. Two tillage systems: conventional and reduced (conservation) tillage, and two rice based cropping systems: single rice and double rice were selected. Bulk soils were physically fractionated into particulate organic matter (POM) and mineral associated OM (MOM). Both bulk and soil fractions were analyzed for OC and nitrogen. Results revealed that reduced tillage aided to higher OC in bulk soils as well as increased crop yield compared to conventional tillage in both rice systems. In both soil fractions, reduced tillage showed higher OC distribution than conventional which suggests a greater ability of conservation tillage to enhance both the labile and stable OC in the soils. However, higher OC in MOM fractions than POM again indicates OC preservation ability of conservation tillage. Single rice system showed relatively more OC in both labile and stable soil fractions compared to the double rice system, which might indicate the accumulation of OC in less intensify scheme in agricultural field.

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Soil Carbon Sequestration by Conservation Paddy Management

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Abstract
Enhancing soil organic carbon (OC) stocks is not only beneficial for mitigating climate change but also for improving soil health and crop production. Hereof, paddy soils (11 % of total agricultural land surface) occupy a unique position in agricultural sector to serve the need to sequester C. On average, paddy soils store more C than adjacent sites under dryland cropping. Unfortunately, soil OC may also be lost from paddy soils, and particularly because of intensive tillage operation and poor crop residue management (called conventional (CV) management), in spite of actually having a C sequestration potential in these soils. Yet, C sequestration potentials of paddy soils can also be improved by adopting good agronomic practices, such as practicing minimum tillage, retention of crop residues (called conservation (CS) management). Bangladesh has huge potential to contribute in global climate change mitigation through C sequestration in paddy soils via CS managements. But this concept of CS is new to most of the farmers and the adaptation of this practice is still rare at field level of our country, due to the lack of basic research, general knowledge of the farmer. There are few studies which have worked on the influence of CS management on soil general properties and fertility, however, there is still a huge research gap on how effective CS management is to rise SOC sequestration in paddy fields. This study intended to (i) quantify the SOC sequestration in paddy soils under CV and CS management systems in selected areas of Bangladesh, and (ii) to assess the economic feasibility of CS management for paddy cultivation. Conventional and conservation managements, and three common rice based cropping patterns: fallow-fallow-*boro*, fallow-*aman*-*boro* and fallow-*aman*-*boro*-mustard were selected. Top soil (0-15 cm) samples were collected from farmers' fields representing three cropping patterns for each management. Bulk soils were fractionated into two separates to isolate labile OC (particulate organic matter: >53 µm) and stable OC (mineral associated OM: <53 µm) and analyzed for OC and nitrogen. Overall, CS management showed higher OC in bulk soils, as well as in stable fractions in all cases than labile fractions which shows potential capacity of CS in sequestering OC in soils. Comparing the cropping patterns, fallow-fallow-*boro* had significantly higher OC in both soil fractions which could be related to the degree of disturbance of agricultural field. Looking at the economics, CS increased crop yield and reduced tillage related cost compared to CV which leads to more economic return.

Assessment of AquaCrop Model for Irrigation Simulation and Grain Yield of Dry Direct Seeded Rice

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Abstract
Water demand growth in urban, industrial, recreational and environmental purposes creates more competition for the limited resources. The AquaCrop model can be used to simulate rice yield in response to water. With the vision of using AquaCrop for local scale decision making for field level water management, a study was undertaken in the Agronomy Field Laboratory, BAU, Mymensingh to examine the capabilities of the model to describe rice growth, biomass production and grain yield in different irrigation scenarios of Bangladesh. The experiment comprised of four *boro* rice varieties viz.,

BRRI dhan28 (V_1), BRRI dhan29 (V_2) BRRI dhan89 (V_3) and BRRI dhan100 (V_4) and four treatments on different level of irrigation viz., continuous flooding (CF), irrigation at 5 days after water disappearance (5 DAD), irrigation at 7 days after water disappearance (7 DAD) and irrigation at 9 days after water disappearance (9 DAD). The two factorial experiments were laid out in a split plot design with three replications. Data collection on crop parameter, management and weather is going on. The model will be calibrated using the measured data during growing season. The calibrated parameters in the model will be initial canopy cover (%), plant density (plants ha^{-1}), days from transplanting to recovered transplant, days from transplanting to maximum canopy cover, days from transplanting to start of canopy senescence, days from transplanting to maturity and maximum effective rooting depth (m). Therefore, increasing in water productivity with appropriate irrigation management will be identified through this experiment.

Effect of Placement of Nitrogen Fertilizer on Yield and Nitrogen Use Efficiency of *Boro* Rice

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Abstract
A field experiment was carried out during the period from November 2021 to May 2022 at the Agronomy Field Laboratory, Bangladesh Agricultural University (BAU), Mymensingh with *boro* rice varieties at different nitrogen placement. The experiment comprised of three *boro* rice varieties viz., BRRI dhan28 (V_1), BRRI dhan89 (V_2) and Hira-2 (V_3) and four treatments on a different level of nitrogen placement viz., 0 kg ha^{-1}(T_1), Conventional broadcast of N fertilizer (NBP) @ 150 kg ha^{-1} (T_2), N deep placement (NDP) at 10 cm below the soil @ 150 kg ha^{-1} USG (T_3), N deep placement (NDP) at 15 cm below the soil @ 150 kg ha^{-1} USG (T_4). The two factorial experiments were laid out in a randomized complete block design (RCBD) with three replications. The number of total tillers, effective tillers, panicle length, non-effective tillers, number of grains $panicle^{-1}$, grain yield, straw yield, and harvest index varied significantly due to variety. The highest grain yield (6.24 t ha^{-1}) was found in V_3 (Hira-2) and the lowest (2.25 t ha^{-1}) was observed in V_1 (BRRI dhan28). In terms of N management, the highest grain yield (4.43 t ha^{-1}) was obtained due to N deep placement (NDP) at 10 cm below the soil @ 150 kg ha^{-1} USG (T_3) the and the lowest grain yield (4.43 t ha^{-1}) was recorded due to Control practice T_1 (0 kg N ha^{-1}). The interactive effect of variety and N placement exerted that the performance of the combination $V_3 \times T_3$ was the highest (6.55 t ha^{-1}) and the lowest performance (2.02 t ha^{-1}) in grain yield was found in $V_1 \times T_1$. Thus the variety Hira-2 with N deep placement (NDP) at 10 cm below the soil @ 150 kg ha^{-1} USG was superior for attaining the highest yield.

Comparison of Allelopathic Activity Between Shoot and Root Part of *Leucas aspera* and Its Residual Effect to Control Weed and Yield of Rice

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Abstract
A study was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, during the period from July to December 2021 to evaluate the allelopathic activity between shoot and root part of *Leucas aspera* and effect of its residues on weed management and crop performance of transplant *aman* rice. The study was conducted with two experiments- one pot

experiment and one field experiment. In the pot experiment, aqueous extract of shoot and root parts of *L. aspera* were used at five levels of treatment concentrations. The shoot and root extract at different concentrations reduced weed emergence. However, shoot extract showed more inhibition compared to root extract. Therefore, the field experiment consisted of three varieties viz. BR11, BRRI dhan49 and BRRI dhan52 and four *L. aspera* shoot residues such as 0, 0.5, 1.0, 1.5 t ha^{-1} + hand weeding and only hand weeding treatments. The experiment was laid out in a randomized complete block design (RCBD) with three replications. Four weed species belonging to four families infested the experimental plots. The weeds of T. *aman* experimental plots were chesra, shama, panikachu and panimarich. The highest percent inhibition of all the studied weed was found by 1.5 t residue ha^{-1} + hand weeding. The grain yields as well as the yield contributing characters produced by BRRI dhan49 was the highest among the studied varieties. The highest reduction of grain yield was obtained in control treatment. BRRI dhan49 produced the highest grain and straw yields under residues 1.5 t ha^{-1} + hand weeding treatment. Results of this study indicate that *L. aspera* residues showed potentiality to inhibit weed growth and it has a significant effect on the yield of transplant *aman* rice. Therefore, *L. aspera* residues might be used as an alternative way for weed management and sustainable crop production.

Improving Crop Productivity through Adoption of Climate Resilient Cropping Systems in the Selected Charland of Bangladesh

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Abstract

The project is aiming at selecting climate resilient cropping systems along with the modern cultivation technique for increasing cropping diversity and intensity in the vulnerable charland ecosystems. In this connection, to improve rice productivity, intervention was given to select water saving/short duration rice cultivars (such as BRRI dhan56, BRRI dhan66 and BRRI dhan71 etc. for *Aman* season and BRRI released 10 *Boro* rice varieties for season). A number of crops were inserted in the existing rice-rice cropping system. A number of profitable crops like vegetables, maize, groundnut, onion and mustard etc were used in the pattern. Data on sowing/planting time, total growth duration of the crops, turn around period (gap between preceding and succeeding crops), yield, rice equivalent yield and economic return were evaluated. It is found that on the basis of rice equivalent yield and profitability, Squash-Bitter gourd-T. *Aman rice*, Sweet gourd-Cucumber– T. *Aman rice*, Maize – Okra-T. *Aman rice* and Sweet potato- Kaon– T. *Aman rice* are the highest performer than the other cropping patterns. Therefore, these patterns can be further cultivated to validate in the farmers' field.

Assessment of Different Seed Priming Methods for Increased Germination Rate, Enhanced Seedling Vigor and Higher Yield of Wheat

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Abstract

High temperature stress during reproductive stage as the consequence of short winter spell and delayed planting along with moisture stress result in significant yield reduction of wheat. Seed priming has

been reported to be effective in combating abiotic stresses in different crops. Therefore, present study was conducted to explore the potentiality of seed priming technique in combating heat and moisture stresses in wheat. Eight priming agents (H_2O, NaCl, Mannitol, $CaCl_2$, KCl, PEG, KNO_3, NaOCl) at different concentrations along with control were tried for increasing seed germination and seedling vigor under laboratory conditions and growth & yield of wheat (BARI Gom-33) in pot culture in the rabi season of 2021-2022 at the Agronomy Department, BAU. Laboratory experiment was conducted following CRD method with 4 replications while pot experiment was conducted following RCBD method with 3 replications. In laboratory experiment, seed priming increased germination rate by up to 5%, mean germination time by 1.5 days and seedling vigor index up to 7 unit. Seed priming increased seedling length up to 3 cm and seedling dry matter up to 4 mg/seedling. $CaCl_2$, KCl, KNO_3, Mannitol and PEG appeared as promising priming agents. In pot experiment, seed priming increased seed emergence rate by up to 7%, seedling survival rate by up to 3% and plant height up to 4 cm. Seed priming improved different yield parameters by 7-15% and wheat yield by up to 12 %. $CaCl_2$, KCl, KNO_3 and Mannitol appeared as promising priming agents. Identified potential seed priming agents are expected to produce some good results in combating high temperature and/or moisture stress and ensuring potential yield of wheat in field trials (ongoing in the rabi season of 2022-2023).

Development of Nursery Management Package for Minimizing the Exploitable Rice Yield Gap

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Abstract

Healthy seedling is the best component of the transplant rice, which depends on its growing environment and appropriate nursery management techniques. The objectives of this present study were to evaluate efficacy of different seeding density and nutrient management in nursery for improving seedling growth and yield of *Boro* rice to ensure potential yield through minimizing exploitable yield gap. Therefore, a field experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during *Boro* season from January 2019 to May 2020 with rice variety BRRI dhan58. The experiment comprised of two factors, *viz*., Factor A (seeding density): (i) low density 80 g m^{-2}, (ii) medium density 100 g m^{-2}, (iii) high density 120 g m^{-2}; and Factor B (nursery nutrient management): (i) No nutrient applied, (ii) N 10 g m^{-2}, (iii) P 15 g m^{-2}, (iv) K 15 g m^{-2}, (v) N 10 g m^{-2}+ P 15 g m^{-2}+ K 15 g m^{-2}, (vi) Compost 2 kg m^{-2}. The experiment was conducted following a factorial randomized complete block design with three replications. Seed rate in nursery bed exerted significant effect on seedling growth, yield and yield contributing characters of BRRI dhan58. The highest root length (9.86 cm), shoot length (12.77 cm), seedling dry weight (84.27 cm), number of total tillers $hill^{-1}$ (13.31), number of effective tillers $hill^{-1}$ (11.60), number grains $panicle^{-1}$ (115.33), grain yield (6.35 t ha^{-1}), straw yield (6.95 t ha^{-1}) and harvest index (47.78%) were obtained from 80 g m^{-2} seed rate. The highest number of non-effective tillers $hill^{-1}$ (115.41) and number of sterile spikelets $panicle^{-1}$ (11.36) were obtained from 100 g m^{-2} seed rate. On the other hand, the highest plant height (89.82 cm) and 1000-grain weight (24.73 g) were obtained from 120 g m^{-2} seed rate. Regarding the nursery nutrient management, seedlings fertilized with N+P+K produced the highest root length, shoot length, seedling dry weight, number of total tillers $hill^{-1}$, effective tillers $hill^{-1}$ and lowest number of sterile spikelets $panicle^{-1}$, highest number of grains $panicle^{-1}$, highest 1000-grain weight, highest grain yield, straw yield and harvest index. The interaction of seeding density and nutrient management in nursery bed had significant effect on the production of number of effective tillers $hill^{-1}$ and a positive impact on grain yield. The highest number of effective tillers $hill^{-1}$ was obtained from 80 g m^{-2} seeding density with N+P+K in nursery bed, which eventually resulted in the

highest grain yield (6.96 t ha^{-1}). The results revealed that seedlings obtained from low seeding density (80 g m^{-2}) with fertilization of N 10 g m^{-2} + P 15 g m^{-2} + K 15 g m^{-2} in the nursery performed the best for seedling growth and produced the highest grain yield of BRRI dhan58.

Impact of Sulphur Fertilization and Weed Free Periods on the Seed Yield of Faba Bean

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Abstract
The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University (BAU), Mymensingh to study the effect of sulphur and weed free periods on yield and quality of faba bean (*Vicia faba* L.). The experiment consisted with three levels of sulphur viz. 0, 20 and 40 kg S ha^{-1} and four weed free periods viz. Weedy check (no weed free period), Weed free up to 30 days after sowing (DAS), Weed free up to 60 DAS and Weed free throughout the growth period. The experiment was laid out in randomized complete block design with three replications. The highest chlorophyll content (44.29) were recorded at 20 kg S ha^{-1}× weed free throughout the growth period, while the highest number of nodules $plant^{-1}$(59.11), nodule dry weight $plant^{-1}$(0.192g) were highest at 20 kg S ha^{-1}× weed free up to 60 DAS. Tallest plant at harvest (73.43 cm), branches plant (8.22), pods $plant^{-1}$ (41.93), 1000-seed weight (241.5) and stover yield (2.55 t ha^{-1}) of faba bean was observed in 20 kg S ha^{-1}× weed free up to 60 DAS. The highest seed yield (2.46 t ha^{-1}) was recorded in 20 kg S ha^{-1}× weed free up to 60 DAS which was as good as 20 kg S ha^{-1}× weed free up to 60 DAS. All above parameters showed lowest values in control treatments (0 kg S ha^{-1}× weedy check). From the results it can be concluded that faba bean can be cultivated with 20 kg S ha^{-1} × weed free up to 60 DAS in terms of higher seed yield.

Optimizing Sowing Time of Selected *boro* and *aus* Rice Varieties Under Dry Direct Seeded System

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Abstract
Delayed sowing of boro rice in dry direct seeding system paves the way of growing any rabi crop in between aman rice and boro/aus rice. An experiment was conducted at the Agronomy Field Laboratory of Bangladesh Agricultural University, Mymensingh to find out the effect of sowing date on growth and yield of boro and aus rice grown under dry direct seeded system. The experiment comprised seven rice varieties viz. BRRI dhan28, BRRI dhan48, BRRI dhan58, BRRI dhan82, BRRI dhan92, BRRI dhan98 and Black rice; and three sowing dates viz. 9 March, 24 March and 9 April 2022 in a split plot design with three replications. Data on crop phenology, yield contributing characters and yield were collected and compiled. Data analysis was done with a computer package programme STATISTIX 10 and mean comparison was done with LSD-test. Among the seven rice varieties BRRI dhan92 gave the highest yield (8.06 t ha^{-1}) for sowing on 24 March 2022 which was 20.5% and 35.7% higher than sowing on 9 March and 9 April 2022, respectively. BRRI dhan92 required 108 days while BRRI dhan 98 required 109 days from sowing to harvesting. The second highest rice yield was found with variety BRRI dhan98 sown on 24 March. BRRI dhan92 and BRRI dhan98 gave 45% and 12% higher yield

than aus rice variety BRRI dhan48. The higher yields of BRRI dhan92 was attributed mainly due to production of highest number of grains (119.5) panicle^{-1}. The study concludes that boro rice varieties BRRI dhan92 and BRRI dhan98 can be sown in late boro season or in aus season for obtaining highest grain yield which in turn help growing any rabi crop in between aman rice and boro or aus rice under T. aman rice – rabi crops – DDS boro/aus rice patterns.

Characterization and Conservation of Rice Germplasms Collected from Different Ecosystems of Bangladesh

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Abstract
Collection, characterization and conservation of rice germplasms from different ecosystems are important for their effective utilization in varietal improvement. Therefore, this study was under taken to collect, characterize and conserve the rice germplams. In this study, seeds of 38 (thirty eight) *Aman* rice germplasms were collected to assess their morphological traits and genetic diversity. Wide variations were found among the 31 qualitative characters like blade color, culm angle, internode color, culm strength, lodging incidence (%), panicle exertion, shattering, threshability, awn: distribution, apiculus color, stigma color, lemma and palea color, lemma and palea pubescence, sterile lemma color and seed coat color. Therefore, these studied germplasm will be used for developing improved varieties through breeding program that would be high yield potential with superior quality.

Root Architecture and Yield of Rice as Influenced by Agronomic Management

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Abstract
Nitrogen (N) is a highly essential macronutrient for plant root growth and grain yield (GY). To assess the relationship among N, root traits and yield of *boro* (dry season irrigated) rice, a pot experiment was performed in the Department of Agronomy, Bangladesh Agricultural University, Mymensingh, Bangladesh during *boro* rice season of 2021-22. Three *boro* rice varieties namely BRRI dhan29, Hira-2 and Binadhan-10 were planted at four N doses: 0 kg ha^{-1} (N_0), 70 kg ha^{-1} (N_{70}), 140 kg ha^{-1} (N_{140}) and 210 kg ha^{-1} (N_{210}). The experiment was conducted following the completely randomized design with three replications. The varieties were evaluated for root number (RN), root length (RL), root volume (RV), root porosity (RP), leaf area index (LAI), total dry matter (TDM) and yield. Results indicated that the variety Binadhan-10, Hira-2 and BRRI dhan29 produced better root characteristics under N_{140} and at N_{210} level it was decreased. A substantial positive association was noticed between grain yield and root traits except for root porosity. Based on root traits and growth dynamics Binadhan-10 performed best at N_{140} and produced the highest grain yield (26.96 g pot^{-1}) followed by Hira-2 (26.35 g pot^{-1}) and BRRI dhan29 (25.90 g pot^{-1}) under the N_{140} level.

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Response of Different Herbicide Combinations with allelopathic potential plant extracts on weed management and yield performance of t. aman rice

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Abstract
The study was conducted to evaluate the effect of extract of crop residues on weed suppression and crop performance of T. *aman* rice. The treatments consisted of two factors viz. variety (3)- BR22, BRRI dhan49, Binadhan-17 and application of aqueous extract (9)-Control, Mustard crop extracts as pre-emergence, Mustard crop extracts as post-emergence, Pre-emergence (1) as recommended dose (RD), Pre-emergence (2) as recommended dose (RD), Post emergence (1) as RD, Post emergence (2) as RD, Pre-emergence 1 (40 % RD + Pre-emergence 2 (40 % RD) + sorghum crop extracts as pre-emergence and Post-emergence 1 (40 % RD + Post-emergence 2 (40 % RD) + sorghum crop extracts as post emergence. It was noticed that broadleaf weed species were more susceptible to crop residues than grass weed species. In this respect, the highest growth inhibition (100.00%) was observed in controlling Panikachu *(Monochoria vaginalis)*. Growth, yield and yield contributing characters of rice cultivars were significantly influenced by variety and extract application. Among the rice variety, Binadhan-17 showed superior performance in respect of yield contributing characters and yield. In case of rate of aqueous extract application, aqueous extract of mustard and sorghum as post emergence was the best for T.*aman* rice cultivation.

Sustaining Soil Fertility and Improving Crop Productivity in Rice-Based Cropping System by Integrated Use of Organic and Inorganic Sources of Nutrients

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Abstract
Excessive fertilization is one of the major challenges in agricultural production systems worldwide. Although various soil ameliorants have been widely applied in agricultural crop production, their effects remain variable. Seven fertilization treatments, including no additional nutrient supply (T_0), chemical fertilization according to farmers' field (T_1), recommended dose of chemical fertilizer (T_2), and 25 % reduced chemical fertilizer of T_2 in combination with farmyard manure (T_3), poultry manure (T_4), compost (T_5), and green manure (T_6) were tested with three replications under randomized complete block design (RCBD) at field conditions. The yield components, yield, nutrient uptake, and total soil nitrogen (TN), soil organic carbon (SOC) of post-harvest soil were measured to determine the effect of each amendment. The SOC was higher in T_6 (1.51 %) than in other treatments except for T_4; however, treatments had no significant impact on TN. All four organic amendments had similar grain yields, while all had significantly higher yields over control and ranged from 3.01 in T_0 to 6.33 ton ha^{-1} in T_6. Soils with organic amendments and chemical fertilizer had more than 50% higher grain yield and more than 47% higher straw yield over control. The total uptake (grain and straw) ranges of N, phosphorus (P), potassium (K), and sulphur (S) were 52.2-153, 11.1-29.1, 62.4-141, and 14.2-38.7 kg ha^{-1}, respectively, being higher in T_6. We conclude that green manuring will be a promising practice

among the organic amendments to get more yield, nutrient uptake, and post-harvest soil quality, which are the major factors related to rice yield and soil quality.

Comparative Performance of Different Fertilizer Recommendation Methods on Growth and Yield of Rice-Rice Cropping Pattern in Old Brahmaputra Floodplain Soils

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Abstract
For maintaining soil quality and attainable crop yield, it is required to add proper amount of fertilizers and minimize the misuse of soil resources. General farmers hardly use fertilizer based on the recommendation from authorities such as Fertilizer recommendation guide (FRG), Soil test basis (STB), Rice Crop Manager, Farmers' practice and BAU Soil Testing Kit, etc. Balanced fertilizer recommendation has become imperative in Bangladesh to increase fertilizer use efficiency, maintain soil health, protection of the environment and to reduce production cost. The experiment was conducted at farmers' field of Bhabokhali, Mymensingh Sadar to study the comparative performance of different fertilizer recommendation methods in rice (BRRI dhan28) in Old Brahmaputra Floodplain Soils (AEZ 9). There were six treatments namely, T_0 (Control-no fertilizer), T_1 (Farmers' Practice), T_2 (Fertilizer Recommendation Guide-2018), T_3 (BAU Soil Testing Kit), T_4 (Soil Test Basis) and T_5 (Rice Crop Manager). The results revealed that all the treatments showed better performances over control (T_0). Treatment T_3 (BAU Soil Testing Kit) produced the highest value of filled grains panicle^{-1} and 1000-grain weight. The highest grain and straw yields were recorded in treatment T_3 (BAU Soil Testing Kit). The highest total N, P, K and S uptake were obtained in the treatment T_3 (BAU Soil Testing Kit). Control treatment T_1 (no fertilizers) showed minimum performances in all the cases compared to other treatments. The overall results demonstrate that the application of NPK fertilizers following BAU Soil Testing Kit method of fertilizer application system is a better option for maximum and eco-friendly rice production.

Effects of Cadmium Contamination on Growth, Yield and Cadmium Concentration in Different Varieties of T. Aman Rice

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Abstract
Cadmium is a class-1 non-threshold carcinogen and is associated with a range of severe diseases to human, and their major exposure pathways is primarily through food chain especially rice. A pot experiment was conducted to investigate the effects of Cd contamination on growth, yield, zinc concentration, and levels of cadmium in ten rice cultivars. Cadmium was added at two rates viz. 0 and 15 mg kg^{-1} (on soil basis) from cadmium chloride ($CdCl_2.H_2O$). The cultivars tested were BRRI dhan52, BRRI dhan54, BRRI dhan62, BRRI dhan71, BRRI dhan72, BRRI dhan79, Binadhan-12, Binadhan-23, Zeeramala & Local-1. This experiment was carried out in a completely Randomized Design (CRD) with three replications. Cadmium contamination significantly decreased plant height, tillering capacity, panicle length, grains pot^{-1}, 1000-grain weight, grain yield, and straw yield. However, the effect was quite varied with the rice cultivars. The grain yield of rice cultivars decreased

by 16.73%, with the application of 15 mg kg^{-1} Cd. In terms of growth and yield metrics, BRRI dhan72, BRRI dhan79, Binadhan-23, and local varieties showed moderate tolerance to Cd contamination (15 mg kg^{-1}). The rice plants exposed to high levels of Cd showed significant negative effects on their growth parameters. Application of Cd had reduced the concentration of essential micronutrient Zinc (Zn) in rice grain, showing negative interaction between them. In this study, there were remarkable differences among rice cultivars for their sensitivities to Cd in grain Cd and Zn accumulation. The Cd concentration in grain of all rice cultivars increased with an increasing rate of Cd addition. Cultivars BRRI dhan72 had the lowest (0.25 mg kg^{-1}) grain Cd and BRRI dhan52 had the highest (1.7 mg kg^{-1}) Cd concentration in rice grown with 15 mg kg^{-1} Cd.

Restoration of Soil Fertility and Sustainable Rice Production by Quick Composting

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Abstract
Use of compost and manure is a well-known and widely accepted sustainable approach for improving crop production and maintaining soil fertility. Field trials were conducted at the Soil Science Field Laboratory of Bangladesh Agricultural University and in a Farmer's field at Jalapara village under Char Nilokhyia union of Mymensingh Sadar for Boro-T.Aus-T.Aman cropping pattern to investigate the effect of quick compost with organic manures and inorganic fertilizers on the yield attributes, yields and nutrient uptake of rice. The experiments each containing nine treatments were laid out in a Randomized Complete Block Design (RCBD) with three replications. The treatments were T_0: Control, T_1: 100% RFD (Recommended Fertilizer Dose), T_2: 75% RFD, T_3: 75% RFD + quick compost 5 t ha^{-1}, T_4: 75% RFD + quick compost 2.5 t ha^{-1}, T_5: 75% RFD + quick compost 2.5 t ha^{-1} + poultry manure 2.5 t ha^{-1}, T_6: 75% RFD + quick compost 2.5 t ha^{-1} + cow dung 2.5 t ha^{-1}, T_7: 75% RFD + quick compost 2.5 t ha^{-1} + mustard oil cake 2.5 t ha^{-1} and T_8: 75% RFD + quick compost 2.5 t ha^{-1} + ash 2.5 t ha^{-1}. The integrated nutrient management significantly improved production of rice with higher nutritional quality showing no considerable influence on fungal disease occurrence in both locations. Among different treatment combinations, T_7 performed the best for all the seasons causing the maximum increase in yield parameters, grain and straw yields and nutrient uptake of rice over control. Next to mustard oil cake, poultry manure performed well followed by cow dung in association with quick compost and chemical fertilizers that compensated up to 25% of RFD. Therefore, quick compost @ 2.5 t ha^{-1} should be applied with mustard oil cake or poultry manure and inorganic fertilizers for better yield and nutritional improvement of rice.

Development of a Field-scaled Nutrient Balance Calculator for Crops of an Intensively Managed Agricultural System

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Abstract
Declining soil fertility along with increased food demand have tremendously increased the chemical fertilizer use causing concerns for farm profitability and soil, air and water quality. A field-scaled nutrient budget can be used to estimate the nutrient flows, lost or accumulated, for any field and this can be used to determine nutrient/ fertilizer requirements. This research aims (i) to quantify amount of

nutrient input to and output from the field through various pathways, and (ii) to develop and test an in depth N, P, K and S input-output balance calculator and a mobile app for the selected cropping patterns. Combinedly, two levels of residue: no crop residue (NCR; traditional practice) and crop residue (CR; 30 cm of plant height) in combination with four levels of fertilizers-control (CL), farmers' practice (FP), national recommended dose (RD), and 125% of RD (125 RD) for NPKS-were applied in various cropping patterns in different Agro-Ecological Zones (Bogura: AEZ-4, 4 crops in an annual sequence; Cumilla: AEZ-18, 3 crops) and Mymensingh: Muktagacha, AEZ-9, 2 crops). The results revealed that all treatment combinations resulted in a negative N and K balance in all cropping patterns at all AEZs. However, 125 RD with CR reduced the negative N and K balance at all sites. Volatilization and leaching loss of N are two significant pathways of N loss. N_2O emissions caused 1.0-1.3% loss of the applied N in maize. Ammonia emissions caused 20, 30 and 4% loss of the applied N in rice, maize and potato. Compared to the 2-crops pattern, 3-crops resulted in 232% increase in negative N balance, while 4-crops resulted in 337% more negative N balance. The results also suggest that for potato and maize, 9% and 6% of the NUE improvement was caused by the crop residue incorporation, respectively.

Measurement of Gross Nitrogen Transformation and $N_2o/(N_2o+N_2)$ Ratio in Wetland Rice Soils Using Isotopic Tracer Techniques

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Abstract

Gross nitrogen transformation processes in soils were measured using double-labelled ^{15}N isotope tracer techniques. Two sets of laboratory incubation were conducted; i) soil incubation with $^{15}NH_4{}^{14}NO_3$ and ii) with $^{14}NH_4{}^{15}NO_3$ for 10 days using composite soil samples collected from the field at 0-15 cm depth. Soil samples were collected from a field which has been fertilized with two different rates of N (urea): 100% of recommended dose (RD) and 140% of RD under an annual wheat-mungbean-rice sequence since 2012. Well pulverized 200 g (fresh soil; oven dry basis) soils were taken in a one L Kilner jar equipped with a gas sampling port. After taking the soil in each jar, adequate amount of water was added to keep the soil flooded with 3 cm standing water to mimic rice field and left for 5-7 days to minimize the initial N level. After label addition, the soils were thoroughly mixed to ensure homogeneous label distribution. The jars were incubated at 25 °C in a temperature-controlled environment in the dark. On day -1, 0, 1, 3, 5, 7 and 10 three replicates $^{15}NH_4{}^{14}NO_3$ labelled samples were extracted for NH_4^+, and NO_3^- and their ^{15}N isotopic compositions following diffusion techniques. The headspace of one set of jars (left for until day 10) were sampled for N_2O and N_2 on each day at time 0, 30, 60, and 120 minute. The data are under process for estimation of gross N transformation and $N_2O/(N_2O+N_2)$ ratio.

Estimating Nitrogen Management Indices: A Guide to Efficient Fertilizer Nitrogen Management for Better Crop Production and Climate Change Mitigation

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Abstract

Improving nitrogen use efficiency (NUE) is one of the most effective means of increasing crop productivity while decreasing environmental degradation. In addition, NUE has been proposed as an

indicator for assessing progress in achieving the Sustainable Development Goals recently accepted by 193 countries. This study assessed the impact synthetic N coupled with crop residue on NUE, SNMI and compare these models with N uptake, yield and N requirement to produce per ton yield production, and finding out optimum N rate. We have evaluated different indices that indicate better N management towards achieving higher yields with lower N use. The NUE, sustainable N management index (SNMI) and N response index (NRI) were evaluated in varying cropping systems. The results indicated that crop residues contributed to an increase in NUE by 9% and 6% in potato and maize, respectively. The national target for the SNMI in 2022 was not met, putting the country 12 years behind in achieving SDG 2 (Zero Hunger). The comparison of NUE models across crops suggests that the national recommended N rate should be adjusted to 169, 152, 187, 92, and 112 kg ha^{-1} for potato, maize, Boro, T. Aus, and T. Aman rice, respectively. For potato and T. Aman rice, the SNMI index performed better, whereas for Boro, T. Aus, and maize, utilizing both indicators concurrently would provide comprehensive view to get maximum benefit from N management. Instead of NUE, the SNMI index is suggested for potato and T. Aman rice, whereas both indicators can be used simultaneously for Boro, T. Aus and maize.

Co-application of Biochar and Compost with Decreased N Fertilizer Reduced Annual Ammonia Emissions in Wetland Rice

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Abstract
Ammonia (NH_3) emission from rice fields is a dominant nitrogen (N) loss pathway causing negative impacts on farm profitability and the environment. Reducing N fertilizer application to compensate for N inputs in organic amendments was evaluated for effects on N loss via volatilization, rice yields and post-harvest soil properties in an annual irrigated rice (Boro) – pre-monsoon rice (Aus) – monsoon (Aman) rice sequence. That experiment was conducted using the integrated plant nutrition system (IPNS; nutrient contents in organic amendments were subtracted from the full recommended fertilizer dose i.e., RD of chemical fertilizers) where six treatments with four replications were applied in each season: (T_1) no fertilizer (control), (T_2) RD, (T_3) poultry manure biochar (3 t ha^{-1}; pyrolyzed at 450 °C) + decreased dose of recommended fertilizer (DRD), (T_4) rice husk ash (3 t ha^{-1}) + DRD, (T_5) compost (3 t ha^{-1}) + DRD, and (T_6) compost (1.5 t ha^{-1})+ biochar (1.5 t ha^{-1}) + DRD. The N loss via volatilization varied twofold among seasons being 16% in irrigated rice and 29% in the pre-monsoon rice crop. In irrigated rice, T_6 had significantly lower NH_3 emissions than all other treatments, except the control while in pre-monsoon and monsoon seasons, T_6 and T_3 were alike. Pooling the three seasons together, biochar (T_3) or biochar plus compost (T_6) reduced NH_3 loss via volatilization by 36-37% while compost alone (T_5) reduced NH_3 loss by 23% relative to RD. Biochar (T_3) and biochar plus compost mixture (T_6) reduced yield-scaled NH_3 emissions by 40 and 47% relative to the RD of chemical fertilizer (T_2). The organic amendments with IPNS reduced the quantity of N fertilizer application by 65%, 7%, 24% and 45% in T_3, T_4, T_5 and T_6 treatments, respectively, while rice yields and soil chemical properties in all seasons were similar to the RD.

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Nitrate Pollution in Paddy Soil and Associated Human Health Risk Assessment in the Old Brahmaputra River Basin

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Abstract
Groundwater is the main source of drinking water in Bangladesh. Human induced activities, such as excessive uses of urea fertilizers, have increased nitrate in groundwater in Bangladesh, particularly in agricultural areas. It was imperative to assess the nitrate contamination in groundwater from agricultural sources particularly from urea fertilizer application and right doses for sustainable rice yield. The experiment was conducted at farmers field of Mymensingh. Three doses of urea fertilizer i.e. 75%, 100%, and 125% were applied including control (no urea fertilizer application) following randomized complete block design with 3 replications. The HQnitrate was found less than 1 for both children and adults which indicates no potential health risk due urea fertilizer application. 125% RFD was found best for higher yield in the study area as it had given 201% higher yield compared to no urea fertilizer application. This study provides information on the contribution of nitrate pollution from urea fertilizer use in the crop land and other sources may contribute significantly in the groundwater nitrate pollution.

Nitrate Pollution in Paddy Soil and Associated Human Health Risk Assessment in the Jamuna River Basin of North-central Bangladesh

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Abstract
Groundwater is the main source of drinking water in Bangladesh. Excessive use of urea fertilizers has increased nitrate in groundwater in Bangladesh, particularly in agricultural areas. It was imperative to assess the nitrate contamination in groundwater from agricultural sources, particularly from urea fertilizer application and the right doses for sustainable rice yield. The experiment was conducted at the farmers' field of Kazipara, Sirajganj. Three doses i.e. 75%, 100%, and 125% of recommended fertilizer (RFD) were applied including control (no urea fertilizer application) following a randomized complete block design with 3 replications. The HQnitrate was found less than 1 for both children and adults which indicates no potential health risk due to urea fertilizer application. The 125% RFD was found best for higher yield in the study area as it had given 199% higher yield compared to no urea fertilizer application. This study provides insights into the contribution to groundwater nitrate pollution from urea fertilizer use in paddy rice and the appropriate dose for sustainable rice yield.

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Optimization of Degree of Milling for Reducing Nutrient Loss of Rice

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Abstract
Milling is the final step of white rice production which has a decisive role in the nutrient content of the final product. The rice milling process usually includes dehusking (removal of the husk) and polishing (removal of bran) to get white rice. The nutritional composition of polished rice is lower than brown rice because rice bran has dense vitamins, minerals, fibre and other nutrients than the endosperm. A proper degree of milling (DOM) can improve rice quality and quantity by retaining nutrient content as much as possible. As such, the present study aims to evaluate the effect of DOM on the nutritional properties to head rice. Three popular rice varieties (BRRI Dhan 28, BRRI Dhan 49 and Hybrid Hira Dhan) were milled to varying levels of DOM (0%, 5%, 7.5%, 10% and 15%) using a rice polisher (Satake rice machine, Japan). The three rice varieties were parboiled in two methods, traditional (Parboiling of rough rice) and altered (parboiling of wholegrain Rohman et al., 2019). Non-parboiled rice was used as a control for the parboiling methods. The DOM was calculated from the weight of rice before and after milling. The rice samples of different varieties treated in different parboiling methods were milled in different levels mentioned earlier. The samples were powdered in the Ball Mill, and pellets were prepared to analyse in the X-ray fluorescence (XRF) spectrometer at Queen's University, UK. The results showed that, as the DOM increased from 0 to 15%, the content of Ca, Fe, K, Mg, P and S decreased significantly in all three selected cultivars. Ca decreases upto 75% due to an increase of DOM by 15%. Similarly, Fe, K, Mg and P decreased by 67%, 70%, 73% and 74%, respectively. The lowest nutrient loss was observed at 5% DOM, irrespective of the rice varieties and parboiling methods. This study reveals that higher DOM significantly affects rice's nutrient content and human health. Besides this, a reduction in the milling percentage will add to the national rice production for human consumption.

Silicon, an Alternative of Agrochemicals for Improving Grain Quality and Yield of Rice in Bangladesh

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Abstract
Silicon (Si) is the second most abundant element in the soil. It is a beneficial element for crop growth, especially for crop yield. Rice has specific mechanisms for assimilating Si from the soil as soluble silicic acid, which defence against biotic and abiotic stresses such as herbivory, leaf microbial pathogen resistance, toxic metal stress and drought tolerance. The experiment focuses on the highly leached Pleistocene terrace soils and calcareous floodplain soil to know the efficacy of Si to replace the agrochemical demand in rice. Field trials were conducted at four farmer's fields, taking one farmer from each village and two villages from each soil type. The most commonly used, high-yielding rice cultivars were used; BRRI dhan81 during the rabi season (January 2021- May 2021) and BRRI dhan87 during the wet season (June 2021-October 2021). Experiments were conducted on 5m x 5m plots. Six

treatments were used in the experiments. The treatments were: T_1–control, T_2-farmer's fertilizer practices, T_3-Soil test based fertilizer (STB), T_4-Silicon rich household ash (complete K supplementation) with STB, T_5-Silicon rich biochar (complete K supplementation) with STB and T_6-Silicon fertilizer (SiO2) with STB fertilizer. The result shows that among the four locations, maximum rice grain (5.91 t ha^{-1}) and straw (7.27 t ha^{-1}) in Terrace soil during the Boro season. On the other hand, among the four locations, maximum rice grain (6.66 t ha^{-1}) and straw (6.94 t ha^{-1}) were produced in calcareous terrace soil in the T. Aman season. Si fertilizer and Si rich amendments improved rice yields by more than 10% across the locations. Different Si-rich amendments effectively reduced the concentration of heavy metals in pore water. The lowest arsenic (As) was found in the T_6 treatment and the highest in the T_2 treatment. The application of Si fertilizer or Si-rich amendments has excellent potential for increasing rice yield by at least 10% and reducing heavy metal uptake in grain.

Silicon-mediated Aluminium Toxicity Resistance in Wheat Seedlings

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Abstract

Aluminium (Al) toxicity in acidic soil in one of the major constraints in wheat growth, and silicon (Si) can play an important role in mitigating the toxic effects of Al. There is, however, limited information available about the role of Si to mitigate the Al toxicity on wheat. In this net house experiment, wheat (BARI gom33) was grown to vegetative stage (Zadoks 23) with or without foliar Si application (4 and 10 mM Si/L) grown in a soil having Al toxicity (75 mg Al/kg soil) with or without amended with Si (100 and 250 mg Si/kg soil). The treatments were replicated four times using a completely randomized design. The effects of these treatments on plant dry biomass accumulation, root length, chlorophyll content, tissue concentration of Si were characterized. Applying Si (@10 mM/L) to the foliage significantly increased shoot dry weight (by 37.3%), root dry weight (by 17.6%), total root length (by 69.7%) and total chlorophyll (by 43.2%) compared to the plants grown without Si amendment in Al toxic soil. Besides, soil application of Si (@250 mg/kg soil) also significantly increased shoot dry weight, root dry weight, root length and total chlorophyll by 39.2%, 34.5%, 164% and 28.4%, respectively compared to the non-amended plants (no Si application). The results also revealed that shoot Si concentration also significantly increased by 3.7- and 3.4-fold in foliar and soil Si treatments, respectively compared to the plants grown without Si amendment in Al toxic soil. Overall, this study provides valuable insights into the potential benefits of Si-mediated Al resistance in wheat seedlings, and underscores the importance of continued research in this area for improving agricultural productivity and sustainability. Therefore, applying Si foliarly (10 mM Si/L) and to soil (250 mg Si/kg soil) might contribute to improved wheat growth when grown in Al toxic acidic soils.

Trace Element Accumulation in the Grain of Selected Rice Cultivars

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Abstract

For safe rice production, it is important to know the heavy metal content of our rice cultivars. An experiment was, therefore, conducted at the Soil Science Field Laboratory, Bangladesh Agricultural University, Mymensingh under AEZ 9 (Old Brahmaputra Floodplain) to see the yield and trace element accumulation in grains of selected boro rice cultivars. There were 20 rice cultivars, including

10 Bangladesh Rice Research Institute (BRRI) varieties, 8 local varieties, and 2 Bangladesh Institute of Nuclear Agriculture (BINA) varieties, used in this research. Grain and straw yields were recorded, as well as trace element concentrations in rice grain, i.e., arsenic (As), cadmium (Cd), iron (Fe), zinc (Zn), selenium (Se), nickel (Ni), and copper (Cu) were determined. The results revealed that grain yield was 2–3.5 folds higher in the high-yielding BRRI and BINA varieties than in local varieties. The grain yield ranged from 2.41 to 7.88 t ha^{-1}, exhibiting the highest value in Binadhan-10 and BRRI dhan29. In contrast, straw yield was higher in local varieties compared to the high-yielding varieties. The straw yield of different rice cultivars ranged from 5.08 to 11.52 t ha^{-1}. The concentration of As in grain of different rice cultivars ranged from 0.08 to 0.38 ppm. The highest grain As concentration was observed in BR 7 and the lowest concentration was found in Binashail. The ranges of grain Cd, Fe, Zn, Se, Ni, and Cu were 0.01-0.13, 10.87-24.25, 17.58-57.78, 0.011-0.053, 0.1-0.2, and 1.79 to 6.88 ppm. Binashail had the lowest grain As but the highest grain Cd and Ni content. Local varieties had comparatively higher grain Fe & Zn compared to the high yielding BRRI varieties (except for Fe in BR18). Therefore, BRRI dhan29 could be the best rice cultivar for AEZ 9 in terms of grain yield. Although Binashail has the potential grain yield, it can't be recommended due to its higher affinity to accumulate heavy metals. However, local varieties can be recommended considering the micronutrient nutrition.

Assessing Farmer Knowledge of Insect Pests of Different Crops and Management Practices in Haor and Flash Flood Areas and Chittagong Hill Tracts (Chts)

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Abstract
Farmers are concerned about pesticide adulteration by wholesalers and retailers, while using pesticides based on advice from local dealers, leading to pesticide abuse. The goal of this project is to assess the farmers knowledge on diseases and insect pests of different crops and management practices in Haor and flash flood areas and CHTs. A total of 200 farmers were interviewed in two areas with structured interview schedule. The ratio of male and female were as 95:5 and 88:12 Haor and Flash Flood Areas and Chittagong Hill Tracts, respectively, where the age range 36-55 years were mostly involved in agriculture. Majority of the respondents are belonging to the primary education group from class I to V and have middle family size (5-7). Most of the respondents are engaged with faming in a full time with a long experience (>10 yrs). They faced medium to high extent of challenges in crop production considering the insect pest and diseases. They major insect pests are rice yellow stem borer, brown planthopper in boro rice. The diseases are rust and blast. The chemicals utilized for chemical control included organic and inorganic based chemicals. Majority of the respondents used multiple or mixture of pesticides against insects and diseases. Most respondents from Haor and Flash Flood Areas and Chittagong Hill Tracts would like to use mass media (radio/tv) to get information on IPM practices against insect pests and diseases. Majority of the respondent do not like to discuss with neighbors regarding the selection of pesticides. And it is interesting that the majority of respondents visit pesticide shops and consult regarding the selection of pesticides against insect pests and diseases. Therefore, it can be concluded that for the development of sustainable pest management program it is essential to understand farmers knowledge in specific area of diversity.

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Life History Parameters of Spider Mite *Tetranychus Macfarlanei* on Different Host Plants

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Abstract
Spider mites are an incessant potential danger to many food and ornamental plants. Higher reproductive potential and rapid development is the basis for increasing the capacity of population of spider mites. Among different species of spider mites, *Tetranychus macfarlanei* is the serious pests infesting different agricultural crops. This species recorded a broad host range with a potential distribution pattern in Bangladesh. Here different varieties of bean, e.g., BARI Shim 6, 7 and 8, and mashkalai used to determine their population growth using Two-sex MS-CHART program. Host plant species significantly influenced the developmental times, oviposition period, longevity, fecundity, and life table parameters of *T. macfarlanei*. Age-stage specific survival rates (S_{xj}), age-specific survivability (l_x), age-stage specific fecundity (f_x), age-specific fecundity (m_x), age-specific maternity (l_xm_x), age-stage life expectancy (e_{xj}) and Age-stage fecundity (v_{xj}) of *T. macfarlanei* varies on different host plants. The intrinsic rate of natural increase of *T. macfarlanei* was higher on BARI Shim- 6 than the other two bean varieties, and lowest on *Vigna mungo*, suggesting that BARI Shim- 6 was a more suitable host plant for a population increase of the spider mites, *T. macfarlanei*. This study will describe the host-dependent development of the native *T. macfarlanei* under the broad range of hosts generally prevailing in the field. It may promote the understanding of adaptation to supplied hosts and predict how quickly its densities may change over time. The information gathered from this study will be useful in the management aspects of spider mites, by providing a better understanding of its life-table parameters and its ability to survive under different host.

Morpho-Molecular Identification of Fall Armyworm, *Spodoptera Frujiperda* Collected in Maize Field in Bangladesh

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Abstract
Fall armyworm (FAW) *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera: Noctuidae) invaded in Africa and Asia in 2016 and 2018, respectively. with the further progress in time, FAW has now been detected all over the maize growing areas in Bangladesh. Environment of Bangladesh is very much suitable for FAW infestation and outbreak. Accurate identification of organisms is a fundamental requirement for valid biological research. This can be particularly problematic for the species with their minute morphological characters and intraspecific variation. As a result, morphology-based identification along with molecular techniques are valuable for species diagnostics, especially for the closely related species. Initially, FAW samples collected from several districts. After collection, the FAW samples brought to the laboratory, categorized according to location, and the larvae samples were stored in 100% alcohol at -20°C for identification and further analysis. The larvae become darker with white lengthwise stripes and develop dark spots with spines. Older larvae have an inverted 'Y' shape on the head and a distinctive pattern of four large raised dark spots on the second to last body segment. Larvae can grow to up to 40mm long. Adult moths have a brown or grey forewing, a white hind wing, and a wingspan of 32–40 mm. Male fall armyworms are more patterned and have a distinct

white spot on each forewing. The molecular analysis of the *S. frugiperda* COI DNA sequences from GenBank revealed that FAW samples collected from Bangladesh are 98 to 99 % homologous. This clearly identified the FAW presence in Bangladesh. A critical first step to assess the degree of species invasiveness is to predict accurately the changes in its distribution and abundance in space and time.

Evaluation of Some New Generation Insecticides Against Sucking Insect Pests of Brinjal and Assess Their Effect on Beneficial Predators and Parasitoids in the Field

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Abstract

Brinjal (*Solanum melongena* L.) is one of the most economically important vegetables in the world. Several sucking insects attack the brinjal plant from the seedling to fruiting stage causing severe yield loss. Aphids, jassid, whitefly, thrips and leaf hopper are identified as devastating sucking insects of brinjal plant. This study evaluated the effectiveness of selected new generation insecticides such as Pymetrozine, Buprofezin, Abamectin, Chlorfenapyr, and Spinosad against sucking insect pests of brinjal under field conditions. The insecticides were sprayed at 15-days intervals with the first spray on day 30th and the last spray being on day 75th after planting. The number of sucking insects was counted by visual observation on the leaves of three randomly selected plants per plot after 7 days of each spray. Pymetrozine provided effective control of sucking insect pest and significantly lowest number of aphids, jassid, whitefly, thrips and leaf hopper were recorded in the brinjal fields. While, Chlorfenapyr was found less effective against sucking insect pests of brinjal.

Assessment of Different Growth Substrates for Mass Production of Entomopathogenic Fungi for Biopesticide Development

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Abstract

The *Beauveria bassiana* is the most well-known Entomopathogenic fungi widely used throughout the world as biopesticide to control aphids, thrips, whiteflies, and different beetles. We previously isolated several *B. bassiana* strains from Bangladesh. For successful commercialization, a suitable media is required for mass spore production with minimum cost involvement. Hence, the current study was undertaken to assess different growth media for mass production (biomass and spores) using local *B. bassiana* strain, Bb P-1-2 and Bb D5F3. Four growth media, Potato Dextrose Agar (PDA), Potato Carrot Agar (PCA), Sabouraud's Dextrose Agar (SDA) and Sabouraud's Dextrose Agar with Yeast Extract (SDAY) was assessed by measuring radial growth, dry mass and spore production by inoculating 1 x 10^7 spores/ml as inoculum. All the tested media were found suitable for *B. bassiana* but SDAY was most suitable for profound growth of Bb. SDB and SDBY) produced higher amount of dry mass and spores followed by PCB. Thus, its is found that Sabouraud's Dextrose and Potato Carrot based liquid media are suitable for *Beauveria bassiana* mass production. Future experiments shall be carried out using solid growth media.

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Field Evaluation of Seed Treating Agent, Fortenza and Selected Biopesticides for Managing Fall Armyworm, *Spodoptera Frugiperda* Je Smith on Maize in Winter

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Abstract
The field experiments were conducted to evaluate seed treating agent, Fortenza @ 4mlkg^{-1} and biopesticides, SfMNPV (Fawligen @0.1%), pheromone (Fall army-lure @ 1trap plot^{-1}), spinosad (Success 2.5% SC@ 0.5mlL^{-1}) and IGRs (Lumectin 10 WDG @ 1gmL^{-1}) on the infestation of fall armyworm (FAW) on maize plants as well as on the yield of the maize at Entomology Field Laboratory, Bangladesh Agricultural University, Mymensingh during December 2021 to June 2022. The experiments were laid out in Randomized Complete Block Design (RCBD) with three replications. Seeds were treated with Fortenza before sowing in the field. Biopesticides, SfMNPV, spinosad and IGRs were sprayed at 10 days interval. The pheromone trap was set after starting of pest infestation and continued until harvesting and the lure was changed 1.5 months interval. Data were collected at 10 days interval. Data on the no. of infested plants plot^{-1}, no. of infested leaf (SFW & LW) plot^{-1}, no. of infested tassel plot^{-1}, no. of infested silk plot^{-1} and yield (t/ha) was calculated. All the treatments significantly reduced the infestation and increased yield over untreated control. Among the treatments, SfMNPV showed the best performance followed by spinosad at 10 DAS in case of leaf infestation. The highest yield was found in case of SfMNPV treated plots followed by spinosad treated plots.

Integrated Management of Citrus Mealy Bug, *Planococcus citri* Risso in the Field

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Abstract
The efficacy of some IPM packages was evaluated against of citrus mealy bug, *Planococcus citri* Risso in residential area of Bangladesh Agricultural University, Mymensingh, during July 2021 to June 2022. The experiment consisted of 7 treatments viz. T_1= Detergent (2g) + Chilli dust (1g)/L, T_2= Detergent (2g/L) + Neem oil (ml)/L, T_3= Detergent (2g) + Mahogany oil (ml)/L, T_4= Detergent (2g/ L) + Abamectin (2ml)/L, T_5= Detergent (2g/ L) + Emamection Benzoate (1g) / L, T_6= Detergent (2 g) + Chlorpyrifos (2ml) / L, T_7= Untreated control. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The effectiveness of selected IPM packages was evaluated based on different parameters viz. No. of insect/plant, No. of nymph/ twig, No. of adult/twig, No. of infested twig/plant, No. of infested leaf/twig and No. of fruits/plant. The effect of all the IPM packages (treatments) varied significantly than the untreated control. Among the treatments the highest efficacy was observed considering the above mentioned parameters from IPM package consisting of Detergent (2 g/L) + Chlorpyrifos (2ml / L) followed by Detergent (2g/L) + Neem oil (ml/L) after 7days of spraying. Among the treatments the lowest efficacy was found against mealy bug from the untreated control plants at 7 DAS. At 15 DAS the similar results were found in case of the lowest and the

highest effectiveness against mealy bug on citrus plants in the homestead orchard. Therefore, IPM package consisting of Detergent (2 g/L) + Chlorpyrifos (2ml / L) or Detergent (2g/L) + Neem oil (ml/L) might be suggested for the farmers for sustainable management of citrus mealy bug in the field.

Insects Population Diversity in Cotton Ecosystem

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Abstract

Cotton (*Gossypium hirsutum* L.) is the second most important cash crop plays a significant role to social and economic wellbeing. Cotton fields are populated by divergent range of insects, many of which are predators and parasitoids are major concern in the low productivity of cotton. The diversity of insects in any ecosystem is important because of its ecological role, ensuring community stability and as biological indicators of ecosystem integrity. The diversity of different prevailing insects in the cotton field were studied by yellow pan, pitfall trap and beating sheeting method. Nine orders of insects, including Hemiptera, Hymenoptera, Diptera, Coleoptera, Orthoptera, Dermaptera, Lepidoptera, Blattodea, Thysanoptera, and spiders of the order Araneae, were recorded in the cotton field. More arthropods were caught using the yellow pan and beating sheet techniques than using pitfall traps. Fluorescent and yellow pan traps captured the mostly Hemiptera, Hymenoptera, Diptera, and Coleopteran insects. The insects from the Coleoptera, Dermaptera, Hymenoptera, and Orthoptera, on the other hand, were captured using pitfall traps. Cotton aphid (*Aphis gossypii*) and cotton Jassids (*Amrasca biguttula biguttula*) were recorded during early stage of the cotton. The *Pectinophora gossypiella* and *Earias vittella* was found among the bollworm complex. On the other hand, numerous beneficial insects were noted. A number of hymenopteran parasitoid wasps and the Asian planthopper *Ricania* sp. have been identified as new cotton pest that had not previously been reported from Bangladesh. Overall, a wide variety of insects are found and these findings might provide the foundation for further research and monitoring studies.

Scenario of Pesticides Use on Maize Crop and Assessment of Arthropod Biodiversity in Pesticides Treated Maize Field in Two Major Maize Growing Locations of Bangladesh

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Abstract

In the present study, a cross-sectional survey was conducted among four hundred maize farmers in Bangladesh to collect baseline informations regarding the scenario of pesticides use on maize as well as handling practices. During the survey period, we have identified 42 commercial insecticides under different chemical groups those were frequently used by maize growers. As many as 66% of the

insecticides used by the maize farmers belonged to WHO toxicity class II (moderately hazardous) and 10% were under highly hazardous group (Ib). None of the farmers wore personal protective equipment (PPE) while majority of the farmers wore traditional clothes during pesticides application. It was also found that majority of the farmers did not follow recommended doses while making spray solution and disposed remaining solutions or empty bottles/packets in the same or neighboring fields. Different health problems were identified among the maize farmers who were experienced with pesticides application and a significant association was found between health problems and some risk factors. Besides survey study, two field experiments were conducted in two major maize growing districts of Bangladesh to assess the effects of pesticides on the abundances and biodiversity of insect pests and beneficial arthropods. Results showed that beneficial arthropods were significantly reduced in insecticides treated plots than that of control under each functional group except pollinators. From Chuadanga district, a total of 78,751 and 48,216 insects were collected from 39 and 35 families respectively under control and farmers practice condition respectively. In case of Dinajpur district, a total of 70,019 and 43,061 insects were collected from 40 and 37 families under control and farmers practice condition respectively. Diversity indexes (both Simpson and Shannon-Wiener) were found higher in control plots than that of farmers practiced plot in both of the studied locations. In conclusion, adoption of *Bt* maize would be the safe and economical alternative in reducing pesticides use, health and environmental hazards as well as ensuring stable biodiversity in maize ecosystem.

Identification of Rugose Spiralling Whitefly Infesting Host Plants in Bangladesh and Assessment of Its Damage Severity

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Abstract

The rugose spiraling whitefly (RSW), *Aleurodicus rugioperculatus* (Aleyrodiade: Hemiptera) is an invasive insect pest and it was first identified in Bangladesh in 2019 on coconut plants. A baseline survey study was conducted in Bangladesh to identify the RSW-infesting geographical locations, host plants as well as to assess the damage severity. The duration of the survey period was 8 months from May to December 2021. Based on our survey results, we report that RSW has invaded all over Bangladesh with low to very severe infestation level. The highest infestation was noticed in west, south-west and north-east regions while comparatively lower infestation was found in south, south-eastern and central part of the country. It was evident from this study that both border and non-border districts were affected almost equally by this insect pest. During the survey period, sixty one host plants were identified throughout country where 49.18% were fruit plant species, 21.34% ornamentals and flowers, 8.19% field crops, 8.19% forests and 13.13% other species. Among the host plants, very severe infestation was noticed on coconut where 85.72% native and 81.23% dwarf coconut plants were found to be infested by RSW. Results also showed that comparatively lower leaflet infestation, low leaf area encrustation by sooty mould fungus and low abundances of adult RSW were found in dwarf coconut plants than that of native and it might be associated with frequent application of insecticides in dwarf plants. After coconut, next infestation severity was observed on banana (low to severe) and guava (low to medium) although the extent of damage varied from district to districts. On the other hand, low infestation was found on the rest of the host plants under different plant groups *viz.* forests, ornamentals, flowers, field crops, cash crops etc.

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Field Evaluation of Some New Generation Insecticides with Diverse Mode of Action against Fall Armyworm, *Spodoptera Frugiperda* on Maize

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Abstract
Maize is the second most important cereal crop after rice in Bangladesh and its acreage is expanding faster than any other cereals in Bangladesh due to its high yield, minimum cultivation costs, demand for animal feed and fuel etc. Maize is attacked by different insect pests but lepidopteran insect pests are the most harmful. The Fall Armyworm (FAW), *Spodoptera frugiperda* (J.E. Smith) (Noctuidae: Lepidoptera) is a highly migratory and invasive insect pest of maize that is native to tropical and sub-tropical regions of the Americas. This invasive insect pest invaded in Bangladesh in 2019 and after that a severe infestation was found. In the present study, six new generation insecticides were evaluated against FAW in the field condition namely Suspend 5 SG (Emamectin benzoate), Tracer 45 SC (Spinosad), Ravjum 14.5 SC (Indoxacarb), Plenum 50 WG (Pymetrozine), Prabal 10 EC (Alpha-Cypermethrin) and Lumectin 10 WDG (Lufenuron +Emamectin benzoate). Each of the insecticides had two concentrations of each and replicated thrice. Data were collected on percent leaf and cob infestation, yield (t/ha) and abundances of bio-control agents. Among six new generation insecticides, Tracer 45 SC, Suspend 5G and Ravjum 14.5 SC showed the best efficacy in terms of reduction of leaf and cob infestation, provided higher yield and also had high compatibility with bio-control agents like ladybird beetle and lynx spiders. Among six insecticides, Prabal 10EC provided least efficacy, lower yield and had greater toxicity to natural enemies. Thus, considering the reduction of leaf infestation, yield and safety to natural enemies, Tracer 45 SC @ 0.6 ml/L and Suspend 5SG @ 1.5 g/L can be used effectively in controlling invasive FAW on maize.

Bio-Intensive Management of Caterpillar-Complex of Major Cruciferous Vegetables through Ecological, Non-Chemical and Biorational-Based Holistic Approach

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Abstract
In this study, field experiments were conducted at the Entomology Field Laboratory, BAU, Mymensingh during the period from Januray 2021 to December, 2022 to develop an IPM approach consisting ecological, non-chemical and biorational insecticides in controlling caterpillar-complex on cabbage. In case of ecological and non-chemical approaches, approximately 27% head infestation was reduced, 28% head yield was increased over control and the highest BCR (1.53) was achieved from the integrated approach, push-pull technology + sticky traps + bait traps. Individual treatments were not much effective. On the other hand, Lumectin 10 WDG @ 1.5g/L showed the best efficacy in respect of the parameters studied that was followed by Capture 75 WDG @ 0.3g/L, Spinosad @ 0.6 ml/L and Fytomax @ 1.5 ml/L respectively. In case of holistic module or integrated approach, module-3 (all ecological approaches + Lumectin 10 WDG @ 1.5 g/L) provided the highest efficacy in reducing leaf and head infestation, highest yield (54.55 t/ha) and BCR (2.24) as well as abundances of beneficial

arthropods in cabbage ecosystem that was followed by module-4 (all ecological approaches + Capture 75 WDG @ 0.3 g/L, module-2 (all ecological approaches + Spinosad @ 0.6 ml/L and modiule-1 (all ecological approaches + Fytomax @1.5 ml/L) respectively. Thus, module-3 can be applied for the effective control of caterpillar complex on cabbage.

Integrated Management of Citrus Mealy Bug, *Planococcus Citri* Risso in the Field

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Abstract
The efficacy of some IPM packages was evaluated against of citrus mealy bug, *Planococcus citri* Risso in residential area of Bangladesh Agricultural University, Mymensingh, during July 2021 to June 2022. The experiment consisted of 7 treatments viz. T_1= Detergent (2g) + Chilli dust (1g)/L, T_2= Detergent (2g/L) + Neem oil (ml)/L, T_3= Detergent (2g) + Mahogany oil (ml)/L, T_4= Detergent (2g/ L) + Abamectin (2ml)/L, T_5= Detergent (2g/ L) + Emamection Benzoate (1g) / L, T_6= Detergent (2 g) + Chlorpyrifos (2ml) / L, T_7= Untreated control. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The effectiveness of selected IPM packages was evaluated based on different parameters viz. No. of insect/plant, No. of nymph/ twig, No. of adult/twig, No. of infested twig/plant, No. of infested leaf/twig and No. of fruits/plant. The effect of all the IPM packages (treatments) varied significantly than the untreated control. Among the treatments the highest efficacy was observed considering the above mentioned parameters from IPM package consisting of Detergent (2 g/L) + Chlorpyrifos (2ml / L) followed by Detergent (2g/L) + Neem oil (ml/L) after 7days of spraying. Among the treatments the lowest efficacy was found against mealy bug from the untreated control plants at 7 DAS. At 15 DAS the similar results were found in case of the lowest and the highest effectiveness against mealy bug on citrus plants in the homestead orchard. Therefore, IPM package consisting of Detergent (2 g/L) + Chlorpyrifos (2ml / L) or Detergent (2g/L) + Neem oil (ml/L) might be suggested for the farmers for sustainable management of citrus mealy bug in the field.

Assessment of Yield, Nutritional Quality and Bioactive Compounds of Tomato Grown with Indole-3-Acetic Acid and Gibberellic Acid

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Abstract
The two-factor experiment following randomized complete block design consisted of two varieties of tomato viz., BARI Tomato-2 and BARI Tomato-15 and four doses of plant growth regulators viz., Control (0 ppm PGR), 100 ppm of IAA (Indole-3-Acetic Acid), 100 ppm of GA_3 (Gibberellic Acid**)** and 100 ppm of IAA + 100 ppm of GA_3. The fruit yield (96.44 t/ha) were the highest in the combination of BARI Tomato-15 and 100 ppm of IAA. The lowest yield (39.59 t/ha) was recorded in the combination of BARI Tomato-2 and 100 ppm of IAA + 100 ppm of GA_3. Results revealed that 100 ppm of IAA had provided 62.46% (87.19 t/ha) more yield than control (53.67 t/ha) in BARI Tomato-2. On the other hand, 100 ppm of IAA + 100 ppm of GA_3 reduced 26.23% (39.59 t/ha) yield compared to control (53.67 t/ha) in BARI Tomato-2. Similarly, 86.29% (96.44 t/ha) more yield was obtained in BARI Tomato-15 when treated with 100 ppm of IAA than control (51.77 t/ha). Results revealed that

50% TSS, 23.64% TA, 24.64% ascorbic acid, 52.63% total chlorophyll, 65.62% lycopene, 53.38% TPC, 79.71% TFC of fruit increased in the combination of BARI Tomato-15 and 100 ppm of IAA + 100 ppm of GA_3 than control and 8.93% p^H, 32.22% IC_{50} value of fruit decreased in the combination of BARI Tomato-15 and 100 ppm of IAA + 100 ppm of GA_3 than control at stage 4 (consumption stage). At stage 6 (processing stage), 29.03% TSS, 35.71% TA, 24.40% ascorbic acid, 52.84% lycopene, 66.44% TPC, 87.78% TFC fruit increased in the combination of BARI Tomato-15 and 100 ppm of IAA + 100 ppm of GA_3 than control and 8.16% p^H, 32.72% IC_{50} value decreased in the combination of BARI Tomato-15 and 100 ppm of IAA + 100 ppm of GA_3 than control.

Effect of Indole-3-Butyric Acid and Different Part of Stem on the Growth and Rooting Performance of Horitoki (*Terminalia chebula*) Sapling

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Abstract
The experiment was carried out at the Landscape Section, Department of Horticulture, Bangladesh Agricultural University, Mymensingh during 2021- 2022 to investigate the effect of Indole Butyric Acid (IBA) and portion of stem cutting in Horitoki. The experiment consisted of three parts of stem cutting viz., apical, middle and basal and six different concentrations of IBA viz., 0, 1000, 2000, 3000, 4000 and 5000 ppm. The experiment was conducted in Randomized Complete Block Design (RCBD) with three replications. Most of the parameters that were studied showed significant variation due to the different part of stem used for cutting. The maximum sprouting percentage (84.88%) was found at basal cutting and minimum (67.75%) was recorded at apical stem cutting at 45 DAPs. The highest number of shoots (6.01), shoot length (4.94cm), number of leaves (5.50), leaf length (2.45cm), leaf width (1.22cm), rooting percentage (17.83%), numbers of root (4.55) and root length (4.70cm) were found in basal cuttings. The lowest number of shoots (4.52), shoot length (3.68cm), numbers of leaf (4.71), leaf length (2.06cm), leaf width (1.03cm), rooting percentage (4.27%), numbers of root (1.52) and root length (1.55cm) were found in apical portion of cuttings. The IBA concentration of 4000 ppm showed the highest sprouting percentage (85.94%), number of shoot (7.03), shoot length (7.09cm), number of leaves (7.22), leaf length (2.73cm), leaf width (1.36cm), rooting percentage (15.25%), number of root (4.19) and root length (4.74cm) at 60 DAP and the lowest sprouting percentage (48.24%), number of shoot (3.06), shoot length (2.48cm), number of leaves (3.08), leaf length (2.06cm), leaf width (1.03cm), rooting percentage (2.68%), number of root (1.41) and root length (1.77cm) were recorded without IBA application. Basal stem cutting with 4000 ppm IBA showed the highest sprouting percentage (95.50%), number of shoot (7.85), shoot length (8.45cm), number of leaves (8.93), leaf length (3.25cm), leaf width (1.63cm), rooting percentage (22.69%), number of root (6.49) and root length (6.83cm) at 60 DAP and apical cutting with 000 ppm IBA (control) showed the lowest sprouting percentage (45.85%), number of shoot (2.94), shoot length (2.28cm), number of leaves (3.63), leaf length (1.73cm), leaf width (0.87cm), rooting percentage (2.50%), numbers of root (0.55) and root length (0.63cm).

Study on Postharvest Behaviour of Strawberry and Dragon Fruit in an Attempt to Reduce Loss and Prolong Shelf Life Without Deteriorating Quality and Safety

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Abstract
Postharvest loss of fruits and vegetables in Bangladesh range from 17-32%. Strawberry and dragon fruit are recently introduced, nutritious, commercially profitable and non-climacteric fruits in Bangladesh. There are lack of reports related to packaging, storage and shelf life extension of strawberry and dragon fruits in Bangladesh. Therefore, the present research attempted to reduce postharvest loss and extend shelf life of dragon fruit and strawberry through various options including modified atmosphere packaging, heat treatment, and application of coating substance, irradiation and botanical extracts. The objectives were to evaluate packaging materials with or without ethylene scavenger, to examine the efficacy of hot water and irradiation, and to investigate the potential of botanical extracts on the shelf life and quality of strawberry and dragon fruit. A number of experiments were carried at the Postharvest Lab of the Department of Horticulture, BAU. The experiments were laid out in completely randomized designs, and the parameters investigated were physiological weight loss, ripening rates (colour and firmness), TSS, disease incidence and severity, nutritional properties, shelf life and organoleptic quality. Preliminary results suggested that 25µ polypropylene (PP) bags was found suitable for packaging of dragon fruit with prolonged shelf life at ambient condition and reduced weight loss, disease incidence and severity. Dragon fruits when treated with hot water (50±2 ^{o}C for 15 minutes) and held in 25µ PP bags with $KMnO_4$ had prolonged shelf life with the retention of acceptable taste and quality. Strawberry and dragon fruits were gamma irradiated through ^{60}Co Cobalt source, and 1000 Gy was found effective to prolong shelf life of dragon fruit at ambient condition (29-30 ^{o}C and 74-79% RH). The above results would have commercial implications during postharvest handling and marketing of the highly nutritious but perishable strawberry and dragon fruit.

Effects of Planting Dates and Planting Spacing on the Growth and Yield of BAU Released Sweet Potato Variety

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Abstract
The study was conducted at Horticulture Farm, Department of Horticulture, Bangladesh Agricultural University, Mymensingh during January 2021 to December 2022. This project work was carried out to determine a suitable combination of planting dates and variety and also to find out an effective combination of planting spacing variety of BAU released sweet potato. Two-experiment was conducted following randomized complete block design (RCBD) with three replications. In experiment 1, four planting dates (1st November, 15th November, 1st December and 15th December) and four BAU released sweet potato varieties (V_1: BAU Sweet Potato-1, V_2: BAU Sweet Potato-2, V_3: BAU Sweet Potato-3 and V_4: BAU Sweet Potato-4) were used. In experiment 2, four planting spacing (S_1: 60 cm x 40 cm, S_2: 60 cm x 50 cm, S_3: 90 cm x 30 cm, and S_4: 60 cm x 30 cm) and similar varieties were used. Data on plant growth, yield contributing traits and yield of sweet potato varieties were recorded at different days after planting and after final harvesting. Results shows that different variety performed

differently in terms of planting dates, and planting spacing. It was observed that the combination of P1V2 (BAU Sweet Potato-2 planting on 1st November) produced the maximum number of tuberous roots per plant (7.00), fresh weight of tuberous roots per plant (970.11 g) and gross yield per hectare (51.5 tons). On the other hand, the number of tuberous roots per plant (6.93), fresh weight of tuberous roots per plant (65.0 g) and yield tuberous roots per hectare (24.2 tons) were the highest from the combinations of S_4V_2 (i.e., BAU Sweet Potato-2 with 60 cm x 30 cm planting spacing). While the lowest results (3.43, 23.22 g and 10.1 tons) were obtained from the combination of S_2V_1 (i.e., BAU Sweet Potato-1 with 60 cm x 50 cm spacing). In conclusion, it can be stated that among the BAU released sweet potato varieties, V_2: BAU Sweet Potato-2 would have performed superior in terms of plant growth and root yield if it is planted in 1st November using 60 cm x 30 cm planting spacing.

Effect of Corm Size and Plant Growth Regulators for Corm Dip Treatment on Growth, Flower Yield and Corm Production of Gladiolus

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Abstract
Gladiolus is an important bulbous flower and plays an important role as cut flower both in domestic and international market. Demand for flower is increasing significantly in Bangladesh. Cultivation of gladiolus flower is gaining popularity among the farmers in various areas of the country. In order to enhance the yield and quality of gladiolus use of proper physiological mature corm is very important. Major constraint for gladiolus cultivation is the corm dormancy. Small sized corms take longer time for physiological maturity, hence the plant growth regulators can play a definite role to enhance plant growth and ultimately to shorten the cycle and increase the corm production. Therefore, keeping in view the role of growth regulators, the present study is under taken to evaluate the effect of growth regulators on the performance of gladiolus regarding flower and corm yield. The project is a two years project and comprising with three experiments. First year experiment is a two factor experiment laid out with Randomized Complete Block Design (RCBD) with 3 replications. One factor was corm size, such as C1= Small (Average weight 10-15 g), C2 = Medium (Average weight 16-20 g) and C3 = Large (Average weight 21-25 g) and the other factor is five levels of Gibberellic acid such as T1: Control, T2: GA_3 50 ppm, T3: GA_3 100 ppm, T4: GA_3 150 ppm, T5: GA_3 200 ppm. The experiment is now in the field and data collection is going on

Application of Botanical Extracts: An Eco-Friendly Postharvest Management Tool to Enhance Shelf Life and Quality of Fruits During Storage

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Abstract
Application of synthetic chemicals in agriculture is subjected to restrictions because of growing concern on human health and environment. So it is important to reduce the use of agro chemicals

during storage and ripening fruits. Plant leaf extracts were applied as coating materials during storage of fruits to investigate the postharvest physio-biochemical changes as well as storage life of Banana cv. Amritsagar and Mango cv. Amrapali. Two separate experiments were carried out to find out the effects of botanical extracts on postharvest shelf life and nutritional qualities of Banana and Mango. The experiments were conducted at the Postgraduate Laboratory of the Department of Horticulture during July 2021 to June 2022 following completely randomized design with three replications. There were seven botanical extract coating treatments namely T_0: Control, T_1: Gandavhadalu leaf, T_2: Garlic clove, T_3: Lemon leaf, T_4: Custard apple leaf, T_5: Aloe vera leaf, T_6: Neem leaf. Fruits were soaked in extract solutions for five minutes thereafter kept in the laboratory at ambient condition. Data were recorded at 3 days intervals from the day of storage i.e., 0, 3, 6, and 9 days after storage (DAS). Data were statistically analyzed to find out the significance of the differences between the treatments. Botanical extracts significantly impacted on the physio-chemical traits as well as shelf life of fruits. In control condition, all traits relating to ripening and chemical changes during storage were very quicker and reached maximum within short time. Whereas, botanical extract coated fruits showed a significantly slower trend. It is assumed that coating creates a physical barrier which ultimately reduce biochemical changes by inhibiting ethylene production and other enzymes. Among the coating treatments, T_1 (Gandavhadalu leaf), T_5: Aloe vera leaf, and T_6: Neem leaf extract exhibited better performance in reducing the biochemical changes of fruits thus increase the storage life.

Screening of High Capsaicin Rich and High Yielding Hot Chili Genotypes for Future Varietal Improvement

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Abstract

An experiment was conducted at the Horticulture Farm, Department of Horticulture, Bangladesh Agricultural University, Mymensingh during July 2019 to June 2022. Fifty (50) chili genotypes collected from home and abroad were used for this study. The study was conducted to evaluate chili germplasm based on growth, yield and yield contributing traits. Field experiments were conducted following randomized complete block design with three replications. Morphological and yield contributing traits were recorded following the descriptor for Capsicum developed by IPGRI. Distinct variations were observed among the chili germplasm. Plant height, leaf area and other yield contributing characters significantly differ among the germplasm. The maximum variations were observed in fruit size and yield per plant. Path analysis with the phenotypic correlation matrix compared with yield per plant showed that plant height had positive direct (0.057) effect on yield per plant. It had positive indirect effect on yield per plant via leaf area (0.142) fruit length (0.231), fruit dia. (0.002), total number of per plant (0.085), individual fruit weight (0.453), and thousand seed weight (0.143). Whereas, it had negative indirect and direct effect number of seed per fruit (-0.0436, -0.038) on yield per hectare. Plant height, fruit length and individual fruit weight finally made significant positive phenotypic correlation (0.265**, 0.404** and 0.485**) with yield per plant with the residual effect of 0.628. The findings of this study noticed that the tested genotypes show the great genetic potential. Nine promising genotypes were identified from this study these were G1, G5, G10, G12, G23, G24, G34, G40 and G49. These genotypes have huge potentiality to be used in future breeding programs for getting productive and quality traits. Moreover, the variability observed in the current study could be used in crop improvement program.

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Identification of Atoxigenic *Aspergillus Flavus* in Controlling Aflatoxins Contamination in Maize

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Abstract
Aflatoxins are secondary metabolites produced by several *Aspergillus* species and poses acute life-threatening toxicity to human and animal. Several approaches have been practiced to mitigate aflatoxin contamination, however, none of the approaches provide a long-term solution. However, pre-harvest application of atoxigenic *A. flavus* has been demonstrated to limit aflatoxin contamination in maize. In the present study, atoxigenic *A. flavus* isolates from maize samples were isolated and identified to evaluate their efficacy in limiting aflatoxin contamination in inoculated maize grains in *in vitro* and *in planta* cob. A total of 215 *A. flavus* isolates were identified by morphological characteristics and representative isolates of *A. flavus* were identified by sequencing of ITS region. In *in vitro* assessment, 38 isolates were able to deminish aflatoxin accumulation in inoculated maize grains, among the isolates, AF71 showed 92.35% reduction of aflatoxin in inoculated maize followed by AF75 (92.03%), AF44 (91.40%), AF191 (91.19%) and AF202 (85.43%) and conversely 6 isolates increased aflatoxin accumulation ranging from 2.73% to 49.16% compared to uninoculated maize grain. However, isolates AF72, AF73 and AF76 increased aflatoxin accumulation even they were confirmed as atoxigenic, on the other hand, isolates AF153, AF11, AF13, AF191 and AF90 were able to diminish aflatoxin accumulation though they were confirmed as toxigenic. Assessment of atoxigenic *A. flavus* isolates in *in planta* cob inoculation showed that all isolates reduced aflatoxin accumulation by 80% to 90% compared to uninoculated maize except the isolate AF01 and AF165 which showed 67.10% and 74.65% reduction, respectively. Furthermore, isolate AF72 and AF73 surged aflatoxin in *in vitro* but in *in planta* assessment they were able to diminished aflatoxin accumulation in cob. A total of 33 atoxigenic isolates were confirmed by no amplification of *nor1*, *aflR* and *omtA* genes of aflatoxin biosynthesis gene cluster and 11 isolates were confirmed as toxigenic by positive amplification of any of these genes either *nor1*, *aflR* and *omtA.* Therefore, mulpliplex PCR with CAP (Cluster Amplification Patterns) analysis will be required to confirm either partial or complete deletion of genes in aflatoxin biosynthesis gene cluster before being declared as an atoxigenic *Aspergillus* isolates for developing biocontrol product.

Development of Nutrient Based Innovative Technology for Improved Management of Citrus Greening Disease of Sweet Orange

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Abstract
Citrus greening caused by *Candidatus* Liberibacter asiaticus (*C*Las) poses a great threat to the growing citrus industry of the country. In this study, the effects of some selected nutrient elements were

assessed in managing citrus greening of sweet orange both by applying as soil application and as foliar spray along with standard citrus fertilization (SCF). The results revealed that all of the treatments showed positive effects in reducing citrus greening severity by (36-72%) over control in 2022 (trees received improved nutrient management package) compared to 2021 (trees without improved nutrient management package). The minimum rate of increase of citrus greening severity was recorded when sweet orange trees were treated with T_4 (SCF + foliar spray of Boron), T_{10} (SCF + soil plus foliar application of Ca, Zn, Mn, B, Mg, Cu and Fe) and T_6 (SCF + foliar spray of Hamoxy) compared to untreated trees. However, the maximum reduction rate of *C*las bacterial titre was estimated by qRT-PCR in trees received treatment $T_{10,}$ T_1 (SCF + foliar spray of Hay Cal) and T_{11} (SCF + soil plus foliar application of Ca, Zn, Mn, B, Mg, Cu and Fe + Bactroban (Bismerthiazol) + Spray of Guava leaf extract + Oxytetracycline as compared to control. The results of the nutrient management experiments clearly showed that the uptake of all nutrient elements by sweet orange trees was higher in 2022 as compared to the untreated trees of 2021. Furthermore, the maximum fruit yield was obtained when trees were treated with T_8 (SCF + foliar spray of Ca, Zn, Mn, B, Mg, Cu and Fe) followed by T_{12} (SCF + Bactroban (Bismerthiazol) + Spray of Guava leaf extract + Oxytetracycline + Compost), T_{10} and T_{13} (SCF + Bactroban (Bismerthiazol) + Spray of Guava leaf extract + Oxytetracycline + Compost treated plants. In terms of fruit quality, the maximum juice was determined in fruits harvested from trees treated with T_{10} followed by T_{12}, T_{13} (SCF + soil plus the foliar application of Ca, Zn, Mn, B, Mg, Cu and Fe + beta-amino butyric acid (BABA) + 3Ascorbic acid (AA) + Salicylic acid (SA) + compost). The results also revealed that the maximum pH (5.12) of juice was obtained when trees were treated with T_3 (SCF + foliar spray of Hay Zinc+) and T_{10}. The maximum amount of vitamin C was estimated in juice of the fruits harvested from trees treated with T_7 (SCF + foliar spray of $FeCl_2$) and the maximum soluble sugar was estimated in the juice of sweet orange harvested from trees treated with T_{13}. Taken together, the results of the present study indicated the effects of nutrient management in increasing fruit yield and quality through minimizing citrus greening severity.

Analysis of Genetic Diversity of *Magnaporthe oryzae* Causing Rice Blast Disease in Haor Areas of Bangladesh and Its Bio-Control with Plant Growth Promoting Endophytic Microorganisms

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Abstract

Blast is one of the most important disease of rice in Bangladesh including haor areas. Due to that, this experiment was performed to isolate and identify promising bacteria which could potentially act as plant growth promoting bacteria (PGBR) from rice phylloplane and rhizosphere that are antagonistic to *Magnaporthy oryzae.* This study was conducted at the Plant Microbe Interaction Laboratory, Department of Plant Pathology and Professor Golam Ali Fakir Seed Pathology Centre, Bangladesh Agricultural University Mymensingh-2202. From different haor areas of Bangladesh, 105 bacterial isolates were isolated from rice rhizosphere and phyllosphere, and the antagonistic performance of those bacterial isolates was observed in *in vitro* condition by the dual culture triangular method against *Magnaporthe oryzae* causing rice blast disease. Among the 105 bacteria isolates, 50 isolates showed antagonistic activity against *M. oryzae* and 30 bacterial isolates out of 50 isolates showed moderate to strong antagonistic activity (66.52% to 91.00% growth inhibition) *against M. oryzae.* Plant growth-promoting activities of those 30 antagonistic bacterial isolates were observed with the production of Indole Acetic Acid (IAA), phosphate solubilization test, siderophore and HCN production. Out of the

30 rhizobacterial isolates, 10 isolates were found to produce IAA, 8 isolates showed the capability of phosphate solubilization, 16 produced siderophore and 23 isolates showed the capability of producing hydrogen cyanide. The growth promotion of rice plants was also assessed using 30 bacterial isolates in this study by the determination of germination percentage, root length, shoot length and vigor index in bacterial treated and control plants. Twelve bacterial isolates can boost root growth, shoot growth and vigor index compared to the control. On the other hand, 20 isolates of rice blast pathogen, ***M. oryzae*** were developed in this study and morphological variation among the isolates was evaluated based on their colony colour, colony shape and sporulation. Genetic variation among the 20 ***M. oryzae*** isolates collected from different haor areas and bio-contro of blast disease using plant growth promoting bacteria in the control condition is going on.

Assessment of Diseases of Dragon-Fruit in Bangladesh and Their Fungicidal Management

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Abstract
Dragon fruit (*Hylocereus undatus*) is a popular fruit in South East Asia as well as a introduced exotic fruit in Bangladesh. It can be infected with several complex diseases caused by different fungi. Thus, it is necessary to identify the disease and respective pathogen as well as to develop a bio-rational disease management strategies for safe Dragon-fruit production in Bangladesh. The experiment was conducted in the Microbiology and Boi-control Laboratory of Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh. Few diseases were identified and their management through used of several fungicides were applied in-vitro and in-vivo. Stem canker (*Neoscytalidium dimidiatum*), Anthracnose (*Colletotrichum gloeosporioides*) and *Phytophthora* blight (*Phytophthora* spp.) were identified and their causal organisms were isolated and confirmed by Koch's Postulates. Effects of nine chemical fungicides *viz.* Nativo 75 WG (50%Tebuconazole + 25%Trifloxystrobin), Topral 52.5 WP (35%Iprodione+ 17.5%Carbendazim), Autostine 50 WDG (50%Carbendazim), Sprinter 72 WP (64%Mancozeb + 8%Cymoxanil), Kimia 21.5 WP (Bismerthiazol + Kasugamycin), Unilux 72 WP (8%Metalaxyl + 64%Mancozeb), Dithane M-45 (80%Mancozeb), Azonil 56 SC (6% Azoxystrobin + 50%Chlorothalonil), Potent 250 EC (25%Propiconazole) was evaluated against the isolated fungi. Radial mycelial growth of *Neoscytalidium dimidiatum*and *Colletotrichum gloeosporioides* in PDA were recorded for fungicides evaluation. Topral 52.5 WP, Autostine 50 WDG, Potent 250 EC and Azonil 56 SC were found effective to completely suppressed the growth of *Neoscytalidium dimidiatum* over untreated PDA media. Topral 52.5 WP, Autostine 50 WDG, Dithane M-45, Potent 250 EC and Azonil 56 SC showed the best inhibitory effect over untreated PDA media on *Colletotrichum gloeosporioides.*

Elucidate the Effect of Plant Growth Promoting Rhizobacteria on Drought Responses of Rice

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Abstract
Drought, a long period with no rain or unusually low levels of rain or other precipitation is one of the most significant abiotic stress factors causing the reduction of growth and yield of rice cultivated in

drought-prone regions of Bangladesh. Owing to that, this study aimed to evaluate the effect of some plant growth promoting rhizobacteria (PGPR) in drought response of two rice varieties (Drought tolerant BRRI dhan71 and drought susceptible IR 64) by observing morphological and yield parameters under different drought stress conditions. This study was conducted at the Plant Microbe Interaction Laboratory, Department of Plant Pathology and Professor Golam Ali Fakir Seed Pathology Centre, Bangladesh Agricultural University, Mymensingh-2202. In this study, around 100 rhizobacterial isolates were collected from the rice rhizosphere of eight drought prone districts (Naogoan, Rajshahi, Chuadanga, Jessore, Chapainawabgong, Kustia, Shatkhira and Rangpur) and the antagonistic performance of those bacterial isolates was observed in *in vitro* condition by the dual culture triangular method against *Rhizoctonia solani and Xanthomonas oryzae* pv. *oryzae (Xoo)* causing sheath blight and bacterial blight disease of rice respectively. Among the 100 rhizobacterial isolates, 30 isolates showed moderate to strong antagonistic activity against *R. solani* and *Xoo*. Nine (9) isolates out of 30 rhizobacterial isolates showed strong antagonistic activity to *R. solani* (80.00% to 84.62% growth inhibition) and 8 isolates showed moderate to strong antagonistic activity to *Xoo* (70.49% to 82.94% growth inhibition). Plant growth-promoting activities of those 30 antagonistic rhizobacterial isolates were observed with the production of Indole Acetic Acid (IAA), phosphate solubilization test, siderophore and HCN production. Out of the 30 rhizobacterial isolates, 12 isolates were found to produce IAA, 9 isolates showed the capability of phosphate solubilization, 17 produced siderophore and 21 isolates showed the capability of producing hydrogen cyanide. The growth promotion of rice plants was also assessed using 30 rhizobacterial isolates in this study by the determination of germination percentage, root length, shoot length and vigor index in treated and control plants. Ten rhizobacterial isolates can boost root growth, shoot growth and vigor index compared to the control. Following the dual culture assay, eight antagonistic PGPR isolates were found to exhibit moderate to strong antagonistic behavior against two rice pathogens (approximately 70.49% to 84.62%). Out of eight PGPR isolates having higher growth inhibition ability against two pathogens, five were identified by 16S rDNA gene sequence analysis and all the identified bacterial isolates belonged to three different genera such as *Bacillus, Pseudomonas* and *Serratia*. Evaluating the effect of PGPR on the drought response of rice is going on.

Management of Stemphylium Blight of Faba Bean by Antagonistic Trichoderma Spp. and Induced Resistance Chemicals

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Abstract

Faba-bean *(Vicia faba* L.) is one of the important legume crops cultivated in several districts of Bangladesh. It is the source of protein for human and animal (Cazzato et al., 2012; Rubiales, 2010). It increases soil fertility. But it is attacked by many plant pathogens (Stoddard *et al.,* 2010) and stemphylium blight caused by *Stemphylium botryosum* is considered as the most devastating disease. Chemical fungicides are mostly used to control this disease which makes our environment pollution. Therefore, it is urgent to search out non-chemical approaches to manage this disease. Incidence and severity of Stemphylium blight disease of Faba bean were recorded following the methods of Bakr *et al*., (2000). Stemphylium blight Pathogen was isolated from the infected field of Faba bean. Culturing and incubation were done according to the methods of Pragya *et al.,* (2017). Three bioagents viz: *Trichoderma* spp. viz : *T. harzianum*, *T. asperellum*, and *T. viride* were cultured as described by Islam *et al.,* (2016). Chemicals were tested as postive control. Net house and field experiments were carried out following the methods as described by Bakr *et al.,* 2000). Fungal pathogens associated with Stemphylium blight diseases of faba bean have been isolated and morphologically identified as

Stemphylium botryosum. It was found that this disease was more prevalent in Mymensingh compared to Tangail district. The highest percentage of Stemphylium blight incidence and severity were ranged from 12.2%-63.6% and 21%-56% in Mymensingh followed by Tangail district (9.0%-42% and 14%-38.2% respectively). Among the bio-agents, *T. asperellum* was found potential in reducing stemphylium blight of faba bean caused by *S. botryosum*. From both *in vitro* assay and field experiment, it was revealed that Stemphylium blight of faba bean can be significantly controlled spraying with Score (Difenoconazole) followed by bio-control agent *T. asperellum* and induced resistant chemicals.

Mortality and Disease Detection of Underutilized Fruit Trees at Southern Part of Bangladesh and Their In-Vitro Management

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Abstract

An experiment in farmers gardens was done on underutilized fruit trees at the three districts of southern part of Bangladesh namely, Joshore, Khulna and Satkhira showed that there is great opportunity to produce underutilized fruits and consumption would be high. Bangladesh Agricultural University Germplasm Centre (BAU-GPC) was kept as a control location. For adaptation test 27 different underutilized fruits saplings of Sofeda, Lotkon, Amra, Amloki, Jambura and Bilati gab were planted in each of the 30 farmers of these selected districts. After 24 months of the plantation at the field showed that the highest 27% mortality was observed at Latkon. Sofeda showed the lowest 17% mortality. Among the different locations, BAU-GPC the highest 100% mortality was at Satkhira. The experiment showed that there was different mortality % in each location. BAU-GPC showed 0% mortality in Sofeda, Jambura, Amra and Amloki. Diseases in sapling played an major role of high mortality in the three southern districts. An intensive study of the diseases of planted saplings and pathogen detection was done. Several fungal isolates were established. Eight isolates of *Pseudopestalotiopsis* sp. from Latkon, eight isolates of *Colletotricum sp.* were purified. Three isolates from Sofeda were *Neopestalotiopsis* sp. and three isolates from hog plum (amra) were *Pseudopestalotiopsis* sp. In-vitro fungicidal application study showed that Topral, Autostin and Potent were effective to control *Pseudopestalotiopsis* sp., *Colletotricum* sp. and *Neopestalotiopsis* sp. causing diseases of Latkon, Sofeda and Hog plum.

Morpho-Physiological and Molecular Diversity Analyses of *Stemphylium Vesicarium* of Onion and Garlic for Healthy Seed Production

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Abstract

Stemphylium leaf blight caused by *Stemphylium vesicarium* is the most damaging disease of the onion and garlic crops, and poses a serious threat to the cultivation of these crops in Bangladesh. In this work, a total of twenty-two isolates of *Stemphylium* spp. were isolated from several geological areas that were identified both morphologically and at molecular level by sequencing of ITS region. Result revealed that isolated fungi produced cottony, fluffy, and velvety colony texture with circular and

irregular colony shapes. The colony elevation was umbonate, raised, and flat type. Colony colors ranged from light yellowish, white, light green, light gray, dirty white, light brown, and ash. Oblong, ovoid, and ovoid to oblong shape conidia and light brown to deep brown conidial color were found in these isolates. The length of conidia varied from 15.49 µm to 33.57 µm and the breadth of conidia ranged from 10.20 µm to 18.74 µm. The mean vertical septation varied from 1.83 to 7.00 and horizontal septation varied from 1.50 to 6.83. The universal primers ITS1 and ITS4 were used for the amplification of the internal transcribed spacer (ITS) region and amplicon size was 600 bp. Then the twenty-two PCR products were sequenced unidirectionally and found in 82.92 to 100 % identity with *S. vesicarium* and *Stemphylium* spp. GenBank accessions. The phylogenetic relationships among twenty-two isolates representing two species of *Stemphylium* and their analysis revealed genetic variation among the isolates. Among the isolates, S_3 (*Stemphylium vesicarium* 3) exhibited highest virulence on both onion and garlic plants. In *in vitro*, elicitors, bioagents, botanicals and fungicides were screened for their growth suppressing ability against *Stemphylium vesicarium* using dual culture technique. CHI @ 0.5 %, *Bacillus subtilis*-41, *Pseudomonas fluorescens*-3, *Achromobacter* spp., *Trichoderma* spp. and 10 % Garlic-Ethanol extract, Trooper @ 0.08% showed the highest inhibitory effect (100%, 75.95 %, 64.83 %, 66.98 %, 53.27 %, 100 % and 100 % respectively) against *Stemphylium vesicarium* in *in vitro* condition. In *in vivo*, a total of eight single and fourteen combined treatments were applied at fifteen days interval for 3 times on onion and garlic plants and subsequently vegetative parameters, disease incidence and severity were recorded. Among all single and combined treatments, the best result was observed in treatments T_2 (*B. subtilis* + Chitosan @ 0.5 %) and T_{11} (*B. subtilis* +*P. fluorescens*+ 10 % Garlic-Ethanol extract in onion and garlic plants respectively. Therefore, the findings of this experiment revealed that both morphological and molecular characters are necessary for proper identification of this pathogen and it is assumed that the best treatments can manage *Stemphylium* blight disease of onion and garlic plants effectively.

Development of Formulation of Antagonist Yeast from Phylloplanes and Fructoplanes for Post-Harvest Management of Major Diseases of Papaya and Banana

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Abstract
The post-harvest losses of papaya and banana fruit are extensive due to both biotic and abiotic causes resulting huge economic losses every year in Bangladesh. Therefore, the present investigation focused on isolation, evaluation of the efficacy of antagonistic yeasts from phylloplanes and fructoplanes against post-harvest diseases especially anthracnose. Yeasts were randomly isolated from the leaves and fruit surfaces and the pathogen (*Colletotrichum* spp.) used for the experiment was isolated from diseased fruits and identified based on different morphological distinctions. For antagonistic capability assessment, the yeast isolates were cultured together with the pathogen on potato dextrose agar (PDA) medium using dual culture technique. Isolates from Amloki fruit Y11, Malta fruit Y4 and Grape fruit Y3 showed the highest growth suppressing ability against *Colletotricum* spp. in *in-vitro* condition. These isolates had been selected for assessing their efficacy in *in vivo* trial. In in-vivo assay, antagonistic yeasts were applied against the pathogen in fruits in two ways: 1. Inoculation of 0.02 mL of *Colletotrichum* spore suspension was placed on the wounds after 6,12 and 24 hrs of yeast inoculation 2. Dipping fruits for 5 min, 15 min and 30 minutes into the yeast cell suspensions. Then data on lesion expansion average, percent disease reduction were recorded. Treatments T_3 (Inoculation of *Colletotrichum* on fruit treated with Y_{11} after 24 hours) and T_9 (Inoculation of *Colletotrichum* on

fruit treated with Y_3 after 24 hours) showed best the results in reducing lesion expansion and percent disease reduction of anthracnose in both papaya and banana fruits. So, it can be assumed that these treatments can be used against post-harvest anthracnose disease in papaya and banana.

Isolation and Evaluation of Plant Probiotics from Saline - Prone Areas for Mitigating Salt Stress of Rice

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Abstract
Salinity is one of the detrimental factors that significantly limits the crop productivity. Salt-tolerant plant probiotic bacteria could be an effective alternative to alleviate salinity problems in rice plants grown in the coastal areas. This study was conducted to isolate salt-tolerant bacteria from soil and assess their efficacy on the physiological and biochemical properties of rice plants grown under artificial saline condition in the net house. 140 rhizosphere soil sample were collected from the different locations of Khulna, Satkhira and Bagerhat districts and pH and EC (Electrical conductivity) value of the samples were determined. 225 isolates of bacteria were obtained from the rhizosphere soil samples. Among them, 66 isolates were capable of phosphate solubilization and 86 isolates were capable of IAA production. Finally, 60 bacterial isolates showed positive response to both IAA and Phosphate solubilization assay. These 60 isolates were used for initial screening. Based on initial screening, 20 isolates showed significantly better performances considering germination % and seedling height. Based on initial screening, 21 treatments including control were selected for further pot experiment maintaining artificial saline condition. The treatments were T_0 (Control: without bacteria), T_1 (BDISOB08KhuDu), T_2 (BDISOB26KhuDu), T_3 (BDISOB31KhuDu), T_4 (BDISOB38KhuDu), T_5 (BDISOB41KhuDu), T_6 (BDISOB69KhuDu), T_7 (BDISOB81KhuDu), T_8 (BDISOB89KhuDu), T_9 (BDISOB103KhuBa), T_{10} (BDISOB117KhuBa), T_{11} (BDISOB120KhuBa), T_{12} (BDISOB121KhuBa), T_{13} (BDISOB126KhuBa), T_{14} (BDISOB135KhuBa), T_{15} (BDISOB138KhuBa), T_{16} (BDISOB142KhuBa), T_{17} (BDISOB146KhuBa), T_{18} (BDISOB205KhuDa), T_{19} (BDISOB219KhuDa), T_{20} (BDISOB221KhuDa).

Seed Priming and Exogenous Application of Abscisic Acid and Glycine Betaine Enhanced Drought Tolerance in Wheat at the Seedling Stage

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Abstract
Exogenous application of plant growth regulators and compatible solutes is an effective strategy to combat negative effects of drought stress in plants. A germination test and a hydroponic experiment were set following CRD with four replications to investigate the enhancement of drought stress in wheat by seed priming and exogenous application of abscisic acid (ABA) and glycine betaine (GB). In germination test, the seeds of three wheat cultivars (WMRI-1, BARI Gom-33 and BARI Gom-21) were primed with ABA (10 and 20 µM) and GB (50 and 100 mM) and established in control and

drought (10% PEG) conditions. In hydroponic culture, the seedlings were raised in four growth conditions such as i) Control, ii) Drought (10% PEG), iii) Drought + ABA 20 µM and iv) Drought + GB 50 mM. In all cultivars, seed priming with both ABA and GB under drought conditions significantly increased root and shoot length, root and shoot fresh and dry weight in comparison to the other treatments. Seed priming with 20 µM ABA and 50 mM GB performed better in relation to seedling growth compared to the other levels applied. The hydroponic results revealed that the plant height, biomass and leaf chlorophyll contents were significantly declined in drought with or without ABA and GB. However, the values were significantly higher in ABA and GB treatments compared to sole drought condition. The lipid peroxidation, proline content and total antioxidant capacity in root and leaf were significantly higher in drought condition followed by drought + ABA/GB and control treatments. The heatmap using stress tolerance index (STI) indicated that the exogenous application of ABA and GB enhanced drought stress in three wheat cultivars by increasing plant height and biomass, restoring chlorophyll contents and by reducing oxidative damage with increased activities of antioxidants.

Biofortification of Wheat Grain with Zinc Through Foliar and Root Application

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Abstract

Zinc (Zn) deficiency in human health is a widespread global health burden especially in developing countries like Bangladesh. Unfortunately, the potential of agriculture system to supply nutritious food to overcome micronutrient malnutrition (hidden hunger) for human health has received little attention than the common malnutrition and related issues such as calorie intake, food demand, crop yield and environmental sustainability. Different interventions could be used to overcome malnutrition, but biofortification is most impactful, convenient, sustainable and acceptable. Wheat is one of the major crops grown and consumed in Bangladesh which could prevalent Zn malnutrition; therefore, this is suitable target for Zn biofortification. Zn biofortification of wheat could be achieved through agronomic approach as soils in Bangladesh are deficit of Zn. Two wheat varieties such as BARI Gom-32 and BARI Gom-33 were grown with four Zn treatments including nil Zn (control), root Zn application, foliar Zn application and root+foliar Zn application in a RCBD with three replications. The root Zn application treatment consisted of 50 kg $ZnSO4{\cdot}7H2O\ ha^{-1}$, incorporated into soil before seed sowing. The foliar Zn application treatment consisted of two times of foliar Zn application at the heading and milk stages. At each time of foliar Zn application, 0.5 % (w/v) aqueous solution of $ZnSO4{\cdot}7H2O$ with 800 litre per hectare. Root+foliar Zn application is the combination of root Zn application together with foliar Zn spray. Zn application in root or in foliage or apply in root plus foliar had no significant effect on the plant growth and yield of wheat crops. But Zn treatments increased zinc concentration in wheat grain as compared to nil Zn application in the order of: root+foliar Zn>foliar Zn>root Zn>nil Zn. Thus people's malnutrition can be reduced with providing wheat grain biofortified through foliar Zn apply in alone or combine with Zn apply in soil.

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Biofortification of Mungbean (*Vigna Radiata*) Grain with Zinc for Improved Nutrition to Malnourished People of Bangladesh

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Abstract
Nutrition of Bangladesh people is largely deficit in zinc (Zn) despite the Zn plays exclusively key role in human health. Mungbean (*Vigna radiata*) is cultivated throughout the country especially in the vast salinity prone coastal land in dry season when other crops are difficult to grow. However, its yield potential along with Zn content in grain is not achieved as marked due to wide spread deficiency of zinc in soil. Therefore an experiment was conducted in the Field Laboratory of the Department o Crop Botany, BAU to evaluate the four seed priming treatments viz. no priming (i.e. control), hydropriming (with deionozed water), two osmopriming like 0.01 M Zn and 0.05 M Zn solutions on the growth and yield, and grain Zn content of two varieties of mungbean e.g. BARI Mug-5 and BARI Mug-6. Mungbean seeds were soaked for 6 hours at room temperature with 1:5 seed to solution ratio in deionized water for hydropriming or aerated solution containing 0.01 M Zn and 0.05 M Zn for osmopriming. After 6 hours, seeds were removed from priming media and washed four times with ordinary tap water. The experiment was conducted during the *Kharif-I* season following the Randomized Complete Block Design with three replications. Data were collected on plant height, yield components, yield and Zn content of mungbean grain. Plant height, pod length, number of pod per plant and grain per pod, 1000-grain weight, and grain and stover yield significantly increased when the used (sown) mungbean seed primed with 0.01 M Zn solution followed by hydropriming while the 0.05 M Zn (seed) primed plants exhibited minimum performance. As compared to no priming, the crop grown with 0.01 M Zn priming solution enhanced 12 percent zinc content in grain followed by hydropriming about 8 percent.

Application of Zinc and Silicon Fertilizer: Influences on Yield and Nutritional Quality of Purple Rice in Rice (T Aman)–Rice (Boro) Cropping Pattern

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Abstract
The micronutrients are equally important as macronutrients although they are required in a minute quantity. Zinc (Zn) and silicon (Si) are important micronutrients for the healthy and competitive growth and yield of all cereals including rice in Asia. To explore the effect of Zn and Si on the growth and yield of rice, a two-factorial experiment with three rice cultivars, *viz*. Purple rice, Pahari rice, and Binadhan-7, and four fertilizer treatments, *viz*. T_0- ControL (recommended dose of fertilizers; RDF), T_1- RDF + 6 kg ha^{-1} $ZnSO_4$, T_2- RDF + 40 kg ha^{-1} $CaSiO_3$, and T_4- RDF + 60 kg ha^{-1} $CaSiO_3$ was conducted following randomized completely block design with three replications at the T. Aman season of 2021. The experiment was repeated in the Boro season 2021-2022 with the same fertilizer combinations and three rice cultivars *viz*. Purple rice, Pahari rice, and BRRI dhan28. Results revealed that the application of zinc and silicon significantly influenced the growth and yield of rice. Plant

height, flag leaf length and width, and panicle length were recorded maximum with the application of recommended fertilizer dose. The number of primary and secondary branches per panicle and filled grains (no.) per panicle were recorded maximum with the application of RDF + 6 kg ha^{-1} $ZnSO_4$. Thousand seed weight was recorded maximum with the application of RDF + 60 kg ha^{-1} $CaSiO_3$; although the seed yield and harvest index did not affect significantly. The grain yield followed the trend Binadhan-7>Pahari rice>Purple rice in T Aman season and BRRI dhan28>Purple rice>Pahari rice in Boro season. The nutritional quality of rice grains varied on fertilizer management and cropping seasons. The application of zinc (@6 kg ha^{-1} $ZnSO_4$) significantly improved the Fe content in grains of Purple and Pahari rice and the application of silicon (@60 kg ha^{-1} $CaSiO_3$) improved the Zn concentration in grains of BRRI dhan28. Both Zn and P contents of grains were higher in the Boro season compared to those of the T. Aman season.

Popularization of Short Duration Varieties for Safer Boro-Rice Production Escaping Flash Flood Damage in the Haor Areas of Kishoregonj

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Abstract

Haor wetlands have significant ecological importance and economic contribution to the country. The occurrence of flash floods during the months of late April-May in the haor districts is a common phenomenon every year due to the intrusion of upstream flood water from India and causes colossal yield loss (10-100%) of Boro-rice, the only rice crop available for haor communities. Thus, the recurring flash flood events have become a curse for the haor communities. The chief aim of the study is to popularize the transplanting of short-duration Boro-rice cultivars in such a time that those could be harvested within mid-April avoiding damage from a flash flood that occurs every year. Therefore, the experiments were conducted in the farmers' fields at Mithamoin and Gupdighi unions under Mithmoin Upazila (flash flood-prone areas) of Kishoregonj district during the Boro-season of 2021-22 with two short-duration (BINA dhan10 & BRRI dhan88) and one long-duration (BRR dhan92 as a check) Boro-rice cultivars for the safer Boro-rice harvest escaping damage from flash flood. The lifespan of the short-duration rice cultivars was 120-135 days and that of long-duration was >150 days. The selected farmers along with the concerned DAE personnel (AEO & AAO) were trained up about the technology through an inception workshop and then inputs for Boro-cultivation were distributed among the contacts farmers under the supervision of DAE personnel. Sprouted rice-seeds were sown on 19 November 2021 and the seedlings were transplanted on 26 December 2021. Results reveal that BINA dhan10 produced the tallest plants (109.25 cm) followed by BRRI dhan88 (91.5 cm). BRRI dhan92 produced the highest number of tillers per hill and grains per panicle. BRRI dhan88 was harvested on 8 April followed by BINA dhan10 on 18 April 2022 till then flash flood water did not inundate experimental sites although the Sunamgonj and Sylhet districts were severely flooded after 15 April 2022 and causes colossal damage to Boro-rice. Therefore the short-duration varieties *viz.* BRRI dhan88 followed by BINA dhan10 is preferable for Boro-rice cultivation in the haor region to escape flash flood. BRRI dhan92 gave the grain the highest yield (6.7 t ha^{-1}) which was higher than BRRI dhan88 (5.3t ha^{-1}) and BINA dhan10 (4.9t ha^{-1}). Our survey report reveals that about 82% farmers gave strong positive option for the cultivation of short duration varieties in the haor region to escape colossal damage from flash flood.

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Estimation of Potential Gaps to Climate-Smart Agricultural Practices in Vulnerable Coastal Region of Bangladesh

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Abstract
Due to slow onset climate change and extreme weathers coastal region of Bangladesh experiences multiple threats which along with dearth of appropriate technologies in agriculture and long-term poverty induced food insecurity. Although many technologies are recommended and released for the region through service providers but the achievement to sustainable development and food security didn't reach to the mark. Therefore the aim of the present study is to find out the potential barriers and gaps for adopting befitted climate-smart agricultural (CSA) practices that would ensure the agricultural production and sustainable food security in the region. The study is using a mix mode methodology that covers the collection of both secondary and primary data. Secondary data collected from literature include the CSA practices that would enhance the production in the said climate-stressed areas. Primary data include the qualitative information collected through focus group discussion with climate-stressed farmers and consulting official stakes working in agricultural development. A semi-structured questionnaire is developed for collecting quantitative primary data from the farmers. Important agricultural practices or possible options needed for ensuring the three CSA-pillars like productivity, adaptation and mitigation in favour of food security and sustainable development are charged to a possible maximum extent in the questionnaire. Farmer's climate change perception and delivery of agro-met and agro-advisory information from service providers have also been considered in primary data collection. In the preliminary stage of the study, the agricultural options or technologies in line with CSA principle suitable in the climate-stressed coastal region have been collected through literature survey and stakeholder consultation. Many befitted technologies potentials to maximize the utilization of natural resources in the areas for better productivity have been categorized. Collection of primary data from climate-vulnerable farmers through questionnaire survey and other methods is going on, and the result will be reported in due course.

Evaluation of Sunflower Genotypes for Drought Tolerance Based on Morpho-Physiological and Biochemical Traits

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Abstract
Drought stress has become a key challenge acting as a crop production limiting factor in the climate changing scenario. Sunflower has the capability to survive under stress condition than other oilseed crops to some extent, but it is sensitive to drought stress from flowering to grain filling stage due to inadequate availability of soil moisture. Therefore, this study was undertaken to screen six sunflower genotypes for drought tolerance based on morphological, physiological, and biochemical traits. To fulfill this purpose, two experiments were conducted in the Plant Physiology Laboratory and Net House of Department of Crop Botany, Bangladesh Agricultural University, Mymensingh. Firstly, a germination test was done with six sunflower genotypes under three drought levels (Polyethylene glycol induced); 0 % PEG (control), 10 % PEG and 20 % PEG. Based on the performances of germination, vigor index and morphological traits, four genotypes were

selected for seedling growth study in pot culture under four drought levels (100 % FC, 80 % FC, 60 % FC and 40 % FC). Tolerant genotypes exhibited minimum relative reduction of morpho-physiological properties and increased value of leaf proline content compared to sensitive ones, at vegetative stage under drought stress. Among the genotypes, Hysun 33 was found drought tolerant while Big sunflower appeared as drought sensitive based on morphological and physiological attributes. The effect of drought stress on number of filled seeds per head, number of sterile seeds per head, weight of total seeds per flower head, weight of 1000 seeds were significantly varied in all sunflower genotypes. Thus, based on yield attributes Hysun 33 was drought tolerant genotype among the genotypes. Moreover, further study is needed to evaluate the potential genotype in the field condition, especially in the drought prone areas in Bangladesh for their adaptability to grow.

Evaluation of Profitable and Agro-Ecologically Suitable Cropping Pattern Considering Soil Fertility for Increasing Cropping Intensity in Northern Region of Bangladesh

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Abstract

Increasing cropping intensity in rice-based cropping system is very important for food security, poverty alleviation and livelihood improvement. The main challenge is to produce more food in limited area and the most important option is to increase cropping intensity by producing three or more crops over the same piece of land in a year maintaining soil fertility. To develop agro-ecologically suitable and profitable intensive cropping pattern with proper fertilizer combinations for increasing productivity and farmers income, the project is continuing in the farmer's fields of Rangpur and Bogura district. The first year (2020-21) project activities were completed to evaluate "Evaluation of agro-ecologically suitable and profitable cropping pattern for increasing cropping intensity at different locations". The trial was carried out in RCBD design with three dispersed replications. A total of 12 farmers were involved with the four different types of cropping pattern related trials. Three promising alternative cropping patterns (CP) were selected against existing cropping pattern i.e. CP0 (existing) = Boro rice (BRRI dhan28)-Fallow-T. Aman rice (Swarna); CP1= Mustard (BARI Sarisha-14)-Mungbean (BARI Mung-6)-T. Aus (BRRI dhan48)-T. Aman (BRRI dhan75); CP2= Potato (BARI Alu-25)-Maize (Kaveri)-Sesbania (Local)- T. Aman (BRRI dhan75); CP3= Potato (BARI Alu-25)/Sweet gourd (Sweety)-Jute (BJRI Toshapat-8)-T. Aman (BRRI dhan75). From the first-year trial, it was found that in Boro rice-Fallow-T. Aman rice (CP0) cropping pattern, the whole pattern rice equivalent yield (REY) was 14.10 t ha-1. In case of Mustard-Mungbean-T. Aus-T. Aman (CP1) cropping pattern, the REY was 18.65 t ha-1, which was 32.27% higher than existing pattern CP0. The alternative pattern CP1 was found 4.71% less efficient than existing cropping pattern CP0. The alternative cropping pattern CP1 used the land for 88.77% time of the year, whereas farmers existing pattern CP0 used the land for 63.84% time of the year. The whole pattern gross margin was higher in alternative pattern CP1 (Tk. 209790 ha-1) than existing pattern CP0 (Tk. 157550 ha-1). The MBCR was 2.07 in CP1 over existing pattern. In case of Potato-Maize-Sesbania-T. Aman (CP2) cropping pattern, the REY was 29.73 t ha-1, which was 110.85% higher than existing pattern CP0. Maximum production efficiency (86.67 kg ha-1day-1) was obtained from CP2. The alternative pattern CP2 was found 43.21% more efficient than existing cropping pattern CP0. Land use efficiency indicated that

CP2 used the land for 93.97% time of the year. The whole pattern gross margin was higher in CP2 (Tk. 382460 ha-1) than existing pattern CP0. The MBCR was 2.89 in CP2 over existing pattern CP0. In case of Potato / Sweet gourd-Jute-T. Aman (CP3) cropping pattern, the whole pattern rice equivalent yield was 33.46 t ha-1, which was 137.31% higher than existing pattern CP0. Maximum production efficiency (100.79 kg ha-1day-1) was obtained from CP3 compared to CP0. The alternative pattern CP3 was found 66.54% more efficient than existing cropping pattern CP0. Land use efficiency indicated that CP3 used the land for 90.96% time of the year. The whole pattern gross margin was higher in CP3 (Tk. 445459 ha-1) than existing pattern CP0 (Tk. 157550 ha-1). The MBCR was 3.09 in CP3 over existing pattern. Finally, it was observed that Potato / Sweet gourd-Jute-T. Aman and Potato-Maize-Sesbania-T. Aman cropping pattern are more profitable and suitable than other tested pattern and these were selected for next year trial.

Production Potentials of Maize Germplasms for Drought Tolerance in the Northern Charland of Bangladesh

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Abstract
Charlands are highly dynamic, and no systemic crop cultivation is practiced in this area due to unavailability of seeds of early & short duration drought tolerant crop varieties. Scarcity of water is a severe environmental constraint to plant productivity. Drought-induced loss in crop yield probably exceeds losses from all other causes, since both the severity and duration of the stress are critical. For this, it is necessary to find out short duration drought tolerant crops varieties for charland areas. Drought stress severely affects the growth of maize. An experiment was carried out at the Plant Physiology Laboratory of Department of Crop Botany, Bangladesh Agricultural University, Mymensingh from May to June, 2022 to investigate the morpho-physiological and biochemical traits of seven varieties of maize under two phases of drought stress at early vegetative stage during hydroponic experiment with Polyethylene Glycol (PEG). Complete Randomized Design (CRD) was followed for the experiment with four replications during hydroponic state. At 21 DAS of hydroponic experiment, different morpho-physiological and biochemical parameters such as root length, shoot length, plant height, root fresh weight, shoot fresh weight, total fresh weight, root dry weight, shoot dry weight, total dry weight, root shoot ratio, relative water content, relative greenness (SPAD), photosynthesis, transpiration, stomatal conductance, chlorophyll content, carotenoids content, proline content and total antioxidant capacity were studied. The effects of drought stress on all morphological, physiological and biochemical parameters were significant in all maize genotypes. Thus, based on overall observation it might be suggested that NK-40, BHM-9 and BWMRI-1 showed better performance in morpho- physiological parameters in drought stress condition at early vegetative stage. In case of biochemical traits, NK-40, Dekalb-981 and BHM-9 showed better performance. NK-40 and BHM-9 showed improved tolerance in almost all studied parameters whereas Kanak exhibited sensitivity to drought stress in all the studied parameters.

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Effect of Auxin-Transport-Inhibitor and Defoliation on Wood Biomass Formation in Hardwood Trees

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Abstract
Environmental factors and endogenous components of trees interact to influence the formation of wood. Endogenous components such as auxin, plays an important role on wood biomass formation. Auxin is produced in young needles and/or elongating shoots and is transported basipetally to the cambium. It appears to be an essential stimulant of cambial cell division and the formation of xylem cells. In this study, cambial growth such as initiation of new cell plates in the cambium, pattern of cell division and xylem differentiation, number of layers of fusiform cambial cells, layers of expanding xylem cells and mature xylem cells were investigated and compared the results within control, NPA treated and defoliated seedlings. Removal of apical sources and inhibition of the supply of IAA to the cambium decreases levels of IAA in cambial regions. Decreases in levels of IAA in cambial regions are associated with the inhibition of cambial activity and xylem differentiation. In addition, auxin-transport inhibitors, such as N-(1-naphthyl) phthalamic acid (NPA), inhibit the polar transport of auxin and drastically decrease xylem production below the corresponding treated portions of hardwood stems. Moreover, the application of NPA on the stem inhibits the formation of wood in hardwood trees**.** A supply of adequate auxin and an increase in levels of auxin in cambial regions, via polar transport from buds and leaves, might increase wood biomass production as well as wood quality and quantity.

Cellular Mechanisms and Anatomical Adaptations of Major Crop in Coastal area of Bangladesh-Focusing Salinity Stress

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Abstract
Salinity is one of the major environmental stresses limiting crop production in many parts of the world. Every year saline affected area is increasing in an alarming rate due to the inundation by salinization from the sea in the southern part of the country. Salinity stress involves changes in various physiological, anatomical and metabolic processes, depending on severity and duration of the stress and ultimately inhibits crop production. However, few information available on salinity stress in relation with the cellular mechanism of crop adaptation. The present results of anatomical traits showed that cell wall thickness of xylem vessel was increased in saline tolerant maize and sorghum genotypes. Reduced vessel diameter of maize roots in response to saline, with the reduction proportional to the severity of the salinity and greater reduction was observed under more severe saline condition. Interestingly, the saline-resistant genotypes showed smaller xylem vessel diameters than saline susceptible ones when grown under the severe saline condition. The results suggested that the response of maize and sorghum genotypes to salinity stress showed same anatomical traits. Therefore, it is very important to investigate the adaptation mechanism of coastal crop plants at cellular level under saline condition.

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Do Mild Drought and Salinity have an Effect on Lamiaceae Plant Growth?

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Abstract
Plant reactions to salt and drought stress are quite similar since both induce yield loss due to lower water potential. However, a very mild drought and salinity may not necessarily always reduce plant masses significantly, and in some situations may instead accelerate plant development. This study investigated the effects of mild drought and salinity on the growth of plants. A two-factor completely randomized design was followed to execute an experiment from June 2022 to December 2022 in which the total treatment combination was 18 [6 (plant species) × 3 (stress elicitors)]. In four replicates, 72 (18 × 4) number of pots were housed in the pothouse of the Department of Crop Botany, BAU. Six different species of Lamiaceae family namely, *Ocimum basilicum* var. *thyrsiflora*, *Hyptis suaveolens* (L.), *Ocimum tenuiflorum, Ocimum americanum,* and two morphotypes *of Ocimum basilicum (L.)* were cultivated. In the salt treatment, NaCl was applied to reach the mild salinity (EC 4 dS m^{-1}) at day 30. Control and moderate drought were maintained at 60% and 90% of field capacity, respectively. In all cases, plants were harvested after three months of growth. Six different Lamiaceae species had fresh shoot masses ranging from 21.5 to 71.6 g $plant^{-1}$, 12.3 to 57.1 g $plant^{-1}$, and 11.60 to 131.4 g $plant^{-1}$ under control, drought, and salinity conditions, respectively. In contrast, the shoot dry weight of six distinct species varied between 7.83 and 15.0 g $plant^{-1}$, 6.6 and 28.8 g $plant^{-1}$ and 3.9 and 29.6 g $plant^{-1}$ under control, drought, and salinity conditions, respectively. Plant height under control, drought, and salinity ranged from 88.4 to 107.5 cm, 66 to 125.7 cm, and 53.5 to 157.7 cm, respectively. Plant responses to mild drought and salinity vary between species in Lamiaceae.

Nutritional Profile of Quinoa (*Chenopodium quinoa*)

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Abstract
Quinoa (*Chenopodium quinoa* Willd.) is a member of Amaranthaceae, rich in protein, vitamins, minerals and phytochemicals of health benefits. Its uses include seeds as soup, ground flour in bakery products, leaf and tops as vegetables, and sprouts as salad. Quinoa is being sold as superfood in the supermarket of Europe, north-America and Middle-east. Published information regarding nutritional profile of quinoa is scanty in Bangladesh. Hence, research was aimed at investigating proximate compositions and mineral contents of leaf, seed and sprout in the four quinoa genotypes (G1, G2, G3 and G4). Seeds of the four genotypes (4 treatments) of quinoa were sown in the field following Randomized Complete Block Design with three replications. Seeds were sown on 15 November, 2019 using 25cm x 15cm spacing and were harvested on 25 February, 2020. Standard protocols were followed for quinoa cultivation. For chemical analyses, Completely Randomized Design was followed with four treatments (4 genotypes). Plant parts were analyzed following AOAC guidelines. Results revealed that significant differences among the four genotypes existed for total fresh biomass and seed yields and were higher in G4 (2208.33 and 636.66 kg/ha, respectively) than in the G1 (1208.33 and 336 kg/ha, respectively). In respect of proximate composition, leaves had higher crude protein

(18.74%) and ash (18.22%) in G1, crude fibre (10.66%) in G4. In sprout, crude protein, fibre and fat were greater in G4 (13.55, 6.48 and 7.32%, respectively). In case of mineral nutrient content of seed, P, K and Ca were higher in G3 (0.31%, 0.52% and 513.00 ppm, respectively); Fe was higher in G2 (411.13 ppm). In sprout, P, Ca and Fe were higher in G3 (3290, 1715.33, and 145.73 ppm, respectively). It might be concluded that the genotype G4 appeared better in terms nutritional composition.

Selection of Coloured Rice Genotypes Based on Morphological Traits, Phenology and Yield

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Abstract
Recently, coloured rice (*Oryza sativa* L.) is becoming increasingly popular due to its uses as a functional food and nutritional and health benefits. Scanty information exists, in Bangladesh, on the morphological, phenological and yield forming descriptors in coloured rice required for the selection of the genotypes. A survey was conducted to collect coloured-grain rice germplasms from different parts of Bangladesh for subsequent selection for further studies. Thirty-three rice genotypes /cultivars with endosperm of brown, red and black grain were collected from the different regions of Bangladesh using a semi structure questionnaire. Thirty-three rice genotypes (33 coloured including two white-grain control) were grown in pots and processed during 13 April-December 2021 following CRD with three replications using standard cultural protocols. Plant height, phenological data (flowering and maturity time), leaf and tiller numbers, biomass and paddy yield and yield attributes plant^{-1} basis were recorded. Data were analyzed using Minitab and means are adjudged by DMRT. Results revealed that wide variations in spikelet and seed colour, hairiness on spikelet, and grain size (length, width & their ratios) existed among rice genotypes. Canopy trait (plant height & tiller production), flag leaf size (length & width) and phenology (days to flowering) also varied significantly among the genotypes. The magnitude of yield traits, *viz*., panicle size, inflorescence branching, spikelet production and seed size varied to a good extent. Based on colour of spikelet & grain, and magnitude of 1000-seed weight, and biomass & grain yields hill^{-1}, eleven *viz*., 5 black, 4 red and 2 white-grain rice genotypes were selected for the subsequent detail experimentations.

Phyto-Fabricated Silver Nanoparticles: A Noble Technique Enhances Vase Life of Commercially Cultivated Gerbera

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Abstract
Phyto-fabricated nanoparticles decrease post-harvest wastage i.e. vase life of cut flowers. The vase life of cut flowers depends on microbial proliferation in vase solution and vascular occlusion as well. In this experiment, phyto-fabricated silver nanoparticles (AgNPs) were used to find out a novel preservative solution to extend the vase life and reduce the vascular occlusion of gerbera (Gerbera hybrida). The formation of phyto-fabricated AgNPs was characterized by means of visual observation, UV–Vis, FTIR techniques, and SEM. After bio-reduction of Ag+, a signatory color of AgNPs was developed and it was further characterized by UV–Vis spectrophotometer. In addition, FTIR data

confirmed the presence of both bio-reducing and capping agents in the leaf extract. Enhancement of the vase life of cut flowers by applying plant-based AgNPs has been a hot spot in postharvest flower physiology recently. Silver nanoparticles (5, 10, 20 ppm) and silver nitrate 10 ppm were used in the four treatments compared with the control (only distilled water) arranged in a complete randomized design with 3 replicates. The vase life was observed daily. Relative fresh weight, water uptake, stem chlorophyll contents, petals anthocyanin contents, flower head diameter, and microscopy assessments of vascular occlusion were also measured. Silver NPs (5ppm) inhibited microbial growth in the vase solution thus reducing vascular occlusion and the vase life of gerbera extended up to 18 days while the control caused senescence and early wilting of flower in almost 11 days.

Expression Profiling of Drought Responsive Genes of Potato under *in Vitro* Drought Stress

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Abstract
Drought is the most significant abiotic stress which hinders potato production in most of the countries of the world. Cultivation of drought tolerant potato cultivar is one of the effective solutions for increasing potato yield in drought prone areas. *In vitro* screening followed by molecular confirmation is an effective way to identify drought tolerant potato germplasms. This study was designed for three years time schedule with the objectives to identify drought tolerant potato germplasms based on *in vitro* study, gene expression analysis and *ex vitro* study under greenhouse condition. Five potato germplasms such as BARI Alu 17 (Raja, drought tolerant), Asterix (drought susceptible), sada pakri, kufrisinduri and jhau alu was used to initiate the in vitro screening experiment. BARI Alu 17 were used as positive control and Asterix were used as negative control. From different experiments of the first year, *in vitro* response on different growth parameters of five germplasms of potato were observed. At this moment, *in vitro* regenerated plantlets are maintaining at different stress level of drought for expression analysis of drought responsive genes. The dehydrin gene *TAS14*, an Ethylene Responsive Transcription Coactivator *ER24*, A master regulator for drought response *NF-YC4* gene, the genes for the enzyme families invertases *STIN6* and *STIN8* along with Sucrose synthase *SUS3* have been reported to be associated with drought responses. Their expression level may therefore signify the capability of the crop to retain its productivity when subjected to drought stress. The expression analysis data and data from field experiment will be presented in the upcoming years.

Biological Nitrification Inhibition (BNI) Potential of Sorghum Root Exudates for Enhancing Nitrogen Use Efficiency in Rice Production System

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Abstract
The irrational use of nitrogenous fertilizers in agricultural systems has generated a negative impact on the environment since around 70% of these fertilizers are lost due to nitrification and associated

processes. Regulation of nitrification could be a key strategy to improve N-recovery and agronomic nitrogen use efficiency of crops. The studies were made with the emphasis to investigate the impacts of sorghum root exudates for exploiting the biological nitrification inhibition (BNI) function to slow down the soil nitrification process to improve the nitrogen use efficiency in rice cropping system. To accomplish these purposes, two experiments were conducted in the Field Laboratory of Department of Crop Botany, Bangladesh Agricultural University, Mymensingh both in pot culture and field conditions. Rice (BRRI dhan28) were grown in the *boro* season following the standard means of cultural operations. Root exudates of hydroponically grown sorghum were collected and applied during the three splits of urea application in rice. Therefore, five following treatments viz., T_0= No root exudates + No urea; T_1= Sorghum root exudates + 137.5 Kg Urea ha^{-1} (55% RD); T_2= Sorghum root exudates + 175 Kg Urea ha^{-1} (70% RD); T_3= Sorghum root exudates + 212.5 Kg Urea ha^{-1} (85% RD); T_4= 250 Kg Urea ha^{-1} (recommended dose, RD) were employed in a single-factor CRD design. In both pot and field experiment, the novel natural nitrification inhibitors from sorghum root exudates enhanced the nitrogen use efficiency by improving yield and yield contributing characters of rice. The results also manifested that urea applied with reduced doses along biological nitrification inhibitors exhibited more apparent recovery efficiency than urea added alone and maintained statistically similar grain yield of rice. It can be concluded that sorghum root exudates have the enormous potentiality to increase nitrogen use efficiency in rice cropping system.

Phytofabrication, Characterization and Application of Silver Nanoparticles for Improving Vase Life of Cut Flower

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Abstract

Exploiting plant extracts to form metallic nanoparticles has been becoming the promising alternative routes of chemical and physical methods owing to environmentally friendly and abundantly renewable resources. In this study, the fruit of *Azadirachat indica*, *Areca catechu*, *Citrullus lanatus*, *Coffea arabica* and *Syzygium aromaticum*, leaves of *Adenanthera pavonina*, *Camellia sinensis*, *Momordica charantia*, *Terminaliabrellica*, *Prunus dulcis*, *Brassica rapa*, *Brassica juncea*, *Raphanus sativus*, *Murrayakoenigii* and *Acalypha hispida*, bulb of *Allium cepa* extracts were exploited to fabricate different kinds of biogenic silver nanoparticles. Then, the phytofabricated AgNPs were characterized by visual observation (color change), UV-Vis spectrophotometry and FTIR spectroscopy techniques. FTIR spectra indicate the presence of O-H, C=O,C-O-C and C=C groups on the surface of silver nanoparticles which is corresponded with three elements of C, O and H found in conformity test analysis. The current study revealed the ability of the tested plant extracts to convert Ag^+ to AgNPs. Interestingly, the phytofabricated AgNPs showed a strong antimicrobial activity in vase solution and vase life of cut roses extended up to 13 days. Microscopic investigation in the current study showed that stem blockage due to microbial colonization was evident at the cut end of the control (without AgNPs) that causes water transport barrier and early wilting of cut flowers/petals whilst AgNPs treated samples effectively inhibiting the microbial growth at the cut end of stem and improving water uptake and water balance of cut roses and enhancing vase lifespan over the control (without AgNPs). Finally, the innovation of the present study is that the phytosynthesis of AgNPs, which is simple, cost-effective, provides stable nano-materials, and can serve as a promising preservative to increase the ornamental value of cut flowers.

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A Systemic Study on the Genus *Kaempferia* L. (Zingiberaceae) and Addition of a New Taxon to Bangladesh Flora

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Abstract
The ginger family member Kaempferia L., a genus that has historically been used to treat a number of ailments, is receiving more commercial and academic interest. In addition to its ability to whiten skin, Kaempferia has antibacterial, anticancer, antidiabetic, cardioprotective, noninflammatory, and protective properties. Five species namely, Kaempferia angustifolia, K. galanga, K. parviflora, K. pulchra, and K. rotunda are found in Bangladesh Agricultural University Botanical Garden. The present study has been planned to systematically examine the morphological descriptors of each species and report K. pulchra as a new taxon to Bangladeshi flora. Each species is described in detail, including its origin and distribution, significant phenology, number of chromosomes, habitat, propagation methods, and economic and ethnobotanical uses. Coloured photographs of each species are provided as well.

Investigating Antioxidant and Ros Activity in Developing Spike of Wheat Under Drought Stress

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Abstract
Flag leaf in wheat and other cereal are thought to be main photosynthetic organ to contribute lion-share of photosynthates to grain. However, recent study found that growing spikes contributes more photosynthates to grain compared to flag leaf, especially in water deficit condition. In a recent investigation, anti-oxidant system for scavenging H_2O_2 found more in growing spikes compared to flag leaf. Considering the above knowledge in mind, an experiment has been set to investigate the anti-oxidant production and ROS activity in growing spike of wheat plants grown under drought stress. Experiment has been conducted at Growth Room of Plant Stress Breeding Laboratory, Dept. of Genetics and Plant Breeding, Bangladesh Agricultural University, Mymensingh. The experiment has been laid out in CRD with 5 replications. Drought stress has induced by maintaining 30% field capacity moisture in root zone by regulating the amount of irrigation. Wheat plants are planned to grow upto maturity. Upon panicle initiation, conc. of APX, CAT, POD, H_2O_2, MDA and Proline activity were measured in both flag leaf and growing panicles at different stages of development. It has found that significant differences were found between flag leaf and panicle of all ages for APX, CAT, POD, H_2O_2, MDA and Proline. Conc. of APX, CAT, POD and Proline has been always higher in growing spike of different ages compared to flag leaf. Conc. of H_2O_2 and MDA, which indicate presence of stress, has been found higher in flag leaf compared to spike of different ages. Conc. of biochemical substances were also found different for different ages of flag leaf and for growing spike as well. For instance, higher POD activity was found in flag leaf and spike during panicle initiation. But for H_2O_2, higher activity was found in flag leaf during panicle initiation, and 25^{th} day older spike. Furthermore, higher MDA activity was found in 25^{th} day older flag and spike. For proline, higher activity was found in flag leaf during panicle initiation and spike at 25^{th} day old age. Interestingly, for APX and CAT, no significant differences were found at different ages of flag leaf and spike. It is

therefore, can be concluded that, flag affected more but spike synthesizes more anti-oxidant and ROS scavengers under drought stress and synthesis rate of anti-oxidant & ROS vary with the developmental ages of flag leaf and spike. The findings can be helpful for breeders to plan a breeding program for improving drought tolerance in cereal.

Seed Production and Dissemination of Abiotic Stress Tolerant Rice Varieties to the Farming Community of Rural Bangladesh

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Abstract
Rice production in Bangladesh has been affected by various abiotic and biotic stresses, of which abiotic stresses like drought, salinity, cold and flood has been the most significant in recent years. Effect of abiotic stresses on rice yield varies based on the stages of stress induction. Farmers of Bangladesh are seriously devoted to rice cultivation; however, due to outbreak of severe abiotic stresses, they often become puzzled to choose the best variety suitable to grow in their location. Also, supply of quality seed for a said variety has been always gruesome. Therefore, attempt has been made to recommend best drought, cold, submergence and salt tolerant rice variety by growing the varieties in farmers own field, as well as to develop a supply chain of quality seed among neighboring farmers. Climate smart rice varieties of T. aman and Boro rice, BAU dhan3 & BRRI dhan69 (cold tolerant), BRRI dhan66 & BRRI dhan71 (drought tolerant), BRRI dhan97 and BRRI dhan99 (salt tolerant), BRRI dhan79 & Binadhan-12 (submergence tolerant) has been selected for production and dissemination at farmers field. Fifty farmers from each three upazillas of Mymensingh district *viz*., Sadar, Haluaghat and Gouripur has been selected for the project. Five kg of each climate smart rice seed per bigha land were given to the selected. Besides, fertilizers and other inputs were distributed free of cost from the project as support. Plants were grown following recommended agronomic practices. Based on field performances, farmers selected BAU dhan3 as cold tolerant, BRRI dhan99 as salt tolerant, BRRI dhan79 and Binadhan-12 as submergence tolerant and BRRI dhan83 as drought tolerant rice varieties for cultivation. Besides, farmers formed their own seed supply chain for the rice varieties they have found as better performer and ready to share with neighboring farmers.

Distribution of Minikits of Salt Tolerant Rapeseed and Mustard Varieties BAU Sharisha-1, BAU Sharisha-2 and BAU Sharisha-3 in Salt-affected Coastal Regions of Bangladesh

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Abstract
Rapeseed and mustard are the indigenous oilseed species in our country. Bangladesh currently produces about 0.35 million tons of *Brassica* oilseeds from 0.31 million ha of land area that can only meet about one-fifth of total domestic demand. That leaves Bangladesh a huge gap in domestic demand in edible oils and total mustard seeds. In Bangladesh about 11.1% of the total cultivable land of the country is affected by salinity to a varying degree. Bangladesh Agricultural University has recently developed three mustard varieties BAU Sharisha-1, 2 and 3, as a successful output of a KGF-funded project, those can tolerate up to 12 dSm^{-1} salinity level. These three varieties have average yield

ranging between 2.0 and 2.5 t ha^{-1} that is 35-40% higher than BARI Sarisha-14. Growth duration of these varieties ranges between 82 and 85 days, oil content is approximately 40%. Introduction and dissemination of these varieties in coastal regions of Bangladesh can increase total oilseed production in Bangladesh and can save our currency that is being spent to import soybean and palm oils. This project distributed minikits of three recently developed varieties to coastal regions of Bangladesh among 132 farmers of 16 upazilas of 5 districts of two divisions of coastal regions of Bangladesh. Yield of the varieties varied in different locations. Severe salinity stress in Dacope upazila of Khulna District affected yield greatly. In several upazilas such as Dumuria, Kolaroa, Tala, Borhanuddin etc. yield of BAU Sharisha-1, 2 and 3 was satisfactory despite salinity stress and submergence for 3 to 4 days due to cyclone 'Jawad'.

Morpho-Molecular Identification and Characterization of Blast Fungus Avirulence (AVR) and Their Corresponding Resistance (R) Genes for Developing Blast Resistance Rice Cultivars

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Abstract
The blast (*Magnaporthe oryzae*) resistance (*R*) gene is the most effective and environmental method to control rice blast disease. This experiment was designed for molecular characterization of *M. oryzae* avirulence (*AVR*) and their corresponding *R* genes in blast fungus isolates and in rice accessions, respectively. One hundred isolates of *M. oryzae* were collected and purified from blast infected rice panicles covering 20 districts of Bangladesh. Blast isolates were separated and morphologically characterized by isolating single spores. Isolate specific DNA was extracted from fungal hyphae of the isolates and were analyzed with polymerase chain reaction (PCR) using *AVR* gene specific primers. We detected *AVR-Pia*, *AVR-Pik*, *AVR-Pizt*, *AVR-Pib* and *AVR-Pi9* genes in more than 80% isolates. Molecular screening of major rice blast resistance genes was determined with molecular markers and found 4 major rice blast resistance genes; *Pi-d2*, *Piz-t*, *Pi-9* and *Pi-ta2*, in 80 accessions of rice cultivars. The natural field evaluation analysis showed none of the 80 rice accessions were completely resistant to rice blast, because most of the accessions had only one or two resistance genes. Therefore, we suggested to pyramiding the identified 4 resistance genes in a common rice elite cultivar for ensure complete resistant against blast disease. These results are useful in identification and incorporation of functional resistance genes from evaluated rice accessions into elite cultivars through marker-assisted selection for improved blast resistance.

Molecular Breeding of Soybean for Drought Tolerance and Quality Protein Approaches

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Abstract
Different plants response differently to drought stress. Abiotic stresses such as drought induced diverse physiological and molecular responses in plants. These responses include changes in gene expression.

One of drought tolerance gene is a gene encoding dehydrin which belongs to the group II or *D*-11 *LEA* protein family. *LEA*-*D*11 gene produces dehydrin protein which has a role in stabilization of membrane structures and protection of macromolecules in the presence of drought. Identification and characterization of drought tolerant gene for developing molecular marker and selecting genetic variation in plants are very useful. The aim of the study was to identify and to characterize soybean genotypes using *Lea* gene specific primers through PCR based detection technique as well as spectrophotometry for the soybean protein quality. Subsequent breeding programs through repeated backcrossing and recurrent selection will be very helpful for rapid generation advancement (RGA) and for varietal release of soybean. The genotypes Shohag, SBM-09, Binasoybean-6, PK-416 and YESOY-4 might be drought stress tolerant as they have low yield reduction (<35%) and low protein degradation. The genotypes G-10180 and Binasoybean-1 were the most susceptible as calculated higher yield reduction (>85%) under drought stress.

Differential Gene Responsiveness in Soybean for Drought Tolerance and Protein Quality Assessment

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Abstract

Soybean genotypes responded differently when subjected to water stress conditions. The prime focus of the study was to identify tolerant genotypes against drought and to investigate physio-chemical defense mechanisms under drought and finally to assess their field performance by conducting yield trial. Only three accessions showed drought tolerant features and thereby, identified for drought tolerance which could be used as potential drought tolerant sources. This was supported by morphological characterization, physiological and biochemical mechanism, molecular marker analysis and field performance etc.Water stress exerted inhibitory effect on growth and yield of soybean genotypes and the reduction was less in tolerant genotypes than the susceptible ones.YESOY-4, PK-416, Shohag, Binasoybean-6 and SBM-09 were more water deficit tolerant than other as they exhibited low yield reduction (<35%) and the genotypes G-10180 and Binasoybean-1 was the most susceptible as higher yield reduction (>85%) by the water stress. The water stress tolerance mechanisms was better in the genotypes SBM-09, YESOY-4, and PK-416 than that of G-10180 and Binasoybean-1 were involved with the maintenance of high Relative Water Content, less chlorophyll degradation, less reduction of leaf area, high levels of proline and Malenaldehyde (MDA) accumulation under water stress conditions. The soybean genotypes SBM-09, PK-416 and YESOY-4 hold the GmLEA DII gene at the size of 700bp and the GmDREB2 gene at the size of 1000bp long. The DREB2 nucleotide sequence of the soybean genotypes PK-416, SBM-09 and YESOY-4 are closely related to the DREB2 nucleotide sequence of other 16 tested plants obtained from NCBI. So, DREB2 can be used as a molecular marker to select the drought tolerance plants. The drought tolerant genotypes SBM-09, PK-416 and YESOY-4 performed better in seed yield under field condition.

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Effect of Heat Stress on Level of Antioxidants and Carbohydrate Accumulation in Potato Tuber

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Abstract
Potato (*Solanum tuberosum* L.), grown in cool weather, is the most important globally cultivated tuber crop. However, worldwide potato production is being challenged by continuously increasing temperature stresses. Frequently rising winter temperature in Bangladesh is becoming a major limiting factor in potato production. To select and develop heat resistant potato varieties, understanding the biological basis of heat tolerance is necessary. ROS mediated biological basis of heat tolerance in potato tubers is not clearly understood. In this study we analyzed the level of two most important primary ROS members (superoxide and hydrogen peroxide) and their scavengers (SOD, APX, CAT, GPX and proline) to evaluate the tolerance level of five potato cultivars including heat resistant (BARI Alu 72, BARI alu 73) and most widely cultivated high yielding but susceptible varieties (Cardinal, Diamond, Astrix). Additionally, we also tried to explain the effect of heat stress and ROS on soluble and insoluble carbohydrates in potato tubers. The results indicate that ROS mediated heat resistance and yield of potato tubers depends on the genotype. The tolerant variety increase their resistance by several fold increase of antioxidant activity mostly related to H_2O_2 detoxification mechanism. Growth status of resistant varieties were comparatively less affected than the susceptible varieties. However, yields of all varieties were reduced significantly. Nevertheless, the effect of heat stress on starch and amylopectin content was insignificant for resistant varieties although the amylose content was significantly reduced. The salt resistant varieties also showed resistance for high temperature stress. The results of this study will be used to select these varieties for further breeding programs of genetic improvement.

Selection of Root Traits and Tolerant Genotypes of Soybean (*Glycine max L.*) under Salinity Stress

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Abstract
Soybean is an oilseed crop with diversified uses. Despite a huge domestic demand, Bangladesh can produce a small amount of soybean due to a lack of high yielding and stress tolerant varieties. In this study, we explored the effects of salinity stress under hydroponic culture on germination, shoot and lateral growth of roots of 13 soybean genotypes under three treatments—0 mM, 50 mM, and 100 mM NaCl following a completely randomized design (CRD). The effects of salinity stress were recorded on germination, seedling, shoot, root, pod traits and also biochemical properties. Reduced percent germination (6.5%), shoot length (65.7%), root length (31.1%), plant height (18.8%), number of trifoliate (46.5%), chlorophyll content (33.7%), shoot dry weight (47.9%), pod length (13.9%), and thousand seed weight (29.2%) are the examples of the traits that showed significant differences among the genotypes under saline treatments. The number of lateral roots greatly increased (30.6%) under salinity stress while the dry weight of the roots reduced by 37.3%. Salinity stress also considerably

changed the biochemical parameters by raising the quantity of proline (292%), hydrogen peroxide (55.8%) and peroxidase (82.4%). The correlation analysis showed a positive association among the biochemical parameters like proline, peroxidase, hydrogen peroxide etc. Genetic analyses along with PCA revealed that secondary lateral root diameter, root dry weight and peroxidase had high heritability with high genetic advance and thus, these traits could be suitable indicators of salinity stress tolerance. The genotypes Lokon, H1H5-W1H5, MTD-176, MTD-6, Bragg, and BINA Soybean-02 were found to be the most suited salinity resistant genotypes. The results of this study could be used to support future research on the development of salt stress tolerant soybean varieties and the discovery of saline stress tolerant QTL in soybean.

Diallel Mating in Oilseed Brassica Genotypes to Select for Short Duration and Abiotic Stress Tolerant Lines from F_2 Population

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Abstract

Short duration oilseed *Brassica* varieties are important to increase cropping intensity as well as total oilseed production. Bangladesh Agricultural University has a considerable germplasm collection of rapeseed-mustard at the Department of Genetics and Plant Breeding. In our previous study, we have selected short duration genotypes from the existing collection of germplasms. In this study, we have conducted a 5 x 5 diallel mating with a view to develop short duration segregating generations. Days to 50% flowering, plant height, total number of siliqua per plant, number of seeds per siliqua, length of siliqua and days to maturity were recorded in F_1. In this study, five advanced breeding lines of *Brassica napus* and their five selected hybrid lines were chosen to assess the genetic variation in their root traits under polyethylene glycol (PEG) induced osmotic stress. Two treatments—0% and 5% PEG—were imposed at 25 days old seedlings. PEG-induced osmotic stress significantly increased the length of main axis, first order lateral roots, second order lateral roots and root hairs. Root hair length, second order later roots and root dry weight accounted for more than 30% genotypic and phenotypic coefficient of variation and more than 60% broad-sense heritability. When the genotypes were assessed against salinity stress root hairs and lateral roots showed genotype-specific variations in salinity stress tolerance under 0 mMol and 100 mmol NaCl concentration. These traits were also found highly heritable. The results indicated that selection for length of fine roots and root dry weight under salinity and drought stress could be effective in developing tolerant rapeseed genotypes.

Development of Oilseed *Brassica* Genotypes Resistant to *Alternaria* Blight through Accelerated Genetic Gain

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Abstract

Mustard oil is the product of rapeseed and mustard, meets 21% oil consumption in Bangladesh. The genetic resources of rapeseed and mustard, belongs to genus oilseed *Brassica*, are indigenous resources of Bangladesh. Every year we spend million dollars of currency to import edible oils from foreign

countries. One of the major reasons of lower production of rapeseed and mustard is infection of a severe disease called the *Alternaria* blight caused by *Alternaria brassicae* and *A. brassicicola.* This disease cause severe infection at all plant parts including siliqua of the plants and that leads to upto 50% crop damage. By developing short duration and *Alternaria* blight resistant genotypes we can potentially increase at least 10% oilseed production domestically. This study initially screened 240 genotypes at the field conditions to assess their *Alternaria* blight resistance. This study also screened 50 selected oilseed *Brassica* genotypes in the laboratory condition. The laboratory screening was based on detached leaf infection. Spores of *Alternaria brassicicola* were isolated in V8 culture medium for the detached leaf infection. The spore concentration was adjusted to 10^7 spores per mL. The detached leaf infection identified five completely resistant genotypes. We screened five resistant and five susceptible genotypes using 20 gene-specific markers. Five out of 20 markers clearly separated the resistant and susceptible genotypes due to presence and absence of genomic DNA bands. In the second year we have grown 30 selected moderately resistant lines together, to induce further selection pressure.

Response of Morphological and Biochemical Traits of Maize Genotypes under Waterlogging Stress

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Abstract

Maize (*Zea mays* L.) is one of the most important cereal crops cultivated around the world. Waterlogging stress is a major production constraint of maize production in the rain-fed agricultural systems. The main objective of this experiment was to investigate the effect of continuous waterlogging on morphological and biochemical traits of maize genotypes at the vegetative stage. Ten maize genotypes were treated under no waterlogging (control) and continuous waterlogging of five centimeters depth for 10 days. The treatments were applied to the plants at their 45 days of age. Visual leaf injury scores from Leaf 4 (youngest leaf is the reference point) to Leaf 7 separated tolerant and susceptible genotypes. Waterlogging stress significantly reduced total number of live lives and chlorophyll content in leaf tissues in susceptible genotypes. Anatomical study revealed that tolerant maize genotypes produce large number of aerenchyma cells under waterlogging stress compared to susceptible genotypes. The enzymatic activities of ascorbate peroxidase (APX) and peroxidase (POD) exhibited greater increase in tolerant genotypes than susceptible genotypes whereas the contents of reactive oxygen species (H_2O_2) greatly increased in susceptible genotypes than tolerant genotypes under waterlogging stress compared to control. Principal component 2 (PC2) indicated that increasing plant height in the genotypes BHM-14, BHM-13 and BHM-9 was associated with waterlogging tolerance. The findings of this experiment will add value to maize breeding to screen out maize genotypes for waterlogging stress tolerance.

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Development of Oilseed Brassica Genotypes Resistant to *Alternaria* Blight through Accelerated Genetic Gain

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Abstract
Alternaria blight is one of the major diseases of rapeseed and mustard in the Indian subcontinent, which is primarily caused by *Alternaria brassicae* and *A. brassicicola*. To reduce the severity of this disease, development of resistant genotype is the most suitable option. The objective of this study was to select *Alternaria* blight resistant genotypes from a large germplasm over a time period of three consecutive years with accelerated genetic gain and also to execute genetic analysis for yield and yield contributing traits. In this study, a total of 254, 40 and 21 morphologically diverse rapeseed and mustard genotypes were screened in field conditions in three consecutive years. Morphological and genetic analyses were conducted for disease score, yield and yield contributing traits. *Alternaria* blight symptoms appear in the leaves at 40 days after sowing (DAS). The frequency of infected genotypes gradually increased from 48 to76 DAS. None of the genotypes showed complete resistance in three years. Only 10 genotypes out of 254 showed moderate resistance in the first year at 76 DAS. In the second and third year, the number of resistant genotypes increased with higher genetic gain when 40 and 21 selected genotypes respectively were grown; and their resistance was assessed at the same DAS. Yield plant^{-1} was increased with increasing days to maturity and decreasing disease severity. Genetic analysis showed that the traits — days to first flowering, days to 50% flowering, and weight of thousand seeds were highly heritable. As the progeny of selected genotypes showed greater resistance against *Alternaria* blight therefore accelerating genetic gain could be possible by increasing selection pressure. The pattern of infection in different genotypes on temporal dimension indicated that resistance to *Alternaria* blight is polygenic in nature.

Research and Development of Biofortified Sweetpotato and Potato for Bangladesh and South Asia - The International Potato Center (CIP)

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Abstract
Genotypic instability of newly developed genotypes is a major limiting factor in plant breeding program for a variety development. Multi-environmental yield trial is obvious for assessing the yield stability across environments before recommending a variety for cultivation at commercial scale in a new environmental location. However, the study on morpho-physiological characterization coupled with G x E interaction of available sweet potato varieties in Bangladesh is limited. In this study, we have characterized the 22 sweet potato genotypes based on morphology and yield components in two different locations and in two seasons. Additionally, the impact of genotype by environment interaction was analysed by Additive Main Effect and Multiplicative Interaction (AMMI) and genotype and genotype-by-environment (GGE) biplot analyses to evaluate their stability and

adaptability across the season and location to recommend the best high yielding, biofortified and short duration cultivars. The selected best yield performing two short-duration genotypes and one biofortified genotype showed sensitivity to both season and location. Highly stable genotypes are found to be low yielding but rich in vitamin A content. BAU Sweetpotato-5 and BARI Sweetpotato 12 were the two highest yielding varieties. High vegetative growth of the sweet potato genotypes grown under high rainfall is good for leaf production. Additionally, the result indicated that the number of economic tubers has a contribution to high yield.

Screening and Biochemical Responses of Tomato (*Lycopersicum Esculentum* L) Genotypes for Salt Tolerance

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Abstract
Tomato (*Lycopersicum esculentum*), is an important nutrition rich vegetable crops generally displays sensitivity to different levels of salinity. In this work, twenty one tomato accessions were hydroponically tested under controlled environmental condition for salt tolerance using 0, 8 and 12 dS/m salinity at seedling stage. All the plants were died after six days at 12 dS/m and data were collected for plants grown in control and 8 dS/m salinity condition. Analysis of variance revealed significant differences for genotypes, treatment and treatment-genotype interaction for both morphological and biochemical traits studied. Genotype T8 and BINA tomato 10 were performed relatively well under stress condition in terms of root/shoot length and weight, leaf area, chlorophyll content and % live leaves. TC0130-41-52-3-56-0-0 and Joint hybrid were considered as more vulnerable accessions. Average leaf injury score was also low in T8 and BINA tomato 10. Biochemical analyses using the selected genotypes shows, the tolerant accession has lower Na^+ concentration and also low Na^+/K^+ ratio, higher catalase (CAT) and ascorbate peroxidase (APX) activity, higher accumulation of hydrogen peroxide (H_2O_2), osmoprotectant; proline and ascorbic acid (AsA) compared to sensitive genotypes upon exposure to salinity stress, which might play important role in cellular protection during stress. Correlation study revealed the significant positive relationships among the studied biochemical traits and in principal component analysis, all the studied traits were reduced to one major component covering about 74.2% of total distinction. The results provide sources of potential genetic resources which can be further investigated to develop morphological and biochemical markers.

Characterization of Wheat Genotypes for Terminal Heat Stress Tolerance in Bangladesh

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Abstract
This study was aimed to determine the types and levels of variability, heritability, genetic progress, relationships between yield and the features that contribute to it, and some key indicators of terminal heat stress tolerance. Twenty different wheat genotypes were planted in the fields over the course of six different treatments spaced 10 days interval following a Randomized Complete Block Design with three replications. A high degree of significant variation was observed for all the characters studied.

Estimates of the genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) revealed that the phenotypic coefficient of variation was higher than the genotypic coefficient of variation, which indicates a large effect of environment on the expression of the characters studied. The highest estimates of PCV and GCV were observed for grain yield/plant followed by the number of tillers/plant. Heritability estimates revealed that characters like pollen fertility and sterility exhibited the highest heritability followed by days to maturity. The genetic advance was higher for grains/plants followed by plant height. Grain yield showed significant and positive phenotypic and genotypic correlations with grains/plant and 100-grain weight. Phenotypic path analysis revealed a significant direct positive effect of 100-grain weight on grain yield. Principal component analysis (PCA) revealed that the first five components having greater than one Eigenvalue contributed to 83.41% variability. The heat stress tolerance indices revealed that Bijoy and BARI Gom-25 had the lowest tolerance index (TOL), stress susceptibility index (SSI) values and highest yield susceptibility index (YSI) values which show more tolerance and less susceptibility to terminal heat stress and produced moderate grain yield under terminal heat stress. Balaka and Shughat had the highest mean productivity (MP), geometric mean productivity (GMP), and stress tolerance index (STI) values and produced high yields under terminal heat stress conditions.

Genetic Diversity Analysis and Screening of Wheat Genotypes for Peg Induced Osmotic Stress Tolerance at Seedling Stage

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Abstract

This study was aimed to determine the types and levels of variability, heritability, genetic progress, relationships between yield and the features that contribute to it, and also screen out the osmotic stress tolerant wheat genotypes at seedling stage. A high degree of significant variation was observed for all the characters studied. Estimates of the genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) revealed that the phenotypic coefficient of variation was higher than the genotypic coefficient of variation, which indicates a large effect of environment on the expression of the characters studied. The highest estimates of PCV and GCV were observed for grain yield/plant followed by 100-grain weight. Heritability estimates revealed that characters like plant height, 100-grain weight, yield/plant exhibited the highest heritability followed by awn length. The genetic advance was higher for number of grains/panicles followed by plant height. Grain yield showed significant and positive phenotypic and genotypic correlations with grains/plant and 100-grain weight. Thirty wheat genotypes were grouped into five clusters, having maximum number of genotypes in cluster 1. The inter-cluster distances were greater than the intra-cluster distances in most of the cases. Upon exposure to PEG induce osmotic stress Kheri and Gourav performed better for germination, Sebia for shoot length, D-141 for shoot fresh weight, PT-1 for highest shoot dry weight, K-9107 for root number, Gourav for root length, D-141 for root fresh weight, PT-1 for root dry weight, Kalyansona for shoot root ratio, K-9107 for leaf injury scoring. The genotypes Kheri, Kalyansona, Protiva, Kheri, Sebia had the highest evaluation score based on the overall performance under osmotic stress condition. These identified genotypes will be further used in breeding scheme to develop water stress tolerant wheat variety.

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Isolation and Morpho-physiological and Biochemical Characterization of Mungbean (*Vigna radiata* L.) Genotypes under Salt Stress

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Abstract

Mungbean is one of the major pulses in Bangladesh and is also an essential menu item in the food habits of Bangladeshi people. However, salt, which is becoming increasingly scarce in Bangladesh, is a major threat to mungbean production. Therefore, morphological characterization of mungbean germplasm has a significant effect on its contingent future use in breeding programs of mungbean to identify salt-tolerant mungbean genotypes. Considering this fact, three experiments were conducted to evaluate the performance of 35 mungbean genotypes, of which 30 genotypes were collected from the PRC, BARI, and the World Vegetable Center in India and 5 genotypes from BINA. The first experiment was conducted at the plant growth chamber, the Department of Genetics and Plant Breeding, BAU. The hydroponic culture technique was used for screening salt tolerance genotypes at the seedling stage, and salt stress was imposed by adding NaCl solution at 0, 50, and 100 mM in the nutrient solution (Peter's professional) to 7-day-old seedlings. Only three genotypes, BARI Mung 5, E44, and V1003255 AG, showed maximum seedling survivability and minimal reduction in growth parameters with a Salt Tolerant Index (STI) score of 0.0–1.0, indicating high tolerance to salt stress, while the other two genotypes, BARI Mung 9 and E831194, showed tolerance with an STI scoring rate of 1.0–2.0 and moderately reduced growth parameters. For validation of the salt-tolerant genotypes, the second experiment was laid out in pot culture in a completely randomized design with three replications under salt stress (irrigated with NaCl solution at 8 EC concentration) and control (irrigated with freshwater) conditions in the Genetics and Plant Breeding Experimental Farm, BAU. Here, 3 genotypes showed high tolerance, another 2 genotypes were tolerant, and 3 genotypes were moderately tolerant. The third experiment was carried out at the Field Laboratory, Department of Genetics and Plant Breeding, BAU, in a RCB design with three replications to learn more about the mechanism of salt tolerance. ANOVA indicated the differences among genotypes for all the morphological traits. The phenotypic coefficient of variance (PCV) was higher than the genotypic coefficient of variance (GCV) in all of the studied traits. Moderate to high heritability (ranging from 50–93%) was found for all traits. The number of pod plant-1 (62.7), number of seed pod-1 (50.2), pod length (45.6), and plant height (58.1) all had high heritability and genetic advance. A significant positive correlation was found for most of the studied characters. To determine genetic diversity, the genotypes were divided into five groups; genotypes that demonstrated tolerance were placed in the same group. The tolerant genotypes have higher SPAD values and proline contents compared to the sensitive ones. In terms of salt tolerance, these findings corresponded with hydroponic culture and pot culture. Therefore, considering all of the information, the genotypes BARI Mung-5, E44, and V1003255AG could be good plant materials to grow in the salt-affected southern region of Bangladesh with moderate salt stress conditions. Evolved information can be exploited for further breeding purposes in developing salt-tolerant mungbean genotypes.

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Phenotyping of Mungbean (*Vigna radiata* L.) Gnotypes and Identification of Morpho-physiological and Biochemical Markers Linked to Salt Stress

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Abstract
Salt tolerance is a complex polygenic trait that is genotype-specific, and tolerance can depend upon a plant's developmental stage. A series of experiments were conducted using 35 mungbean genotypes and salt stress (EC = 8.0 dS/m) to screen salt tolerance genotypes, determine seedling stage specific salt tolerance, and investigate the inherent variability of mungbean (*Vigna radiata* L.) genotypes along with their validation at the reproductive stage considering seed yields and yield-related traits. The first experiment was conducted at the plant growth chamber, the department of genetics and plant breeding, BAU. The hydroponic culture technique was used for screening salt tolerance genotypes at the seedling stage, and salt stress was imposed by adding NaCl solution (EC = 8.0 dS/m) in the nutrient solution (Peter's professional) to 10-day-old seedlings. Only three of the 35 genotypes studied, BARI Mung 5, E44, and V1003255 AG, demonstrated maximum seedling survivability and minimal reduction in growth parameters, with a Salt Tolerant Index (STI) score of 0.0–1.0 indicating high tolerance to salt stress. BARI Mung 9 and E831194 showed tolerance with an STI scoring rate of 1.0 to 2.0 and moderately reduced growth parameters, while the rest of the genotypes, including some released varieties, have very poor seedling survivability and a maximum reduction in growth parameters with an STI score of 3.0 to 4.0. For validation of the salt-tolerant genotypes, the second experiment was laid out in pot culture in a completely randomized design with three replications under salt stress (irrigated with NaCl solution at EC = 8.0 dS/m) and control (irrigated with freshwater) conditions at the Genetics and Plant Breeding Experimental Farm, BAU, Mymensingh. Here, 3 genotypes showed high tolerance, another 2 genotypes were tolerant, and 3 genotypes were moderately tolerant. Morphological characterization of mungbean germplasm has a significant effect on its potential future use in breeding programs to identify salt-tolerant mungbean genotypes. So, a third experiment was conducted to study the morphological characterization and estimation of genetic diversity among the 35 mungbean genotypes. ANOVA indicated the differences among genotypes for all the morphological traits. To determine genetic diversity, the genotypes were divided into five groups; genotypes that demonstrated tolerance were placed in the same group. Biochemical characterization of the selected genotypes will be studied to gain insight into the mechanisms of salt tolerance in the near future.

Assessment of Pre-breeding Materials and Breeding for Development of Melon Genotypes with Desired Yield and Fruit Quality Traits

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Abstract
Rockmelon (*Cucumis melo* L.) is a globally popular sweet, edible, and fleshy fruit of Cucurbitaceae family. The fruit is rich in vitamins, minerals, electrolytes, beta-carotene, tocopherol, and other

antioxidants. Our native melon (Footi/Bangi) varieties are not-preferred by consumers. However, the introduced hybrid varieties of rockmelon, as observed in the last few years from the trials of entrepreneurs, are showing promising results. This requires extensive evaluation of native and global germplasms for selecting potential parent adaptability test which later can be used in breeding for developing suitable varieties. We evaluated the performance of 23 diverse accessions in terms of agronomic and fruit quality tests. Accession M-SCR2-01, M-L994, M-EM-01, M-MC-01, M-HDM-01 more than 80% germination. Accession M-EC-01(51), HDM-01(47), Chinal Bangi (51) had higher numbers male flowers, Accession M-ML-01(27), HDM-01(14), M-EM-01(12) had higher numbers female flowers and accession M-EC-01(29), M-JM-01(28), M-SNO-01(29) had higher numbers bisexual flowers. The crop duration of accessions M-L994 and HDM-01 were quickest while acessions showed longest crop duration. Fruits also varied in terms of qualities such as M-SH01, M-MC-01 and M-L994 is Creamy White, M-HDM-01 is Yellow, M-JM-01 is Light Green etc. HDM-01 and M-MC-01 produced larger fruits respectively. In terms of sweetness, higher brix were observed for accession M-L994 and M-HDM-01. The fruits of Chinal Bangi accession were less sweet other accession. The double hybrids (M-MM-01 × M-SH-01, M-MM-01 × M-L994, M-HD-01 × M-SH-01, M-HD-01 × M-EM-01, M-L994 × M-SH-01) didn't produce fruits of desired qualities as their sweetness were quite low (show data). The F_2 segregating lines and more number of inbreds needed to be evaluated prior to designing breeding programs for developing hybrids of desired qualities.

Development of Advanced Breeding Lines from Diverse Rice Genotypes for Developing Climate Resilient Rice Variety

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Abstract

The development of mutant populations, followed by their characterization, offers a significant opportunity to isolate genotypes and genes with desired traits of interest for developing climate resilient rice variety. Initially, a large number of mutants were developed through physical and chemical mutagenesis from a promising local rice genotype (Fatema dhan). Based on yield and yield attributing traits 22 mutant plants ensued to develop M_3 mutant lines. The seeds of the selected mutants, the original parent, and three cultivars were grown in a randomized complete block design at the research farm of the Department of Genetics and Plant Breeding, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh. Few mutants exhibited superior quantitative phenotypic traits compared with parental genotypes and check varieties. Mutant lines 1 and 83 required minimum days to reach maturity, and mutant lines 9, 17, and 80 exhibited significantly higher yield per plant than the parent and check varieties. Heritability analysis and genetic parameters revealed that genetic components mostly controlled all observed traits, with a minor influence on the environment. The higher phenotypic and genotypic coefficient of variation, heritability, and genetic gain confirmed possible rice yield improvement through phenotypic selection. The traits, including days to first flowering and maturity, plant height, and panicle length, showed a significant positive correlation with yield. The principal component analysis revealed that the first two components explained 69% of the total variation between genotypes. Thus, the promising mutant lines (1, 9, 17, 80, and 83) isolated in this study can serve for the development of high-yielding and early-maturing rice varieties.

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Shifting of Conventional Agriculture towards High Value Enterprise for Better Livelihood of the Rural People

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Abstract
While agriculture in Bangladesh has made a remarkable progress in terms of overall production of crops and increasing resource efficiency, huge transformation is visible in overall agriculture sector. Such transformation is evident not only in the form of commercialization of farming and achieving food autarky, but also development of rural non-farm sectors and overall improvement of livelihoods of rural people. The project was undertaken to investigate the nature of shifting of selected conventional agricultural practices towards high value enterprises and its impact on livelihoods of the members of farming communities. Three component organizations, namely Department of Agricultural Extension Education, BAU, Bangladesh Agricultural Research Council and *Sheba Sangstha* (an NGO) have been jointly executing the research project. For BAU component, two agricultural practices under huge transformation were selected and was planned to investigate in specific, appropriate locations. The selected research locales are Chars of *Gaibandha* (Barren *chars*' shift into special sandbar farming) and *Bandarban* sadar upazila (natural vegetation into fruit orchard). Data have been collected and some more would be collected from ranges of respondents that include farmers, market and input actors, agricultural extension personnel, researchers, NGO staff, local government bodies and other key informants. A total of 870 persons will be interviewed by using structured questionnaire and checklists (FGD, KII and Stakeholder Workshop). These methods were followed after desk review and preliminary assessment of the study locations, and were finalized through an inception workshop of the project. The preliminary field assessment in two locations is complete. A number of FGD, KII and Stakeholder Workshop have been conducted while some capacity development training is already organized. Some of the farmers' level data collected through interviewing has been completed. The results of the data analysis would be completed and report would be submitted soon.

Assessing the Impacts Evaluation of Selected BAURES Project Interventions Provided for Improving Major Aspects of Livelihoods of Farmers

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Abstract
Improving livelihood of haor people is one of the key challenges of development practioners. Thus, many Government and Non-government Organizations have been working for the same issue. In connection to this issue, the study was undertaken mainly to determine the extent of changes in livelihood outcomes of farmers through BAURES project interventions and to identify influential factors affecting the effectiveness of BAURES interventions. Besides, the farmers' problems while working in the BAURES project were also investigated. The study was conducted in two villages under Mohanganj Upazila of Netrokona district where 100 farmers were interviewed for data collection using pre-tested interview schedule. The extent of changes of livelihood outcome of farmers

was the focus variable and measured using 3-point modified Likert scale. Linear multiple regressions were computed to identify influential factors affecting the effectiveness of BAURES interventions. The findings indicated that 64 percent farmers had moderately changed their livelihood outcomes while about 36 percent had high changes and none of them had low changes in their livelihoods outcomes respectively. Majority (72 percent) of the farmers perceived about the interventions provided by BAURES project as moderate to highly effective while suitable cropping patterns as intervention was secured first ranked. Farm size, training received, extension media contact, social mobility were identified as influential factors affecting the effectiveness of BAURES interventions and it's confirmed by the regression model. Fifty three percent of the respondents had faced a medium level of problems while practicing the interventions. "Lack of technical knowledge", 'Lack of irrigation facilities' and 'lack of quality seeds' got the 1st 2nd and 3rd rank, respectively. Based on the above findings, the overall performance of the interventions was satisfactory. However, concerned authority should take necessary steps (e.g., credits, training, motivation etc.) to resolve these problems for improving the livelihood of the farmers.

Ensuring Food Safety through Pre-harvest Interval for Pesticide Use: Identification of Knowledge, Attitude and Pesticide Use Pattern by Vegetable Farmers

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Abstract
The study was conducted to (i) determine the knowledge of vegetable farmers towards the use of the pesticides and (ii) To evaluate the extent of practice of pre-harvest interval (PHI) by the vegetable farmers. A total of 100 vegetable farmers were interviewed by using a structured interview schedule from 4 Villages of Shibganj upazila of Bogura district at their houses and/or farm sites during February to August 2022 and it drew from a population 288 using simple random sampling technique. Fourteen (14) selected characteristics of vegetable farmers viz.: age, education, family size, farm size, experience of vegetable farming, area under vegetable farming, annual family income, organizational participation, extension media contact, training receive, access to market, decision-making ability, knowledge on PHI and attitude towards PHI and were considered as the explanatory variables. From the present investigation it is evident that 54% of the farmers belonged to medium knowledge group, while 30% of farmers had low knowledge and 16% had high knowledge towards the use of the pesticides in vegetable cultivation. In addition, technical know-how regarding pesticide application among vegetable farmers are assessed with using 16 different questions and the study revealed that 91% farmers knew the name of pesticides (formulated name) these were used in vegetable field, 81% of farmers said that excess use of pesticides was very harmful to vegetable production and 79% told that pesticides are associated with current human illnesses. A 10-point rating scale was used to measure the extent of practice of pre-harvest interval (PHI). Most of the farmers (91%) practice 0-2 days to 3-5 days category of PHI and very little portion (9%) practice 6-8 days to > 8 days category of PHI. It indicates that safe category of PHI practice was very poor. Majority portion (62%) had practiced 0-2 days of PHI at the beginning month of the season, whereas large portion (77%) had practiced 6-8 days to > 8days of PHI in the last month of the season. It reveals that the farmers practice of highly toxic category of PHI in the beginning month of the season and safe category of PHI practice in the closing month of the season. Mass campaign, special training program on use of pesticides and practice of PHI by the farmers in vegetable cultivation by DAE, GOs and NOGs is needed to create awareness among the vegetable farmers as well as ensuring food safety issues.

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Developing Extension Strategies for Producing Safe Mangoes at Farmer Level: A Study in Chapainawabganj, Bangladesh

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Abstract
Fruit crops play an important role in the national food security of people around the world. Mango (Mangifera indica L.) is one of the most common and popular fruit and often mentioned as the 'King of fruits' due to its excellent flavor, attractive color, delicious taste and high nutritive value. The objectives of the project were: i) to determine farmers' present practices related to soil fertility, pest and post-harvest management of mango production, ii) to assess on-going programmes of DAE for safe mango production, iii) to formulate appropriate extension strategies for safe mango production by farmers. Data were collected from15th April to 13th May, 2022 using semi-structured interview schedule from 100 mango farmers of four villages of shibgonj upazila under chapainawabganj district. Appropriate scales were developed in order to measure the variables. Descriptive statistics such as mean, standard deviation, range and percentage were used to describe the variables under consideration. About (63.33%) of the mango farmers had medium practice, while (24.17%) farmers had low practice and only (12.5%) farmers had high practice of modern techniques. Among the 100 respondents, 85% used chemical fertilizers (Urea, TSP, MP, gypsum) and 15% respondents used organic fertilizer (cow dung) in their orchards. Most of the respondents (67%) used chemical pesticides for disease-pest control and hormones for early or late ripening of mango fruits. DAE provides campaigning, group discussions and training for safe mango production but, most of the mango growers (65%) opined that these are not sufficient and regular. After two FGD's, (82%) farmers were suggested that extension organizations can provide training, method and result demonstrations, awareness campaigning, organic fertilizers and pesticides, regular monitoring to increase the safe mango production. Besides, proper marketing and storing facilities, developing mango fruit processing industries in the study area can also motivates for producing safe mango.

An Assessment of Farmers' Willingness to Adopt Prescription-based Pesticide Use Guidelines by the Extension Professionals

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Abstract
Bangladesh, a small agrarian country in Asia, has enormous population to feed and therefore, heavily rely on pesticides. The government is trying to reduce human health hazards caused by harmful chemicals to fulfil the SDG target 3 (good health and wellbeing). In this connection, this study was designed to know prescription-based pesticide use related proposed guidelines by the professionals of Department of Agricultural Extension (DAE), and to assess farmers' willingness to adopt the proposed guidelines. The study followed both qualitative and quantitative approaches. Written discourses were gathered from purposively selected newspaper articles and social media (i.e., Facebook). Spoken discourses were collected from the key resource persons of Plant Protection Wing of DAE through informal discussions, key informant interviews (KII), and Focus Group Discussions. 'Content analysis' and 'narrative analysis' were used to know the proposed guidelines. Bamberg's stage model of self-

regulated behavioral change (SSBC) was used as analytical tool to develop structured interview schedule for face-to-face interview of 150 vegetable farmers. The farmer level study was conducted in 3 purposively selected villages of Melandah, Islampur, and Dewanganj upazilas of Jamalpur district. Findings revealed that majority of the farmers had medium (68%) to high (29.3%) willingness to adopt prescription-based pesticide use related guidelines. Almost all the farmers were willing to see and visit plant doctor's clinic and mobile clinic in their locality. A great majority of the farmers were willing to receive prescription from retired government and private sector officials as plant doctors. However, majority of the farmers were unwilling to pay for plant doctors and internet facilities and are not interested to use internet-based apps to receive prescription. Qualitative analysis also implies that 'prescription for solving pest problem' is not an obligation in pesticide use and trade but an expectation to increase farmers' awareness in ensuring judicial use of pesticides.

Risks of Rooftop Gardening in Urban Agriculture: Assessing Residents' Perceptions

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Abstract
Rooftop gardening is a novel approach to urban agriculture that makes best use of urban spaces to enhance environmental sustainability, dietary and nutritional security, and economic strength. However, there are some risks related to rooftop gardening that need to be identified and reduced to encourage rooftop growers. As a result, the current study was designed to examine the perceived risks of rooftop gardening among the residents of Kewatkhali and Aqua in Mymensingh, Bangladesh. From September to November 2022, data was collected from 100 randomly chosen rooftop growers using a structured interview schedule. To examine the data, descriptive statistics, rank order, coefficient of correlation, and multiple linear regression were used. The results showed that nearly all of the rooftop growers in the study area perceived the risks of rooftop gardening at a medium (86%) to high (14%) level. 'Associated technologies are too complex' was identified as the most important risk indicator out of seventeen. The indicator with the lowest ranking was 'negative attitude of neighbors'. The correlation analysis revealed that age, rooftop garden area, total income, experience, extension media interaction, and knowledge of rooftop gardening were all negatively significant to residents' perceived risks of rooftop gardening. According to the findings of the regression analysis, the area and knowledge of rooftop gardening had a significant impact on the perceived risks of rooftop gardening. Expansion of research, demonstration and extension activities, and development of residents' skills and understanding through effective training could all help to reduce the risks of rooftop growers.

Effect of Value Chain Strategies on Livelihood Status of the Commercial Fish Farmers Engaged in Conversion from Crop Farming to Aquaculture

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Abstract
The main purpose of the study is to determine the extent of effect of value chain strategies on the livelihood status of the commercial fish farmers engaged in conversion from crop farming to

Aquaculture. The specific objectives of the study are (i) To determine the extent of livelihood improvement of the commercial fish farmers due to their involvement in value chain process for fish farming. The aspects of livelihood improvement status include: family assets and shelter, social empowerment, bargaining capacity; (ii) To explore the relationship of selected characteristics of the commercial fish farmers with their extent of livelihood improvement, and (iii) To determine the problems faced by the commercial fish farmers in implementing value chain process and suggestions to overcome those problems. This study location is Dhanikhola union of Trishal Upazila of Mymensingh district. As Dhanikhola is the leading union where the frequency of rice farming to aquaculture is a common phenomenon. People of this union change their rice field to aquaculture in a great extent that is why; this place was selected as a study area. The farmers who conversions from crop farming to aquaculture in Dhanikhola union of Trisal upazila under Mymensingh District are the population of the study. With the help of Upazila fisheries officer updated list of fish farmers was collected. From the population the sample respondents was selected purposely in Dhanikhola Union. For a representative sample 25 percent of the respondent from the population of Dhanikhola union was selected. An interview schedule has been prepared for collection of data from the respondents keeping the objectives of study in mind. The questions and statements contained in the schedule were simple, direct and easily understandable by the fish farmers. Various scales, closed and open from statements were included in the interview schedule to obtain necessary information. The drafts interview schedule has been pre-tested with 10 fish farmers. This pre-test facilitated the researcher to examine the suitability of the different questions and statements in general. On the basis of present result, correction, modification and adjustment will be done in the interview schedule. In order to collect valid and reliable information an interview schedule was carefully designed keeping the objectives of the study in mind. Personal interview method was used to collect data. After completion of data collection, the responses were coded, tabulated and analyzed according to the objectives of the study. Livelihood improvement is the dependent variable of the study. It was measured by computing a "Livelihood Improvement Status Index" in mainly three aspects of livelihood status. They were identified through literature review and visit to study area. The aspects are: i) family assets and shelter, ii) social empowerment and iii) bargaining capacity. From the three aspects, total 30 activities (15 from assets and shelter, 8 from social empowerment and 7 from bargaining capacity) will be identified and selected. The respondents was asked to express opinion in what extent his/her livelihood status has been improved in each of 30 activities along a 4-point scale: "high", "moderate", "low" and "not at all". The responses of the scale will be given scores as 3 for "high", 2 for "moderate", 1 for "low" and 0 for "not at all".

Effectiveness of Farmer Field School Approach for Technology Adoption: A Study in Mymensingh District

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Abstract

Adoption of improved technologies and production technologies are important drivers of agricultural development. On the other hand, Farmer Field School (FFS) approach is an important extension approach to disseminate rice production technologies provided an empirical framework for the study. The main focus of this study is to determine the extent of adoption of selected rice production technologies in Bangladesh through the farmer field school (FFS) approach. The other objectives are (i) to assess the sustainability of transferred technologies transferred through the FFS approach; (ii) to determine factors affecting transfer of technologies to the farmers; and (iii) to investigate the strengths

and weakness of IFM FFS methodology. A sample of 182 FFS farmers and 156 non-FFS farmers was chosen for the study using random sampling and snow ball technique respectively. Data were collected from Ishwarganj upazila under Mymensingh district, where the Department of Agricultural Extension (DAE) under the Ministry of Agriculture, implemented FFSs under a number of projects. Among 21 rice FFS practices ten were selected through a judge rating process. The selected FFS technologies were: (i) preparation of ideal seed bed for rice cultivation, (ii) use of air sealed container for seed storage, (iii) transplanting seedlings at proper age, (iv) straight row planting or proper spacing of seedlings, (v) practicing rogueing for seed production, (vi) use of crop rotation, (vii) preparation and use of Farm Yard Manure, (viii) preparation and use of vermicompost, (iv) application of Guti urea in rice cultivation, and (x) use of light trap. A dichotomous scale was used to check the adoption of the selected practices by the farmers where 0 score was given for not adoption and 1 score was given for adoption of the technology. Both qualitative and quantitative data were collected using methods including survey with the help of pre-test interview schedule and Focus Group Discussion. All data have been collected and the preliminary findings indicate a mixed range of adoption of the selected FFS practices by the farmers. Also strengths and weaknesses of the FFS approach have been identified.

Capacity Strengthening of Char women for Household Food Security under COVID-19 Pandemic Situation

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Abstract
Food security and adequate nutrition are among the basic needs of every human being. The Government of Bangladesh is putting utmost priorities in eradicating hunger as it is one of the most important goals of Sustainable Development Goals. Bangladesh has achieved self-sufficiency in terms of calorie availability. People's financial access has increased through a rapid decline in the poverty headcount (upper poverty line) from 49% in 2000 to 21% in 2019. However, around 11% of the population still live in extreme poverty (below the lower poverty line) and are unable to afford a basic food consumption basket (HIES, 2016). After COVID-19 pandemic, the situation has worsened resulting millions of people had fallen under poverty line. It is assumed that the overburden on the health sector causes the reallocation of resources to the health sector to save lives. That may reduce the purchasing capacity of poor people and affect household food security. Apart from the prevailing deficit in total calorie intake, the normal diet of people of Bangladesh is seriously imbalanced, with more than 80 percent of calories derived from cereals. This dietary imbalance reflects insufficient domestic production of non-cereal foods (pulses, oilseeds, meat, milk and eggs), low incomes, food preferences and lack of nutrition education. Women can play vital role in achieving food security at household level. This project focuses on the capacity strengthening of char women as these households are more vulnerable. The existing status of household food security will be assessed and their need for capacity building will be identified. The work is going on in different char areas of Mymensingh district. A total of 200 women were selected as sample of the study.

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Assessing Adoption and Diffusion of Agricultural Innovations in Bangladesh

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Abstract
In recent years, adoption of new technologies aimed at increasing agricultural output, such as innovative farm machinery, crop-based mixed-balanced fertilizers, high-yielding crop types, vegetables, and fruits, has been very strong, and productivity has increased. Rice, for example, has been the most important contributor to the country's food grain self-sufficiency, accounting for 71 percent of the gross cultivated area and 94 percent of food grain production (National Food Policy Plan of Action, 2008-2015). Rice output has increased as a result of a number of agricultural improvements, including the adoption of a better irrigation system, increasing use of other agricultural inputs, and increased coverage of highyielding and modern rice varieties. However, the long-term viability of domestic food is a concern. In addition, anecdotal evidence and opportunistic observations imply that the technology and ideas used by farmers are not always those backed by Bangladesh's government. Anecdotal information from industry professionals and important stakeholders, on the other hand, reveals that the technologies and innovations used in the country's farming systems are frequently imported from neighboring countries. Unfortunately, there is no comprehensive study of whether Bangladeshi rural farmers use homegrown or foreign agricultural advances. Furthermore, the primary issues causing the acceptance of agricultural innovation, as well as how to address them, remain unknown. The key objectives of the project are to identify the adoption characteristics of agricultural technology users in the agricultural value chain of Bangladesh and to explicate the attitudes and values of the users with specific reference towards adopting local versus foreign agricultural technologies. These behavioral elements will then be used to explore the facilitating and hindering factors that influence the adoption and diffusion of the home-grown agricultural innovations in Bangladesh. Finally, optimal policy recommendations will be formulated to promote adoption of homegrown agricultural technologies and innovations.

Application of Plant Growth Promoting Rhizobacteria *Pseudomonas mosselii* in Rice cv. BRRI Dhan29

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Abstract
Rice is our staple food and the major food crop worldwide. Because to both inadequate soil nutrient uptake and disease outbreaks, rice production is frequently constrained. We aimed to improve the growth and yield of rice using endophytic bacterium *Pseudomnas moselli*. To this end, we isolated 14 rhizobacteria from rice rhizosphere from which we identified a native *P. moselli* strain after performing 16SrRNA test. The strain was used in rice variety BRRI dhan29 in four methods of application namely seedling priming, soil drenching, foliar application, bacterial culture filtrate (BCF) foliar application.

The results showed that application of *Pseudomonas mosselii* had significant effect on growth parameters, nutrient contents and yield of rice compared to control. In most of the quality attributes, bacterial application showed better performance over the control. The highest number of grains panicle^{-1} (224.67), root fresh weight (146.93 g pot^{-1}) shoot fresh weight (758.98 g pot^{-1}), flag leaf fresh weight (7.88 g pot^{-1}) root dry weight (42.16 g pot^{-1}), shoot dry weight (97.32 g pot^{-1}) and flag leaf dry weight (2.69 g pot^{-1}) were obtained from seedling priming treatment, whereas, root drenching treatment showed excellent results for maximum plant height (105.67 cm), total number of tillers pot^{-1} (23.7), no. of panicle pot^{-1} (17.67), grain weight (51.7g pot^{-1}) and root length (49.0 cm). Application of bacteria increased the number of grain panicles^{-1} as well as soil organic carbon compared to control irrespective of method of application. BCF foliar application showed best rests in P, Mg and Zn acquisition in shoot while N, P, Ca, Mg and Si acquisition in flag leaf. This treatment yielded the highest number of grain panicle $^{-1}$ and suppressed the natural occurring blast disease maximum. The results suggested that BCF foliar application of *P. mosselii* had the best effects on growth, nutrient content and yield of rice. Combination of BCF foliar application along with seedling priming could be the best management practice for application of *P. mosselii* in rice.

Integrated Effects of Inorganic Fertilizer and Cow Dung on the Yield and Quality of Indonesian and Bangladeshi Black Rice

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Abstract
Black rice contains carbohydrates, fiber, vitamins, microelements, and amino acids. It can increase immunity, improve liver and kidney function, and clean cholesterol in the blood. The objective of the study was to compare the performance of Bangladeshi black rice with Indonesian black rice with respect to yield and quality as influenced by integrated fertilizer management. The experiment was performed at the Field Laboratory of the Departments of Agronomy and Agricultural Chemistry, BAU, Mymensingh from July 2021 to March 2022. The experiment comprised 6 combinations of inorganic fertilizer (IF) and cow dung (CD) viz. 0% IF+0% CD, 100% IF+0% CD, 75% IF+25% CD, 50% IF+50% CD, and 0% IF+100% CD and laid out in a CRD design replicated thrice. Different treatment combinations of IF and CD significantly influenced the yield and yield attributes of both rice. Treatment 25% IF+75% CD produced the tallest plant, maximum number of tillers, longest panicle, highest spikelets, and grains panicle^{-1} except 1000 grain weight. The highest grain yield was also found in the same treatment. The biochemical and nutrient contents of both rice were obtained from 100% CD treatment. The performance of Indonesian black rice was better than Bangladeshi rice with respect to yield but the nutritional quality was superior in the case of Bangladeshi rice. It can be suggested that 25% IF combined with 75% CD can be used for increasing yield and obtaining high-quality black rice.

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Nutritional, Medicinal and Cosmetic Compounds of Aloe Vera as Influenced by Integrated Application of Inorganic Fertilizers and Organic Manures

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Abstract
Black rice is considered as super food due to its various health benefits to the human being. In Bangladesh this rice is cultivated in a very limited area of Chittagong hill tracts and its cultivation technique in plain land ecosystem is still unknown. Therefore, a study was undertaken to evaluate the performance of few black rice cultivars cultivated year-round in plain land environment. The experiment was performed at the Agronomy Field Laboratory of Bangladesh Agricultural University, Mymensingh. The experiment comprised two factors viz. A) three rice cultivars: Kongnam ene, Gelong ni and Gelong se; and B) Twelve date of transplanting starting from 01 July 2018 to 01 June 2019. The experiment was laid out in a split plot design where date of transplanting was distributed in main plots and rice cultivars were allocated in sub plots. It has been found that cultivar Kongnam ene can be cultivated as a short duration variety as it required only 40 days to panicle initiation, 60 days to flowering and 80 days to harvesting after transplanting. All the three cultivars can be cultivated in all the three seasons viz. aus, aman and boro. The cultivar Gelong ni produced significantly highest grain yield (4.0 t/ha) among the cultivars when transplanted in January (boro season) Black rice is considered as super food due to its various health benefits to the human being. In Bangladesh this rice is cultivated in a very limited area of Chittagong hill tracts and its cultivation technique in plain land ecosystem is still unknown. Therefore, a study was undertaken to evaluate the performance of few black rice cultivars cultivated year-round in plain land environment. The experiment was performed at the Agronomy Field Laboratory of Bangladesh Agricultural University, Mymensingh. The experiment comprised two factors viz. A) three rice cultivars: Kongnam ene, Gelong ni and Gelong se; and B) Twelve date of transplanting starting from 01 July 2018 to 01 June 2019. The experiment was laid out in a split plot design where date of transplanting was distributed in main plots and rice cultivars were allocated in sub plots. It has been found that cultivar Kongnam ene can be cultivated as a short duration variety as it required only 40 days to panicle initiation, 60 days to flowering and 80 days to harvesting after transplanting. All the three cultivars can be cultivated in all the three seasons viz. aus, aman and boro. The cultivar Gelong ni produced significantly highest grain yield (4.0 t/ha) among the cultivars when transplanted in January (boro season).

Integrated Effects of Inorganic Fertilizer and Organic Composts on Leaf Biomass Yield, Nutrient Concentrations and Medicinal Compounds of *Aloe Vera* (2021-22)

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Abstract
A. vera is a wonder plant with so many health benefits that hardly any part of the human body remains uninfluenced by its healing ability. Commercial cultivation of this plant is very limited in Bangladesh

due to a lack of information. A field experiment was conducted at farmer's field, *Kashigonj, Tarakanda*, Mymensingh from September 21 to May 22 to determine the integrated effects of inorganic fertilizer (IF) and organic compost (OC) on the leaf biomass yield, nutrient concentration, and medicinal compounds of *A. vera*. There were altogether nine treatment combinations of IF and OC {Cow dung (CD) and poultry manure (PM)} viz. $IF_{100}OC_0$, $IF_{85}OC_{15}$, $IF_{70}OC_{30}$, $IF_{55}OC_{45}$, $IF_{40}OC_{60}$, $IF_{25}OC_{75}$, $IF_{10}OC_{90}$ and IF_0OC_{100}. The experiment was laid out following a randomized complete block design (RCBD) with three replications. The application of different combinations of IF and OC exerted a significant influence on the growth, leaf yield, nutrient concentrations, and medicinal compounds of *A. vera*. The highest yield and yield attributes and cost-benefit ratio (BCR) were obtained from the plant fertilized with 25% of IF and 75% CD. In contrast, the highest N, P, K, and S concentrations of the aloe vera gel were obtained from their highest additions ($IF_{100}OC_0$). About 9.48% more leaf biomass yield was obtained from CD than from PM application. The highest number of suckers was noticed in the CD amended soils compared to PM at $IF_{25}OC_{75}$. The highest micronutrient concentrations, medicinal and cosmetic compounds were biosynthesized in the plants receiving the highest additions of organic manures. Soil acidity was decreased but fertility was proportionately increased with the increased addition of CD or PM. The results suggest that farmers can be advised to apply 75% cow dung along with 25% inorganic fertilizers for producing higher leaf yield, better quality *Aloe vera* gel maintaining soil fertility

Production of *Aloe vera* under Integrated Fertilization of Inorganic Fertilizer and Cow Dung

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Abstract

A. vera is a wonder plant with so many health benefits that hardly any part of the human body remains uninfluenced by its healing ability. Commercial cultivation of this plant is very limited in Bangladesh due to a lack of information. A field experiment was conducted at farmer's field, *Oshudhi village,* Natore, Rajshahi from September 21 to May 22 to study the integrated effects of inorganic fertilizer (IF) and cow dung (CD) on the leaf biomass yield, nutrient concentration, and medicinal compounds of *A. vera*. There were altogether nine treatment combinations of IF and CD viz. IF_0CD_0, $IF_{100}CD_0$, $IF_{75}CD_{25}$, $IF_{50}CD_{50}$, $IF_{40}CD_{60}$, $IF_{30}CD_{70}$, $IF_{20}OC_{80}$, $IF_{10}OC_{90}$ and IF_0OC_{100}. The experiment was laid out following a randomized complete block design (RCBD) with three replications. The application of different combinations of IF and CD exerted a significant influence on the growth, leaf yield, nutrient concentrations, and medicinal compounds of *A. vera*. The highest yield and yield attributes and cost-benefit ratio (BCR) were obtained from the plant fertilized with 30% of IF and 70% CD. Leaf yield increase over control ranged from 42 to 85% across the treatments. In contrast, the highest N, P, K, and S concentrations of the aloe vera gel were obtained from their highest additions ($IF_{100}OC_0$). The highest number of suckers was noticed in the treatment $IF_{10}CD_{90}$. The highest micronutrient concentrations, medicinal and cosmetic compounds were biosynthesized in the plants receiving the highest additions of organic manures. Soil acidity was decreased but fertility was significantly and proportionally increased with the increased addition of CD. The results suggest that farmers can be advised to apply 70% cow dung along with 30% inorganic fertilizers for producing higher leaf yield, better quality *Aloe vera* gel improving soil fertility

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Integrated Effects of Inorganic Fertilizer and Cow Dung on the Yield and Quality of Indonesian and Bangladeshi Black Rice

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Abstract
Black rice can be used as natural medicine as a cure for degenerative diseases like cancer. Anthocyanins function as antioxidants that can have anticancer activities The pigment contains the active material of flavonoids and the level is five times that of white rice and plays a very large role in preventing the hardening of the arteries and preventing the formation of uric acid in the body. The objective of the study was to compare the performance of Bangladeshi black rice with Indonesian black rice with respect to yield and quality as influenced by integrated fertilizer management. The experiment was performed at the Field Laboratory of the Departments of Agronomy and Agricultural Chemistry, BAU, Mymensingh from July 2021 to March 2022. The experiment comprised 6 combinations of inorganic fertilizer (IF) and cow dung (CD) viz. 0% IF+0% CD, 100% IF+0% CD, 75% IF+25% CD, 50% IF+50% CD, and 0% IF+100% CD and laid out in a CRD design replicated thrice. Yield and yield attributing characters of Indonesian and Bangladeshi black rice were significantly influenced by different combinations of inorganic fertilizers and cow dung. Except for plant height, the highest values of most parameters including grain yield were observed when 75% IF and 25% CD was applied. On average, IBR gave a 7.23% higher grain yield than BBR. Starch and protein concentrations were also significantly affected by different treatment combinations of IF and CD. The highest starch content of Bangladeshi black rice was found in 100% CD amended treatment but in the case of Indonesian black rice, it was highest in $IF_{25}CD_{75}$ Highest protein was biosynthesized in the plant which received 100 percent inorganic fertilizers without cow dung. The highest N, P, K, and S concentrations were also found in their highest additions ($IF_{100}CD_0$) though the micronutrient concentrations were found with 100 % cow dung-treated pot. The performance of Indonesian black rice was slightly better with respect to grain yield but the grain quality in terms of starch, protein, and nutrient concentrations was higher in Bangladeshi black rice. It can be suggested that 75% IF combined with 25% CD can be used for increasing yield and obtaining high grain quality black rice.

Effect of Silicon Amendments on the Alleviation of Induced Wheat Blast Disease

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Abstract
A field experiment was carried out at Bangladesh Institute of Nuclear Agriculture Headquarters Farm, Mymensingh from November 2021 to March 2022 with artificial inoculation of MoT to study the effects of various silicon supplements on the blast disease incidence and severity as well as growth and yield of wheat. The test crop used in the study was wheat variety BARI Gom26 and it was conducted in Completely Randomized Design (CRD) with three replications. Total 24 Plots were prepared with the recommended dose of fertilizers along with different levels of Si supplements. Total 24 plots were prepared and Si supplements were applied as per treatments *viz.* Tac (absolute control treatment where all fertilizers are absent), T0 (control treatment having no Si supplement), T1 (6 mM Si L^{-1} from $MgSiO_3$

as Foliar Spray), T2 (100 kg Si ha^{-1} from $MgSiO_3$ as Basal dose), T3 (6 mM Si L^{-1} from $CaSiO_3$ as Foliar Spray), T4 (100 kg Si ha^{-1} from $CaSiO_3$ as Basal dose), T5 (100 kg Si ha^{-1} from Super Silica as Basal dose), T6 (2.5 ton ha^{-1} rice husk ash as basal dose), respectively. In the study, the efficacy of Si supplements was evaluated by observing % disease incidence, % disease severity matrix and yield pot^{-1}. All the Si supplements showed a significant reduction in disease severity in comparison to controls throughout the days after inoculation. All the silicon supplements showed significant reduction in disease severity in comparison to controls throughout the days after inoculation. Among all of them Super Silica @100 kg Si ha^{-1} showed significant decrease in wheat blast disease severity matrix compared to both control and absolute control. $MgSiO_3$ @6 mM Si L^{-1} from $MgSiO_3$ as foliar spray and $CaSiO_3$ @6 mM Si L^{-1} from $CaSiO_3$ as foliar spray followed by Si @100 kg Si ha^{-1} and rice husk ash @2.5 ton ha^{-1} showed the best result than all other basal doses of $MgSiO_3$ and $CaSiO_3$. Yield parameters showed that $CaSiO_3$ basal dose @100kg Si ha^{-1} at 55DAS showed best results for wheat plant height. Rice husk Ash @2500kg Si ha^{-1} showed best results for wheat spike length. The best results for total spike $plot^{-1}$, weight of seed $spike^{-1}$, total number of seed $plot^{-1}$ and yield $plot^{-1}$ (2500kg Si ha^{-1}) were observed in the plots treated with Super Silica. The flag leaf sampling was accomplished to determine the concentration of different mineral nutrients such as Ca, Mg, K, P, S, B, Si, and Na. The average concentrations of Ca, Mg, K, P, S, B, Si, and Na in the collected plant samples were 0.57%, 0.39%, 1.14%, 0.50%, 0.36%, 50.12 ppm, 3.26% and 0.33%, respectively. The highest Ca content was found in the T1 treatment (6 mM Si L^{-1} $MgSiO_3$ as Foliar Spray), the highest K and S content were found in the T4 treatment (100 kg Si ha^{-1} $CaSiO_3$), the highest Mg and Si content were in the plot treated with Super silica. From the present study, it may be concluded that Silicon supplements incorporated in the study showed significant reduction in blast disease and at the same time higher yield in comparison with the controls. The best disease reduction was done by Super silica and rice husk ash, the spray doses of $MgSiO_3$ and $CaSiO_3$ performed well in reduction of wheat blast disease and better yield than those of the basal doses of $MgSiO_3$ and $CaSiO_3$.

Application of Biochar and Activated Carbon Adsorbents for Removal of Heavy Metals from Wastewater

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Abstract
Heavy metal contamination in the untreated industrial wastewater has become a serious environmental problem due to their non-biodegradable and toxicity nature. Wastewater reuse for irrigation is a widespread practice in the periurban areas of Bangladesh. For this reason, heavy metal removal from wastewater is of prime importance for a clean environment and human health. Samples were collected to determine pH, EC TDS, Cd, Cr, Cu, Pb, Mn and Zn from hand-loom dyeing, textile, dyeing and tannery industries at Bhaluka upazila in Mymensingh district; Savar upazila in Dhaka district and Belkuchi upazila in Sirajgonj district. The level of heavy metals in samples was analyzed by atomic absorption spectrometric method. In batch sorption experiments, samples were shaken in shaking incubator at 25°C and 200 rpm with adding adsorbents at rates of 0.05, 0.10 and 0.20%, respectively. Aliquots were taken at 0, 1, 3, 6, 12 and 24 h intervals and then, were analyzed. As per FAO standard, the levels of Cr ion in tannery wastewater and Mn ion in textile wastewater were above the permissible limits for irrigation indicating contaminants. Accordingly, Cr and Mn ions were considered for sorption experiments. As compared to control and activated carbon treatments, the ability of biochar prepared from rice straw (RSBC) and biochar derived from water hyacinth (WHBC) was found for removing 84% and 88% of Cr ion from tannery wastewater, respectively and 80% and 85% of Mn ion from textile wastewater, respectively. Maximum sorption efficiency in tannery and textile wastewater samples was obtained at 24 h reaction time with adding 0.20%

biochar as compared to granular and powdered activated carbons. Sorption efficiency was enhanced with the increase of contact time and adsorbent rate. From these findings, it is concluded that biochar could be applied effectively for removal of Cr and Mn ions from wastewater.

Formulation and Chracterization of Slow Release Nitrogen Fertilizer for Enhancing Crop Yield and Quality of Baby Corn

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Abstract

The application of slow-release organo-mineral fertilizers (OMF) is gaining popularity day by day due to their potential effect on enhancing crop productivity and soil fertility. Therefore, this research work aimed to formulate and characterize a slow-release peat soil based OMF and to observe its effect on baby corn yield and soil health compared to commercial urea. Two peat soil based slow-release fertilizers were formulated (PSU-L 15.48% N) and (PSU-H 26.23% N) following granulation technology. The physicochemical properties of PSU fertilizers satisfied international fertilizer standards and are suitable for long-term storage and handling with currently used farm machinery. The addition of PSU fertilizer to soil significantly enhanced the water holding and retention capacity compared to commercial urea. A pot experiment was conducted in the net house of the Department of Agricultural Chemistry, BAU, Mymensingh to observe the effect of newly formulated PSU on the growth, yield, and quality of baby corn in comparison to commercial urea. The experiment was laid out following a completely randomized design (CRD) with 4 replicates. In this trial, N was applied from three sources (urea, PSU-L & PSU-H) at a rates of 50, 75, and 100% of the recommended N application dose. Soil application of slow-release PSU fertilizer showed a significant influence on the growth, yield, and quality parameters of baby corn. The highest plant height, cobs plant^{-1}, cob length, and cob circumference were found in PSU treated pots followed by urea treated pots. A substantially higher leaf chlorophyll and cob vitamin C content were found in PSU treated plants than in commercial urea. Soil application of PSU produced about 20% higher cob and 14% fodder yield than commercial urea. The nutritional analyses of cob, fodder and post-harvest soils are on going.

Enhanced Efficiency Organo-mineral Nitrogen Fertilizer for Sustainable Crop Production

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Abstract

Increasing crop yield and fertiliser nitrogen (N)-use efficiency is important for sustainable crop production with a reduced environmental footprint. Therefore, this research work was carried out at the pot house of the Department of Agricultural Chemistry, Bangladesh Agricultural University, Mymensingh to study the comparative effect of different conventional and newly developed enhanced efficiency N fertilizers on the growth, yield, quality and N use efficiency of red amaranth (*Amaranthus tricolor cv. BARI lal shak 1*). The experiment was laid out in a completely randomized design (CRD) comprising of five treatments with four replications. Nitrogen was applied from urea, diammonium phosphate, brown coal-urea (BCU) (top dressing) and BCU (basal) with different rates N_0 (no

N/Control), N_{50} (50 kg N ha^{-1}), N_{75} (75 kg N ha^{-1}), N_{100} (100 kg N ha^{-1}) and N_{150} (150 kg N ha^{-1}). Different rates and forms of N significantly influenced the growth parameters and biomass yield of red amaranth. The highest biomass yield was obtained from 150 kg N ha^{-1} whereas 100 kg N ha^{-1} gave the highest plant height and the number of branch $plant^{-1}$. Biomass N concentration, protein content, and N uptake (NUP) by red amaranth showed the best performance at 100 kg N ha^{-1}. On the contrary, N concentration of post-harvest soil was maximum at 150 kg N ha^{-1}, and nitrogen use efficiency (NUE) was higher at 50 kg N ha^{-1}. All the growth parameters, biomass N, protein content, NUP and NUE were showed better performance in BCU basal treated soil. In contrast, the post-harvest soil N content was higher in BCU top-dressed soil. Finally, BCU basal at 150 kg N ha^{-1} showed the best result for all the growth and yield contributing parameters. On the other hand, biomass N, protein content and NUP were maximum from BCU basal at 100 kg N ha^{-1} treated pots, whereas the NUE was maximum when N was applied at 50 kg N ha^{-1} from BCU basal 50. Form the overall results, it can be concluded that application of enhanced efficiency organo-mineral N fertilizer could be a potential alternative of conventional N fertilizers for sustainable crop production with less environmental impact.

Zinc Solubilizing Rhizobacteria as Potential Biofertilizer for Tomato and Capsicum

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Abstract

Plant growth promoting rhizobacteria (PGPR) are heterogenous group of bacteria residing in the vicinity of plant rhizosphere and promote plant growth using a diverse array of direct and indirect mechanisms under normal and stressed conditions. The current research work was conducted to evaluate some potential Zn solubilizing rhizosphere bacteria as plant growth promoter and their effect on the growth and development of two important horticultural crops, tomato and capsicum. The research work was conducted at the Department of Agricultural Chemistry, BAU, Mymensingh. The results revealed the potential of rhizobacteria as ZnO solubilizer. In liquid culture, the highest ZnO was solubilized by MQ1 (185±4 mg/L) followed by MQ2 (183±5 mg/L) and the lowest was solubilized by isolate OSBr5 (28±3 mg/L). Most of the Zn solubilizing bacteria showed phosphate solubilizing and / or indole-3-acetic acid (IAA) in varying capacity. Two PGPR consortia (A= MQ1+MQ2 and B= FB4+OSBr6) was formulated based on the IAA production and phosphate solubilization ability of the rhizobacteria and evaluated their effect on the growth and yield contributing parameters of tomato and capsicum. In general, the application of PGPR increased the parameters studied over control. The application of PGPR consortia along with half of recommended dose of fertilizers (T5 and T7 treatments) significantly increased the growth and yield contributing characters of both the test crops over control (T1) and produced statistically similar results with T2 treatment (Full dose of recommended fertilizers). The plant trial results revealed that the application of PGPR consortia can reduce significant amount of synthetic fertilizers. However, field trials are necessary before recommending these potential plant growth promoters for extensive application as biofertilizer.

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Biodegradation of Textile Wastewater Using Indigenous Bacteria

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Abstract
Textile is the foremost part of industrial sectors in Bangladesh and discharges from this industry is the major source of water and soil pollution. We focused on biological treatment of textile wastewater using bacteria. To this end, we collected textile water from a dying industry in Gajipur, Bangladesh and investigate the biodegradation capacity of the bacteria isolated from the textile wastewater. Immediate analysis of the collected wastewater sample showed that the water is deep blue to blackish blue colored medium acidic water with the EC value of 6760 µS/cm and the TDS value of 3380 ppm. Several physio-chemical characteristics such as amount of dye, level of pH, EC, TDS, BOD, COD, and amount of Ca, Mg and Cl^- were found in significant amount in the initial wastewater. Whereas, the amount of phosphorus, sulphur, potassium were in acceptable limit. It is worth mentioning that the collected textile wastewater did not contain any of the toxic heavy metal in detectable limit. For the biological treatment of wastewater five bacteria were isolated based on morphological dissimilarities and designated as Tex-1, Tex-2, Tex-3, Tex-4 and Tex-5. All the five isolates were able to remove the textile dye with a removal efficacy of more than 90%. However, Tex-5 showed the best performance in removal of dye in 48 hr treatment cycle followed by Tex-2. Further treatment in four different doses of bacterial solution of Tex-5 (2%, 5%, 10% and 15%) isolate showed the highest dye removal at 10% bacterial solution. The bacterial treatment by Tex-5 isolate resulted in 98% of dye removal from initial wastewater while the acidic solution turned to neutral solution with a reduction in EC and TDS at a rate of more than 60% to be within permissible limit for irrigation usage. The treated water resulted in 60% of BOD removal from initial wastewater. The amount of Ca and Mg ion was also removed at a rate of 34% and 39% while the amount of chloride ion reduced by 59%. It could be concluded that all the bacteria isolated from the textile wastewater are able to degrade the textile dye and other contaminant while Textile -5 could be the best option to choose for biodegradation of textile wastewater.

Comparative Evaluation of Heavy Metal Contamination in Potato Tubers Cultivated in the Greater Mymensingh Area of Bangladesh for Human Health Risk Assessment

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Abstract
This study was undertaken to determine heavy metal concentrations in potato tubers cultivated in 4 Upazila namely, Muktagacha, Fulpur, Gafargaon, and Ishwarganj of Mymensingh district, Bangladesh. In total 24 sites were selected from the aforementioned Upazilas. Four (4) potato tuber samples were collected from each location of the farmer′s field. Thus, this study handled a total of 96 potato tuber samples, which were analyzed for different heavy metals by atomic absorption spectrophotometer (AAS). The mean concentrations of metals in potato tubers were in the sequence of Fe > Zn > Mn > Cu > Ni > Cd, while the contents of Pb, Cr and Co were below the detectable limit. The average calculated hazard quotient (HQ) values for Zn, Cu, Fe, Mn, Ni and Cd were 15.90, 34.78, 11.82, 12.84, 65.22, and 6.96 for males, and 22.26, 48.69, 16.55, 17.97, 91.31, and 9.74 for females, respectively, which indicate non-carcinogenic human health risks (HQ > 1.00) of these metals due to dietary intake of potato tubers. On the other hand, the calculated incremental lifetime cancer risks (ILCR) posed by

Cd and Ni due to oral exposure to potato tubers varied from 0.00E+00 to 1.93E-01 and 0.00E+00 to 2.48E+00 in males, 0.00E+00 to 2.70E-01 and 0.00E+00 to 3.47E+00 in females, respectively. The study results revealed that the calculated ILCR values for Cd in 96% of samples and Ni in 83% of samples were several hundred times higher for males and females than the threshold (1.00×10^{-6} to 1.00×10^{-4}) of USEPA. Such high ILCR values suggested that consumers who ate potato tubers grown in the area were at much higher cancer risks. In contrast, both the calculated HQ and ILCR values were negligible for Pb, Cr and Co in all samples indicating potato tuber samples were below the non-carcinogenic and carcinogenic risks threshold.

Screening of Drought Tolerant Zinc-rich Rice Varieties Through Morphophysiological and Biochemical Approaches

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Abstract

Zinc is one of the three most vital micronutrients, a deficiency of which adversely affects children's natural growth and immune system. Rice biofortified with zinc could help to address the critical gap by delivering a major portion of their daily dietary zinc requirements. The scarcity of water alters morphological, physiological, biochemical, and molecular responses by regulating stress-induced gene and protein functions. Drought-tolerant zinc-rich rice variety is one of the best possible ways out to encourage the production and consumption of Zn-rich rice varieties in drought-prone areas. The present study was conducted to investigate and compare the potentiality of available zinc-rich rice varieties to withstand drought stress. Germinated seeds of BRRI dhan 62, BRRI dhan 74, and BRRI dhan 84 were sown in individual pots. Drought stress was imposed by withholding irrigation 21 days after sowing. Different physiological and biochemical parameters were measured at 14 days after drought stress. Ascorbate concentration decreased in BRRI dhan 74 and BRRI dhan 84 whereas it increased in BRRI dhan 62. Remarkable decreases were observed in BRRI dhan 74 and BRRI dhan 84 but not in BRRI dhan 62. Drought stress increased CAT and APX concentration in BRRI dhan 62. DPPH scavenging activity was slightly reduced by drought in BRRI dhan 62 whereas remarkably decreased in BRRI dhan 74 and increased in BRRI dhan 84. Leaf area, root length, and shoot length were moderately affected by drought in BRRI dhan 62. High level of non-enzymatic antioxidant (ascorbate), minimum reduction in pigment (chlorophyll and carotenoid) concentration, free radical scavenging ability, high antioxidant enzyme activities, profound root and shoot performance under drought conditions pointed towards the degree of drought tolerant of the variety. Therefore, the present study revealed that among the three Zn-rich rice varieties BRRI dhan 62 may perform better in drought-prone areas.

Nutritional and Biochemical Evaluation of the Fruits and Vegetables Grown in Soilless Cultivation Systems

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Abstract

Bangladesh is one of the most densely populated countries in the world. The agriculture sector faces new challenges as a result of population increase, dwindling cultivable areas, pollution, and climate

change, which have emphasized the vertical expansion of agriculture. Hydroponic systems can regulate the growing environment through the management of nutrient solutions, growing medium, and weather factors. However, high nitrate concentration has been reported to cause significant toxicity conditions to plants. Therefore, this study was done to evaluate and compare the biochemical and nutritional composition of the products grown in a modified Hoagland solution with different doses of nitrate (0.5, 1, and 2 M). When compared to vegetables grown in soil, we revealed that the biochemical and nutrient content of vegetables cultivated in hydroponic systems varied substantially. Particularly in tomatoes, hydroponic products have relatively lower chlorophyll, vitamin C, and TSS concentrations while having higher protein and antioxidant activity when compared to soil-grown tomatoes. Vitamin C, total soluble sugar, titratable acidity, and antioxidant levels increased at first with an increase in nitrate percentage but decreased in the presence of very high nitrate levels in capsicum. While the DPPH inhibition % was noticeably lower in hydroponic kalmi shak, the vitamin C and beta carotene levels were comparable. In lettuce, beta carotene, total soluble sugar, vitamin C, and titratable acidity increased with increasing nitrate administration and then declined with high nitrate content. Considering all tested parameters, nitrate concentration at 1M in the hydroponic system may have a similar biochemical and nutritional content as soil-grown vegetables. However, modification of nutrient composition may modulate the composition of the fruits and vegetables grown in the hydroponic system. Along with other benefits of the hydroponic system, it is feasible to produce nutrient-rich vegetables through the hydroponic system to ensure nutrition security.

Establishment of a Bioinformatics Lab to Facilitate Molecular Studies of Biological Systems

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Abstract

Bangladesh Agricultural University is one of the pioneer universities in Bangladesh working to develop agricultural commodities and their utilization. The advancement of science and technology explored innovative ways of research activities for a better understanding of biological systems. Techniques such as molecular characterization, genomics, cloning, hybridization, etc. require sophisticated software and database facilities to design experimental tools and to understand the treatment's impacts based on the molecular datasets. To produce quality graduates, it is essential to have laboratory facilities equipped with the necessary instruments and devices. Omics studies based on biological experiments are essential for future research activities. Resources available in the online platforms need to be explored and utilized by the students and teachers of the university. Bioinformatics lab having the facilities of several computers and internet facility is the basic need to provide students with better utilization of online-based resources. Advanced computers with internet connection are the basic need for bioinformatics labs to facilitate data analysis and interpretation of the outcomes of molecular studies. Therefore, we established the bioinformatics lab to offer the above facilities for the students studying and conducting research in the Department of Biochemistry and Molecular Biology.

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Evaluation of Anti-hyperglycemic and Lipid-lowering Properties of Amla (*Emblica officinalis*) Fruit Extract on High-sugar Diet-fed Mice

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Abstract
Diabetes mellitus and obesity are the major metabolic diseases due to the disorder in the metabolism of glucose and lipid metabolism abnormalities. A high sugar diet (HSD) leads to a well-characterized metabolic syndrome such as hyperinsulinaemia, insulin resistance, hypertension, hypertriacylglycerolaemia, dyslipidaemia and a decrease in serum HDL- cholesterol concentration. Hence, the current study aimed to evaluate the beneficial effects of amla (*Emblica officinalis*) extract on mitigating the detrimental effect of high sugar and sugary food consumption. Mice were treated with or without amla extract in both normal and HSD (30% sucrose)-fed mice. Amla extract (20mg/kg BW) also exerted a remarkable effect to hamper the hyperphagia due to high sugar diet consumption in mice. Administration of amla extract (AE) effectively precluded the excessive body weight gain caused by HSD. Furthermore, oral administration of AE also improved glucose tolerance in high-sugar diet-fed mice. Liver weight but not heart and kidney weights were significantly different in the AE-treated group. Weights of white adipose tissue (WAT) and brown adipose tissue (BAT) were significantly reduced in the HSD+AE group when compared with the HSD-fed group. Total cholesterol and triglycerides were significantly lower in the AE-treated HSD-fed group. These findings suggest that the ethanol extract of amla could normalize the metabolic dysregulation caused by high-sugar diet consumption.

Evaluation of Hypoglycemic and Hypolipidemic Potential of Jackfruit Seed Flour Supplementation in Diets: An Approach to Achieve Sustainable Food Security

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Abstract
Excessive consumption of high sugar diet tends to gain more weight and have a higher risk of obesity, type 2 diabetes, and dyslipidaemia. Jackfruit seed powder (JSP) is a good source of dietary fiber, resistant starch and could be a possible dietary tool to fight against metabolic diseases. Therefore, this study was conducted to evaluate the potential role of jackfruit seed powder supplementation to maintain glucose and lipid homeostasis in normal and high-sugar diet-fed mice. Six weeks-old Swiss albino male mice were divided into two groups- normal diet and high-sugar diet, and each group was supplemented with two doses (10 and 20%) of jackfruit seed powder (JSP). The results of the study revealed that supplementation of JSP with high sugar diet decreased food intake in a dose-dependent

manner. JSP supplementation also reduced the body weight of ND and HSD diet-fed mice, but a significant decrease was noticed in the HSD+20% JSP group. JSP showed a significant effect to improve glucose tolerance in both the normal and high-sugar diet groups. Moreover, Mice fed with (20%) jackfruit seed powder could significantly decrease the liver and white adipose tissue (WAT) weight in HSD and a minor decrease was found in the ND-fed group. Furthermore, 20% JSP supplementation significantly decreased the total cholesterol (TC) and Triacylglycerol (TG) levels in HSD diet-fed mice and TC levels in ND diet-fed mice. HDL and LDL concentrations were also slightly lower in both diets fed mice. Histological study revealed that JSP supplementation reduced the fat accumulation in the liver tissue persuaded by HSD feeding for 8 weeks. Jackfruit seed powder supplementation effectively sustains a normoglycemic state and healthy serum lipid parameters against the development of diabetes and obesity caused by HSD in mice. Therefore, jackfruit seed powder could be an important dietary tool in the management of metabolic disorders.

Exogenous Selenium Improves Combined Drought and Heat Stress Tolerance in Maize

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Abstract

Maize (*Zea mays* L.) is an essential crop grown in Bangladesh which is sensitive to drought and heat stress. Selenium (Se), an important trace element with low concentrationincreases abiotic stress tolerance in plants. The aim of our study is to investigate the potential impacts of exogenous Se in maize plants during seedling stage under concurrent drought and heat stress. Seeds were grown in eighteen pre-labelled plastic pots containing one kg soil in each pot. Drought stress was maintained by controlling irrigation of water and heat was maintained by keeping seedlings in growth chamber and treated with 1µM and 2µM concentration of Se. The result of this study reveals that growth of maize seedlings were hampered due to the drought and heat stress including root and shoot growth, photosynthetic capacity, altering biochemical and oxidative stress marker, enhance lipid peroxidation and decrease antioxidant enzymatic activities. However, exogenous Se application improved the growth and biomass related parameter under drought and heat stress. Se treated with both 1µM and 2µM decrease oxidative stress marker including hydrogen peroxide and proline content. Furthermore, exogenous Se decrease membrane injury by reducing malondialdehyde in stress seedlings. Se treated drought and heat stressed plants displayed the enhancement of chlorophyll content and also increased the defensive role by elevating antioxidant enzymatic activities such as catalase (CAT), ascorbate peroxidase (APX), peroxidase (POX). Our findings reveal that exogenous Se application can develop drought and heat stress tolerance in maize plants and suggests field trial to validate the result.

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Effect of Traditional Processing Methods on Nutritional Composition and Anti-nutritional Factors in Perole (*Vigna unguiculata* L) Seed, a Wild Cowpea Grown in Bangladesh

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Abstract
The study was conducted to investigate the effect of traditional cooking process: boiling and pressure cooking on the proximate composition, macro elements and ant-nutrient: phytate, total polyphenol contents of Perole (*Vigna unguiculata* L.) cowpea seeds. This research showed that heat processing amounted to loss of nutrients; this may be due to leaching during heat application. There was drastic reduction of anti-nutrients content of boiled and pressure cooked peroles and this probably is because the anti-nutrients are heat labile. The Boiled Peroles (BDP) had the lowest values of crude protein (17.46%), crude fat (2.84%) and crude fibre (0.99%) while Pressure Cooked Peroles (PCP) had values of crude protein (20.22%), crude fat (2.94%) and crude fibre (0.91%). There was comparable value of ash content in all the samples except for BDC with the least. The decreasing order of anti-nutrient factors in treated cowpeas is: RWC > PCC > BDC. This result inferred that boiling is an adequate processing for drastic reduction of the anti-nutrient factors (phytate) in perole. Total polyphenol content (TPC) of the pressure cooked & boiled samples significantly ($p \leq 0.05$) decreased but the DPPH scavenging activity in both samples significantly ($p \leq 0.05$) increased. The macro elements composition of perole showed that heat processing amounted to loss of nutrients; this may be due to leaching during heat application. Boiling and pressure cooking had increased the amount of this macro element content when compared with the raw sample. Therefore, it could be concluded that the heat treatments had significantly reduced that anti-nutrient factors in perole. More research should be conducted into ways of reducing anti-nutritional factors, improving in-vitro protein digestibility (IVPD) and improving cowpea proteins.

Effect of Germination on the Mineral Compositions and Anti-nutritional Factors of Perole (*Vigna unguiculata* L) Seed, a Wild Cowpea Grown in Bangladesh

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Abstract
The work was carried out on a sprouted cowpea variety locally called “perole” in Chittagong region to study its mineral composition, total polyphenol content and antioxidant activity Germination is one of the most effective processes to improve the quality of legumes. The study was conducted to investigate the effect of germination on the mineral Compositions and Anti-nutritional Factors of Perole (*Vigna unguiculata* L) cowpea seeds. This research showed that germination had increased the amount of macro elements (0.0033 mg/kg for Na, 0.020 mg/kg for K, 0.025 mg/kg for Ca, 0.039 mg/kg for P, and

0.022 mg/kg for Mg). Germination reduces phytic acid content. The breakdown of phytic acid during germination could be due to increase in the activity of endogenous phytase for its use as source of inorganic phosphate during germination. Germination resulted in minimum reduction in polyphenol content in parole that may be because of the presence of polyphenol oxidase and enzymatic hydrolysis Therefore, germination (sprouting) significantly reduced that anti-nutrient factors in perole and had excellent nutritional qualities. Future research work should be carried out on combination of heat treatment with germination to reduce the anti-nutrient factors in grain legumes.

Nutritional and Functional Properties of Some Indigenous Rice Varieties Cultivated in Haor Areas of Keshoregonj District

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Abstract

An analytical laboratory experiment was conducted at the Department of Biochemistry and Molecular Biology, Bangladesh Agricultural University, Mymensingh. The experiment was accomplished with seven indigenous rice varieties namely Pijam, Lakhaiya, Rata boro, Topa boro, Zira, Kalizira and Katari. They were collected from local field from Tarail and Mithamain haor of Kishoreganj district. The samples were collected directly from the farmers of the haors to know the physical, chemical and functional properties. Among the physical parameters, 1000 grains weight was highest for Lakhaiya (17.8g), whereas slender shaped Zira showed the highest length/wide ratio (4.28). Among the proximate composition; Rata boro contained more moisture (13.67%), Katari was the best performer for carbohydrate (76.54%) and amylose contents (28%), Pijam for fat (4.89%) and energy contents (379.22 kcal/100g), Topa boro for protein (11.12%) and ash contents (4.45%) and Zira rice variety for crude fiber (3.03%). Functional properties; bulk density, fat absorption capacity, water absorption capacity, oil absorption capacity, foaming capacity, the least gelation concentration, gelatinization temperature, swelling capacity of rice varieties were also studied. Kalizira flour was found to hold the highest value for water absorption capacity (203.41%) and emulsion activity (24.88%). Rata boro and Top boro was the highest performer for bulk density (0.62 g/ml), whereas Rata boro, Lakhaiya and Pijam showed the maximum swelling capacity (0.96%) and Lakhaiya found to be the best for oil absorption capacity (214.41%). All the examined varieties showed the alike performance for least gelation concentration at 14%. Similarly, all the varieties formed gel at 100 ºC excepting Rata boro, which formed gel at 70 ºC. Although there are variations in the properties of the rice varieties but the above stated results may be considered for healthy and nutritious food preparation at home and others and also in formulation of rice-based food products.

Post-harvest Shelf Life Prolonging of Cherry Tomato (*Lycopersicon esculentum*) by Edible Coating

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Abstract

Edible coatings using natural biomaterials are being explored as a safer alternative to synthetic antioxidants and preservatives to extend the post-harvest shelf life of perishable food crops and to improve food appearance. Recently, an edible coating based on *Aloe vera* gel has been used to increase the shelf-life of various fruits and vegetables for their storage. The present study was aimed at

investigating the effect of *Aloe vera* gel alone and in combination separately with oil and alginate to increase the shelf-life of cherry tomatoes. The experiment consisted of four post-harvest treatment groups and a control group. The cherry tomatoes were coated with 10% *A. vera*, 15% *A. vera*, oil + 15% *A. vera,* and alginate + 15% *A. vera,* and after that, the samples were stored at room temperature for 14 days. The biochemical parameters such as vitamin C and lycopene content, TPC, antioxidant properties, TA, pH, color, and firmness of the fruits were examined on the 7th and 14th day of storage. The color (l*, a*, b*) of cherry tomatoes did not differ among the treatment groups. Vitamin C and lycopene content decreased throughout the duration of all groups. However, those coated with 15% *A. vera* fruits exhibited the best in decreasing the same. Expectedly, the antioxidant activity was the highest for 15% *A. vera* treated fruits among all groups. Therefore, I conclude that 15% *A. vera* coating could be considered a promising treatment for prolonging shelf life and maintaining the quality of cherry tomatoes during post-harvest storage.

Assessing Interrelationship Among Glycemic Index with Physicochemical Traits of Common Rice Varieties in Bangladesh

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Abstract

The current study was conducted to evaluate the physicochemical traits and cooking properties of some common rice varieties in Bangladesh and to assess the interrelationship among glycemic index with them. Three rice groups such as local (Pajam, Kataribhog, Nizersail, Jirasail, Rata Boro, Binnaful and Ganjia), hybrid (Heera2, BRRI hybrid dhan2, BRRI hybrid dhan3, BRRI hybrid dhan4, BRRI hybrid dhan5, BRRI hybrid dhan6 and BRRI hybrid dhan7) and high yield variety (BRRI dhan50, BRRI dhan63, BRRI dhan70, BRRI dhan75, BRRI dhan81, BRRI dhan86 and BRRI dhan92) were collected from Bangladesh Rice research Institute (BRRI). The physicochemical properties such as rice length, breadth, length-breadth ratio, moisture content, head rice yield, milling outturn, chalkiness etc. were measured in BRRI according to established protocols. Amylose content along with other cooking parameters such as cooking time, grain elongation, water uptake ratio, gel consistency (GC), alkali spreading value, gelatinization temperature (GT) were determined in Bangladesh Agricultural University. Based on the physicochemical traits' mean performance Jirasail, BRRI hybrid dhan7 and BRRI dhan63 was the best performer among their respective groups. According to head rice yield (%) and milling outturn (%) the premium quality grain were Pajam, Kataribhog, Nizersail, Heera2, BRRI hybrid dhan2, BRRI dhan63, BRRI dhan75, BRRI dhan86 and BRRI dhan92. Lowest chalkiness (%) were observed in Nizersail (0.057%), BRRI hybrid dhan7 (2.44%) and BRRI dhan75 (0.34%). High GT were found in Jirasail and BRRI hybrid dhan7. Out of 21 varieties medium GC was observed in 11 rice verities. Determination of glycemic index values is still going on.

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Evaluation of Nutrient Composition, Phytochemistry and Pharmacological Potentials of Marine Algae Collected from the Coasts of Bay of Bengal

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Abstract
Seaweed is becoming increasingly popular as food materials due to its essential nutrients and bioactive compounds. Nutrient composition and phytochemical profile of five seaweed were examined. The proximate analysis revealed the highest protein (19.99%) and dietary fiber (26.82%) in *Gracilaria tenuistipitata*, crude fat (3.85%) in *Spatoglossum asperum* and ash (14.71%) in *Hypnea boergesenii*. Mineral analysis showed significantly higher levels of calcium and sodium in *H. boergesenii* (756.924 and 17.62 mg % DM, respectively), potassium in *S. tenerrimum* (523.77 mg% DM), iron in *Enteromorpha intestinalis* (98.27 mg% DM), copper in *S. tenerrimum* (2.24 mg% DM) and zinc in *S. asperum* (1.90 mg% DM). Phytochemical screening confirmed the presence of tannins, saponins, alkaloids, and flavonoids in algae. Chlorophyll and carotenoid were highest in *E. intestinalis* **(**1.57 mg/g**)** and *S. asperum* (0.19 mg/g), respectively. Taken together, these results indicate that seaweed could be a rich source of essential nutrients and bioactive compounds, suggesting their use as promising functional food ingredients for human well-being.

Biochemical and Physiological Traits as the Determinants of Shelf Life Variation of Tomato (*Solanum lycopersicum* Mill.) at Different Packaging Conditions

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Abstract
Various post-harvest techniques along with storage duration determine the shelf-life of tomato which in turn could be involved in reducing nutrient contents. For assessing and selecting the best post-harvest technique as well as suitable storage duration BINA tomato-6 was grown in 12×12 inches experimental pots in the department of Biochemistry and Molecular Biology, BAU, Mymensingh. Post-harvest techniques involved here were control T_0 (open room storage), air-tight polybag T_1 (room temperature), perforated polybag T_2 (room temperature), refrigerated air-tight polybag T_3 and refrigerated perforated polybag T_4 for 0 day, 4^{th} day, 7^{th} day and 10^{th} day duration. Nutrient contents such as moisture content, vitamin C (titrative method using dye), lycopene (spectrophotometric measurement at 453nm, 505nm, 645nm and 663nm with hexane and acetone as 6:4), reducing sugars (spectrophotometric measurement at 575nm with ethanol, DNS, phenol and Na-k-tartrate), total sugar (spectrophotometric measurement at 620nm with ethanol, H_2SO_4 and anthrone), β-carotene (spectrophotometric measurement at 480nm and 510nm using 80% acetone) in tomato were measured using established protocols at different storage condition and duration. In T_0at 0 day, moisture content vitamin C, lycopene, reducing sugar, total sugar and β-carotene were 95%, 13.7mg%, 2.57mg%, 1.25%, 3.57% and 380µg/100g, respectively. In progress with time there were significant reduction trend in all nutrients. However, in case of T_3 at 4^{th} day, parameters such as moisture content, lycopene,

total sugar, reducing sugar and β-carotene were not statistically (5% level of significance) varied. Thus, it may conclude that refrigerated air-tight polybag condition for four days would be a suitable choice as packing technique and duration in maintaining nutrient content in BINA tomato-6.

Evolving Commercial Medicinal Plants Based Agroforestry Practices in the Madhupur Garh, Bangladesh

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Abstract
Agroforestry production systems are often neglected for its role in meeting the SDGs on food security, poverty and climate change. Low-productive agroforestry practices also provide food and ecosystem services to more than 22 million poor families in Bangladesh. The experiment was conducted at a village, Gaira, in Madhupur Garh during the period from July 2021 to June 2022 to investigate the growth and yield performance of commercial medicinal plants (Aloe vera, Ashwagandha, Kalmegh and Shatamuli) cultivated as understory crops in the existing agroforestry practices as well as to analyze the economic profitability of potential local agroforestry practices in Madhupur Garh, Bangladesh. The study considered four agroforestry practices, viz. Akashmoni – Aloe vera, Akashmoni – Ashwagandha, Akashmoni – Kalmegh and Akashmoni – Shatamuli in the Madhupur Garh. Results showed that the performance of medicinal plants (Aloe vera, Ashwagandha, Kalmegh and Shatamuli) in terms of growth and yield was greater in open conditions than under agroforestry. The production of the medicinal crops was not satisfactory under agroforestry as yield reduction varied between 16-39%. Yield of Kalmegh was found 3.33 tha^{-1} under agroforestry system. In order to evaluate the economic performance, data related to tree and crop parameters were collected from the respective agroforestry practices in order to calculate the incurred cost, gross return, net profit and benefit-cost ratio (BCR). Among the four identified agroforestry practices, the highest gross return and net profit were obtained from the Akashmoni-Kalmegh based agroforestry practice (BCR 1.30). Therefore, the study argued for Kalmegh medicinal plant-based agroforestry practices in the Madhupur Garh and its dissemination.

Enhancing Livelihood and Food Security of the Poor Farmers through Inclusion of Improved Agroforestry Models in the Madhupur Garh of Bangladesh

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Abstract
In the last few decades, agroforestry approaches in depleted forestland have gained enormous shift from traditional forest management to more people-oriented approaches in Bangladesh. The agroforestry practices in the forestland have involved local farmers in order to improve their livelihoods and food security. Therefore, the study was undertaken to identify the potential agroforestry practices and improve those practices through a field trial in order to enhance income-generation and contribute to the food security of local farmers living in the Madhuur Sal forests of Bangladesh. Using different qualitative and quantitative data collection techniques, the study identified mainly eight types of agroforestry practices, and after a field trial, we identified four improved models

that were highly productive, which were comprised of pineapple, ginger, turmeric and aroid crops in association with Acacia trees. The economic analysis showed that the Acacia-Ginger agroforestry model gave the highest gross income, however, in terms of the benefit-cost ratio, the aroid-based agroforestry model was the most profitable production system in the Madhupur Sal forests area. Moreover, these agroforestry models have simultaneously improved poor participants' social, physical, human and ecological assets, and also ensured their family's food sufficiency throughout the whole year. So, the study argues that potential agroforestry models not only provided economic returns but also augmented the livelihoods of the poor participants and thus ensured the food security of the agroforestry farmers. Therefore, the study recommended improved agroforestry models for scaling up in the entire Madhupur Garh so as to improve the livelihood and food security of the local farmers.

Production of Commercially Valuable Medicinal Plants (Kalmegh, Shimulmul, Aloe Vera, Ashwagandha) in the Established Agroforestry Systems for Improving Farmers' Livelihood in the Charland of Mymensingh, Bangladesh

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Abstract

On-field four experiments were carried out at Char Kalibari under Sadar Upazila of Mymensingh district during the period from July 2021 to June 2022 to evaluate the performance of four medicinal plants (MPs) (Kalmegh, Shimulmul, Ashwagandha, Aloe vera) grown under existing agroforestry systems. Each experiment comprised 12 plots where the selected MPs individually were intercropped under the Mahogany, Mango, and Malta tree along with control plot (without tree) designated as T_0 (control), T_1 (Mahogany), T_2 (Mango), and T_3 (Malta). For each experiment, the design was RCBD with three replications. The results of Experiment-1 showed that plant height (cm), number of leaves/plant and leaf area (cm^2) of the Kalmegh plant varied significantly but no significant variations were found in the yield parameters among the agroforestry systems. The highest plant fresh weight (10967kg/ha) was obtained at T_3 treatment (Kalmegh+Malta) and the lowest plant fresh weight (9800kg/ha) was obtained at T_0 treatment. According to the results of Experiment-2, root diameter (cm), fresh weight and dry weight of root/plant (g), fresh weight and dry weight of root (kg/ha) of Shimulmul plant did not significantly influence by the different tree species. The highest fresh root weight (19731kg/ha) was recorded from the Shimulmul+Mango combination whereas the lowest fresh root weight (17313kg/ha) was recorded from the Shimulmul+Malta combination. The results of Experiment-3 showed that different tree species had no significant effects on the yield performance of the Ashwagandha plant as an agroforestry practice. But numerically the maximum root fresh weight (545.33kg/ha) was obtained at the control plot and the minimum root fresh weight (433.23kg/ha) was found at the Ashwagandha+Malta combination. Unfortunately, Experiment-4 on Aloe vera cultivation under various agroforestry systems has not been completed yet. From the results of each experiment, the MPs performed well under different tree species in an agroforestry situation. Therefore, it can be concluded that the cultivation of medicinal plants under existing agroforestry systems could be a viable approach to increase farm productivity and upgrade the livelihood of the farmers in the Charland areas of the Mymensingh district.

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Estimation of Stand Composition, Diversity, Soil Nutrients and Carbon Sequestration Potentials of Cropland Agroforestry Practices in Different Land Ecosystems in Bangladesh

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Abstract
Cropland agroforestry practices are widely implemented over different land ecosystems in Bangladesh to provide multiple benefits to farmers as well as contribute to climate change mitigation. A study was conducted to observe the stand diversity with particular emphasis on its composition, soil nutrients, and carbon stock potentials of three land ecosystems. A total of 150 sample plots were measured from the cropland agroforestry practices of the three land ecosystems viz. Forestland ecosystems, Plainland ecosystems, and Charland ecosystems are considered treatments. To explore the soil's nutrient status and carbon stock, a total of 300 soil samples were collected from each both 0-15 cm and 15-30 cm soil depth from each land ecosystem. Through field observation and tree inventory, the highest 22 tree species (18 families and 17 genera) were recorded from the plainland ecosystem. The highest Shannon-Wiener index (2.66), Simpson index (0.92), and species evenness (0.846) were found in cropland agroforestry in forestland ecosystems than both plainland ecosystems and Charland ecosystems. Furthermore, the highest tree stand density (602 individuals/ha) was recorded from the Charland ecosystem and the lowest tree stand density (577 individuals/ha) was obtained from the forestland ecosystem. The results inferred that organic matter (2.30%), total N (0.13%), P (57.32 ppm), and K (0.389 meq/100g) contents were found to be higher at forestland ecosystems at both 0-15 and 15-30 cm soil depth. The highest total biomass carbon (287.504 Mg/ha) and total carbon stock (373.335 Mg/ha) were estimated in forestland ecosystem and the lowest total biomass carbon (178.434 Mg/ha) and total carbon stock (236.05 Mg/ha) were estimated from Charland ecosystem. Therefore, it is concluded that cropland agroforestry in forestland areas is richer and more diverse; increases soil nutrient status, and sequestrates more carbon stock than the other two land ecosystems in Bangladesh.

Development of Cotton-based Agroforestry Model for Farmers' Livelihood Improvement in the Charland Areas of Bangladesh

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Abstract
Bangladesh has many unproductive wastelands that can be produced through different agroforestry practices (AFPs). Among them, Charland is the most important venue for practicing AFPs. A Ministry of Education (MoE) funded project was conducted from July 2019 to June 2022 at Char Kalibari Village under Sadar Upazila of Mymensingh district to evaluate the potentiality of cotton cultivation in agroforestry systems and develop a cotton-based agroforestry model for enhancing farmers' livelihood in Charland ecosystem. A two factorial Randomized Complete Block Design (RCBD) experiment was carried out with sole cropping and three tree species viz; T_0=Cotton sole cropping (Control), T_1=Mahogany, T_2=Mango, T_3=Guava and three varieties viz; V_1=White Gold-1 (T J6-2), V_2=CDB 12 and V_3=CDB 14. The result revealed that the highest number of balls/plant (44.12), seed cotton

weight/plant (169.12gm), and seed cotton yield (4.67t/ha) was found at the T0 control plot with the V_1 variety. Among the tree-cotton variety combinations, the highest number of balls/plant (41.99), seed cotton weight/ball (3.88gm), seed cotton weight/plant (161.91gm), seed cotton yield (4.47t/ha) was found in Mahogany×Hybrid cotton variety combination which was statistically similar to Mango×Hybrid and Guava×Hybrid cotton combinations. Moreover, the economic profitability of those cotton-based agroforestry practices was calculated. The highest (313360Tk/ha and 1.98) net profit and BCR were recorded in the Guava×Hybrid cotton followed by Guava×CDB 14 (267807Tk/ha and 1.84), Mango×Hybrid (245160Tk/ha and 1.72) and so on. In the case of the Mahogany + cotton combination, the tree component was in the establishment stage. So, the economic output of these systems was nil. As a result, the net profit and BCR of these systems were low except for Mahogany×Hybrid which was (197671Tk/ha and 1.70). In addition, the highest average total biomass carbon (0.366 Mg/ha) was found in Guava and the second average highest total carbon stock (0.319 Mg/ha) was found in the Mahogany tree. The tested soil chemical properties were found to be higher at cotton with Mahogany tree combinations. Therefore, it can be concluded that the cultivation of cotton in combination with different trees was found feasible and economically profitable but Guava×Hybrid, Guava×CDB 14, Mango×Hybrid and Mahogany×Hybrid cotton combinations will be suggested to practice for improving farmers' livelihood in Charland ecosystem of Bangladesh.

Agroforestry Models Development and Productivity Evaluation for Sustainable Agricultural Production

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Abstract

This research was conducted in the field laboratory of the Agroforestry department, Bangladesh Agricultural University, Mymensingh to develop sustainable agroforestry models with different fruit and medicinal tree species. Mango, guava, malta and dragon plant were used as fruit tree species. Amloki, bohera, horitoki and sajna plants were used as medicinal tree species. Different winter vegetables (spinach, radish, mustard, red amaranth, carrot, turnip etc.), summer vegetables (stem amaranth, kangkong, Indian spinach etc.) and annual root crops (turmeric, ginger, Mukhi kachu, panchamukhi kachu etc.) were cultivated with the above fruit and medicinal tree species. During this research period (July 2021 to June 2022) three research experiments were conducted viz. (i) Performance of different vegetables with different fruit tree species as agroforestry practices, (ii) Different vegetables/crops cultivation as intercrops with dragon fruit plantation, and (iii) Performance of turmeric-based agroforestry practices with different tree species. Based on the research results it was found that the yield of all studied crops decreased (18-35%) in association with the studied fruit and medicinal tree species. It was also found that the yield of all studied crops decreased towards the base of all studied fruit and medicinal tree species. The yield of tree components (fruit and medicinal trees) was not significantly varied with and without crop combinations but numerically ≤ 5% lower yield was recorded under intercropping conditions. The Land Equivalent Ratio (LER) of all tree-crop combinations was 1.41 – 1.81, which indicates 41 - 81% yield advantage i.e., under monocultures, 41 - 81% more land would be needed to match yields from the intercropping or agroforestry practices. Benefit Cost Ratio (BCR) analysis also support the LER analysis information which indicates all studied intercropping scheme or agroforestry practices are productive. Among the different studied intercropping practices turmeric and dragon plant-based intercropping practices are more profitable and productive.

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Detecting Salt Tolerance in Wheat Germplasm by hydroponic and pot culture and Analyzing Salinity Related Gene Expression

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Abstract
Wheat is the staple food grain next to rice. It fulfills global food demands by producing 30% of total cereal crops. Soil salinity causes significant loss of crop yield. In Bangladesh, about 1.51 Mha of arable lands are affected by varying degrees of salinity and about 53% of the coastal soils are salt-affected. More than 50% of arable land worldwide could be salt-affected by 2050. The present study aimed to detect diversity for salt tolerance in wheat Germplasm by morph-physiological attributes using hydroponic and pot culture, to Identify Salt tolerant wheat Germplasm by hydroponic and pot culture, and to analyze Salt tolerant gene expression under saline and non-saline condition. Twenty wheat genotypes were used for hydroponic culture. Twelve days old wheat seedlings were imposed with salt stress by adding crude salt (0, 8, 12, and 15 dS/m salinity) supplemented with nutrient solution in a hydroponic system. The pH (5.1-5.2) and EC of the nutrient solution were maintained properly. The experiment was arranged in Complete Block Design (CBD) with 3 replications. Data were collected on Shoot and root length, Number of Roots (at the seedling stage), Shoot length (Final), Shoot and root fresh weight, Shoot, and root dry weight, Spike length, Number of fertile and sterile spikelets, Total number of spikelet, Number of wrinkle seeds, Total number of seeds, Seed yield per plant and 100-seeds weight. Based on the SES and salt tolerance index (STI) using morphological traits, the genotypes were grouped into tolerant, moderately tolerant, and sensitive. At 15 dS/m salt stress, BARI Gom-29, BINA Gom-1, BWMRI Gom-2 were identified as salt-tolerant genotypes. Six genotypes were moderately tolerant and the rest 11 were sensitive. Pot culture is going on with three tolerant, two moderately tolerant, and two sensitive genotypes to analyze the expression of four genes related to salinity tolerance.

Biochemical and Gene Expression Analyses in Rice Seedlings Under Submergence Stress

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Abstract
Plants need water for survival but surplus water is harmful or even lethal. Nowadays, submergence stress is considered as the most important limitation of rice production contributing to its low productivity in lowland and rainfed ecosystem. Characterization of genotypes and using them in breeding programme is likely the best option to withstand submergence and stabilize productivity in these environments. This study aimed to identify tolerance mechanisms by characterizing biochemical and alcoholic fermentation genes expression of rice genotypes under submergence stress as well as recovery. Therefore, eight rice genotypes namely FR13A, BRRIdhan29 BINAdhan11, BINAdhan12, BINAdhan23, BRRIdhan51, BRRIdhan52 and BRRIdhan79were evaluated. Among them, FR13A and BRRIdhan29 were used as submergence tolerant and submergence sensitive checked varieties, respectively. The biochemical parameters studied, namely, proline, chlorophyll, protein, starch and antioxidant enzymes (catalase and peroxidase). In addition, alcoholic genes expression (*Adh1* and *Pdc1*) was also studied under submergence and recovery condition. In this study, BRRIdhan79 and

BRRIdhan51 showed higher content of proline, chlorophyll, protein, starch, antioxidant enzymes (catalase and peroxidase) and higher upregulation of alcoholic genes, *Adh1* and *Pdc1*. These two genotypes had a clear distinction in biochemical properties and gene expressions under submergence and desubmergence. Rice genotypes, BRRIdhan79 and BRRIdhan51 can be considered as highly tolerant to submergence based on the experiment. Evolved information can be exploited for further breeding purpose in developing submergence tolerant rice varieties and identified genotypes should be used for further studying for broader adaptation of submergence tolerance.

Physio–biochemical and Stress–responsive CIPK Genes Expression Analysis in Some Selected Rice Varieties under Salinity Stress to Enhance Food Security

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Abstract
Salinity is one of the most brutal environmental factors that limit plant growth and yield of a wide variety of crops including rice. Under high salinity, rice plants show various morphological, physiological or biochemical and molecular alterations. Therefore, the proposed study has taken to understand the adaptive mechanism of rice varieties against salinity based on physio-biochemical characteristics and stress-responsive, *CIPK9* gene expression analysis. Ten rice genotypes BINAdhan8, BINAdhan10, BINAdhan16, BINAdhan23, BRRIdhan40, BRRIdhan47, BRRIdhan54, BRRIdhan61, BRRIdhan67 and IR29 were studied under 0, 6 and 10 ds/m salt stress in a hydroponic system. Under salt stress, Physio–biochemical characteristics **(**shoot and root length, proline, protein, sugar, catalase and H_2O_2) and stress–responsive *CIPK9* gene expression were analyzed. In the experiment, higher shoot and root length, higher content of proline, protein, sugar, catalase activity, higher upregulation of *CIPK9* gene expression and lower H_2O_2 were observed in BINAdhan8, 23, BRRIdhan61 and BRRIdhan67 with the increase of salinity level. Therefore, these genotypes were identified as the most tolerant genotypes to the salinity stress based on the experiment. The result obtained in this study will help for the breeding programme for the development of salt tolerant rice in Bangladesh.

Utilization of *Saccharomyces Cerevisiae* as Biocontrol Agent Against Important Diseases of Vegetable Crops

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Abstract
In view of the growing concern about the impact of synthetic pesticides on human health and the environment, a significant number of studies have been carried out in recent decades with the aim of finding a biological alternative to inhibit the growth of plant pathogens. A common fungus, *Saccharomyces cerevisiae* yeast occurs in all environments and has been described as potent antagonists of various plant pathogens. Due to their antagonistic ability, undemanding cultivation requirements, and limited biosafety concerns, many of these unicellular fungi have been considered for biocontrol applications. In this study, four isolates of *S. cerevisiae* yeast were evaluated for their

biocontrol potential against *Colletotrichum capsici*, the causal agent of anthracnose in Chilli and *Ralstonia solanacearum*, the causal agent of bacterial wilt in solanaceous vegetables. Putative mechanisms of action associated with the biocontrol capacity of *S. cerevisiae* yeast isolates against these two plant pathogens were studied through *in vitro* analysis. Findings from dual culture test revealed that *S. cerevisiae* isolates effectively inhibited the growth of *Colletotrichum capsici* and *Ralstonia solanacearum*. The diffusible elements and volatile organic compounds produced by *S. cerevisiae* isolates could be useful in the biological control of these plant pathogens. *S. cerevisiae* yeast isolates also produced significant amount of the hydrolytic enzyme such as protease and Cellulase which helps in the plant defense mechanism. In addition, production of significant amount of plant growth regulator i.e; Indole Acetic Acid (IAA) were also observed from *S. cerevisiae* isolates. IAA play very important role in plant growth and development. Therefore, S. *cerevisiae* isolates can be utilized as potential biocontrol agent with low environmental impact which allows a crop protection strategy in sustainable agriculture.

Genetic Audit of Hilsa Shad (*Tenualosa ilisha*) Across Its Distribution Range

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Abstract

In order to investigate genetic variation among different stocks of hilsa (*Tenualosa ilisha*) using morphological parameters and cytochrome b gene analyses, we collected 113 whole fish and 400 fin tissues from 6 different locations from Bangladesh namely Chandpur district, Goalanda of Rajbari district, Hakaluki haor of Moulavibazar district, Kuakata of Patuakhali district, Sundarban of Khulna district and Goadagari of Rajshahi district, as well as 2 locations from Iraq viz. the Arabian Gulf and the Shat-al-Arab. A total of 18 morphological measurements and 8 meristic counts were recorded from the collections. Based on the analyses of meristic counts it was found that the fish of the Arabian Gulf were close to those of the Shat-al-Arab. Similarly fish of Kuakata were close to those of Chandpur. Fish from Hakaluki haor stock showed much more differentiation from other 7 stocks. In multivariate analysis of variance of morphometric characters, significant differences were found between Bangladesh and Iraq stocks but no significant difference was found between two Iraq stocks. Substantial differences were found in some pairs of Bangladeshi stocks. Analysis of cytochrome b gene of hilsa from six Bangladesh stocks showed 99.47% to 99.87% sequence homology with *T. ilisha* mtDNA cytochrome b gene (GenBank Accession Number: AP011611.1 and AP011610.1). Multiple sequence alignment detected eighteen polymorphic sites in which fifteen and three sites were silent and missense mutations, respectively. The Khulna stock had the highest number of polymorphic sites (10), whereas Chandpur had eight and each of the other four stocks had seven. Likewise, the Khulna stock had the highest number of haplotypes (8), whereas the Hakaluki had the lowest (4). Khulna stock also showed the highest intra-population mean genetic distance (0.00306) whilst the Kuakata had the lowest (0.001704). The genetic distance between Khulna and Goalanda stocks was the highest (0.0030) whereas the lowest value (0.0017) was found between Kuakata and Hakaluki stocks. The overall haplotype diversity and nucleotide diversity were 0.81473 and .00227, respectively. The genetic differentiation (F_{ST}) between stocks ranged from 0.06009 to 0.10165. Overall F_{ST} value (0.00388) was found to be insignificant with a P-value of 0.3229. The phylogenetic tree showed admixture of fish from different stocks reflecting existence of a high level of gene flow of the migratory species. Genotyping of fish from different stocks using single nucleotide polymorphism marker is going on.

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GIS-based Approach of Quantifying and Mapping Carbon Sequestration of Medicinal Plants at Germplasm Center of Bangladesh Agricultural University

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Abstract
The ongoing rapid urbanization will influence the vegetation with huge reduction of green spaces, which eventually enhance emission of Greenhouse gases like CO_2. The purpose of this study is to investigate the amount of carbon sequestration and to construct a carbon stock map within the 32 acres of the World's 2nd largest fruit repository named BAU Germplasm Center (GPC). The methodology involves the steps of calculating the amount of CO_2 sequestered in a tree year^{-1}, determining the total (green) weight of the tree, determining the dry weight of the tree, determining weight of C in the tree, determining weight of CO_2 sequestered in the tree, and finally determining the weight of CO_2 sequestered in the tree year^{-1}. For this study only perennial tree species are considered within the huge area of BAU-GPC. The total tree count is Mango (3820), Areca palm (2570), Weeping debdaru (1782), Guava (1438), Jackfruit (1343), Coconut (1305), Koroi (637), Akashmoni (602) and Mahua (565). The top 10 CO_2 sequestering species are Koroi, Shimul, Ficus, Rubber fig, Debdaru, Teak, Christmass tree, Minjiri, Burlflower and African Mahogony. They are sequestering CO_2 at a rate of 409.47, 338.71, 154.86, 453.82, 327.56, 274.88, 207.39, 250.99, 250.87 and 259.16 pounds year^{-1}, respectively. A couple of carbon stock map has been constructed dividing the whole study areas into several blocks that shows the necessity of conserving perennial tree species in a priority basis. Furthermore, these data will support Carbon Credit under CDM that established under Kyoto Protocol for developed country to mitigate greenhouse gas emission.

Exploring Water Pollution of Major Three Rivers – focusing Social and Environmental Impact Assessment

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Abstract
The river is an important component of the environment that carries freshwater keeping a boundless significance for harmonizing a suitable environment on the earth. But most of the rivers of Bangladesh especially near the cities are being polluted through discharging various wastes such as industrial wastes and household wastes without taking any measures and treatments into it. Padma, Meghna, and Jamuna are the major rivers of Bangladesh, which have become highly polluted in recent years. This study has been undertaken to investigate the water pollution scenario and assess the social impact of water pollution of the three major rivers on human health, society, and the environment. Metal contamination of sediment of Padma, Meghna, Jamuna and its possible health impact on the local people were evaluated at three different sites from Oct 2019 to September 2021. Followed by wet digestion, the water and sediments/soil samples were analyzed by Atomic Absorption Spectrophotometer. In water samples, the mean concentration of Cu, Fe, Zn, Pb, Cd, Ni, and Cr were 20.92, 179.06, 1.35, 1.42, 2.16, 7.05, and 2.80 ppm, respectively in Padma. In Meghna river, water samples contain 8.52, 23.78, 11.08, 1.02, 0.02, 7.05 and 0.14 ppm respectively. In the case of Jamuna river water, the metals were assessed 13.20, 98,44, 18.32, 2.45, 0.32, 2.25, and 3.50 ppm respectively.

Based on the permissible limits of EPA, the measured metal concentrations of all water samples of studied three rivers exceeded the limits rather than Cd concentration in Meghna river water. All sediment samples of Meghnariver contain the highest concentrations of Cr, Pb, Ni, Cd, Mn, As, Cu, and Zn ppm than Padma and Jamuna rivers. Therefore, the sediment of the rivers was not contaminated enough to prevail high risk on the ecological health of the river and to pose health risks on local people, but regular practice of discharging contaminants can somehow worsen the river quality in the coming years. Results indicate that concentrations of major elements in the river water were related to the source of the agricultural, industrial and municipal sewerage linked with river channels. Some metals were even above irrigation standards in water from several rivers. Sediment data showed very much higher metal concentrations in most of the rivers especially peripheral rivers in Dhaka and Karnaphuli, Korotoa, Teesta, Rupsha, and Meghna River. Metal concentrations in sediment were above the US EPA threshold value in most of the rivers. Metal concentrations in fish and agricultural crops showed that bioaccumulation of metals had occurred. The concentration of metals showed a trend like water. Most of the industries are established on the bank of the rivers. Thousands of tons of waste materials have been released into the river water every day. Though there are rules and regulations, people do not obey them properly. Industrialists are unwilling to run the effluent treatment plants (ETP) due to high-profit goals despite having those plants. As a result, river water becomes toxic for living biota. The agricultural area close to the polluted river is affected as well. Farmers using this polluted water for irrigation made the toxic materials enter into the food chain and ultimately come to humans. The poor usually use this polluted water for washing and cooking, which is very harmful. Lack of proper management of industrial wastages release and lack of proper implementation of the policies are the main reasons for it. The scenario of water pollution of the river can be improved by considering the recommendations of the study which can bring positive changes to the human and aquatic life, environment, and ecosystem of the river area.

Characterization of Dew and Rain Water of Different Regions of Bangladesh- Focusing Pollutants Deposition

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Abstract

Dew is water in the form of droplets that appear on thin exposed objects in the morning or evening due to condensation. Dew water is the result of atmospheric vapour condensing on a substrate that has cooled down because of a radiation deficit. Dew is the product of direct condensation of atmospheric water vapour on the ground, which has fallen below the dew point but not as low as water is freezing point. To explore the properties of dew and rain water and their probable impacts on environmental pollution this study was conducted. The experiment was conducted based on characterization of dew and rain water focusing pollutants deposition in selected regions of Bangladesh. Sampling was done manually by locating plastic pots on open air areas (in order to contaminate pollution). Dew collection was made just after the beginning of winter season. The collection of dew samples was taken only on rainless night to eliminate the influence of precipitation. To avoid the effects of haze or rain on the particle concentration of air, all dew water samples were collected before sunrise. Rain water collection was made just after the beginning of precipitation events and until it stopped. A total of 90 rain and 90 dew samples (with three replications), were collected. Samples were collected during or immediately after a deposition event. They were stored at a low temperature without chemical preservatives because the analysis was performed in the laboratory. pH, EC, metals (Zn, Pb, Cr, and

Cd) were measured accordingly. Rain water and dew water were collected, filtration and laboratory preparation were completed and laboratory analysis is on-going till the end of the project. Few samples were analyzed and the rest of the activities (sample collection and analysis) of different regions are on-going. Based on the obtained data, the mean pH values are found for dew was 7.1 in Mymensingh and 7.19 in Dhaka and for rain 7.13 in Mymensingh and 6.62 in Dhaka. The pH values of dew are higher than that of rain samples. Rain water was slightly more acidic than dew. The mean EC value for dew was 448.2 µS/cm in Mymensingh and 566.2 µS/cm in Dhaka and the EC value for rain were 1022µS/cm in Mymensingh and 739.8 µS/cm in Dhaka. The EC values of rain samples are found higher than that of dew samples. The concentration of trace metals ranged in order with Zn> Cr> Cd> Pb and the concentration of Zn found in higher value and exceed the WHO recommended limit and the concentration of Cr and Cd are found below the detection limit and no Pb is found in any sample. The respective analysis supported that the increasing pollution levels have significant influence on the dew and rain water chemistry in Mymensingh and Dhaka city. Further results and their comparison will be focused after completion of the project works.

Assessment of Heavy Metals Contamination in Soils of Road Sides and Agriculture Fields: Focusing the Effects of Vehicles Emission

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Abstract

This study has been conducted to assess of heavy metal contamination in soils of road site from Mymensingh to Valuka focusing the vehicles emission and know the soil physio-chemical properties of the study area. Sixteen (16) soil samples were collected consisting of road side traffic area soil and adjacent to road side near agricultural field soil (within 100m) in January 2019. The samples were digested with acid mixture (HNO_3:H_2O_2 =5:2) and then the concentrations of four heavy metals Zn, Pb, Cr, and Cd were determined using Atomic Absorption Spectrophotometer (AAS). The concentrations of heavy metals in road site soil ranged from 51.167- 93.421mg/kg Zn, 11.061 – 55.675 mg/kg Pb, 10.001 – 15.917 mg/kg Cr, 0.002- 0.049 mg/kg Cd. The concentrations of four heavy metals Zn, Pb, Cr, and Cd in agricultural field soil were ranged from 59.865- 84.760 mg/kg,8.005- 18.675 mg/kg,8.516- 17.667 mg/kg and 0.001- 0.189 mg/kg. For assessing the contamination levels of heavy metals, contamination factor (CF), degree of contamination (Cd), index of geo-accumulation (I_{geo}) were measured comparing with the background values of world soils. Elevated metal concentrations were found in road site soil samples. The geo-accumulation index (I_{geo}) indicated that the road was moderately polluted by Zn, moderately to strongly polluted by Pb but field soil unpolluted. Cr and Cd were unpolluted in both sites soil. The values of contamination factor (CF) existed in the Pb> Zn > Cd > Cr in the road side soil. The values of contamination factor (CF) existed in the agricultural field soil Zn >Pb> Cd > Cr. The degree of contamination of all sampling sites show very moderate to low degree of contamination. Pollution load index calculated from the CFs indicates that Zn and Pb are the major pollutants in road soil. Industry activities and waste generation are likely to be the main sources of Zn, Cd whereas vehicular emission is significantly responsible for Pb. Physiochemical parameters of soil include soil texture percentage, pH, organic carbon content. The soils were slightly acidic to neutral and low in organic carbon content.

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Determination of Chemical Residues of different Water Bodies and its impact on Environment and Human Health

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Abstract

Water, the most important natural resource in the world, has the unique property of a huge variety of chemicals and hence water can easily become contaminated. An unadulterated source of water is the most fundamentally important things for sound environment. Various health problems may occur due to inadequacy and poor quality of water. Infant mortality rate is high due to unsafe water supply. Safety and quality of water source is always an important public health concern. Poor sanitation and food sources are integral to enteric pathogen exposure; water is a major source of microbial pathogens in developing regions. So we need to increase public awareness about the chemical residues in different water sources, in this regard the proposed plan of research play an important role at present. There are many pollutants available in different water sources due to natural or artificial activities. So we have to investigate the status of available water in selected regions of Bangladesh. Although the concept of safe water is much discussed and is under consideration to address in Bangladesh. Therefore, the present study will be conducted to emphasis the qualitative and quantitative impact focusing environmental pollution and human health impact. The use of chemicals has been significantly increased in Worldwide, and pesticides used to protect the crops from pest attack in agricultural fields pose harmful effect to the non-target organisms such as human and many other aquatic and terrestrial organisms either directly or indirectly through food chain. The pesticide residues in different sources of water were investigated to evaluate their potential environmental pollution and risks on human health. A total thirteen (13) pesticide residues under organochlorine, organophosphorus and carbamate groups in four different sources of river water, pond water, rice field water and tube-well water collected from randomly selected 5 unions of selected 5 districts. Total 100 water samples were anlaysed using HPCL (High performance liquid chromatography) equipped with UV detector (HPLC, SIL-20ACHT, SHIMADZU). For survey, a structured questionnaire and a guideline for in-depth-interview were developed and 500 respondents were interviewed. Fifty (50) in-depth-interviews were conducted in 25 selected unions to focus the impact of pesticide residues on human health and environmental pollution. Initially, the calibration curves and retention times were recorded from the pesticide standards matrix after repetitions of HPLC injection. In case of organophosphorus pesticides, malathion was detected in 3 water sample at concentrations ranging from 6.25 to 402-90 ppm; whereas diazinon was detected in 4 water samples at concentration of 284.46 ppm and trace amount of carbaryl was recorded but the detection was very limited. No such detection observed with DDT. As compared to ground water (tube well water), higher concentrations of organophosphates and organochlorines pesticides were found in surface water (pond and rice field water). Surface water was reported to be more contaminated than ground water. Regional comparison of pesticide residues in water samples will be studied presently. The case study reveals that Bangladesh agriculture is conventional with heavy usage of pesticides and chemicals, highly concentrated on paddy cultivation. After analysis of collected primary data, the survey results will be shared in future. To manage the misuse of pesticides and to reduce the possible health risk, appropriate control systems of pests should be implemented immediately by the proper authority of the country.

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Effect of Different Trasplanting Date on Phenology, Growth, Yield and Agrometeorological Indices for T-aman Rice

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Abstract
Agrometeorological variables have a major role on crop growth and yield formation. A field experiment was conducted at the Environmental Science field farm of the Faculty of Agriculture, Bangladesh Agricultural University, to study the influence of thermal regimes on phenology, yield, and agrometeorological indices for T-aman rice. The experiment included two factors: four transplanting dates (D1= 15 July, D2= 31 July, D3= 15 August and D4= 31 August) and three varieties (V1 = BRRI DHAN 49, V2 = BRRI DHAN 87 and V3= DHANI GLOD) tested in RCBD with three replications. Agrometeorological indices, viz., Growing Degree Day (GDD), Heliothermal Unit (HTU), Phenothermal Index (PTI), and thermal use efficiencies, viz., heat use efficiency (HUE), heliothermal efficiency (HTUE), and hydrothermal use efficiency (HyTUE), for attaining different phenological stages in both, were studied. V2 required the maximum number of days to attain different phenological stages, thereby accumulating the most heat units, followed by V1 and V3. D3 conditions required a minimum number of days to attain different phenological stages, thereby accumulating fewer heat units as well as significantly higher HUE, HTUE, and HyTUE, which consequently resulted in the highest grain and biological yield, while D1 conditions required maximum heat units and the lowest heat unit efficiencies were recorded in D4 conditions. Thermal utilization efficiencies showed a strong correlation and regression with biological yield. Therefore, in addition to the heat requirement, the heat utilization efficiency is also a decisive factor for the crop yield.

Assesment of Potentially Toxic Heavy Metals and Health Risk in Farmed Fish and Fish Feed Collected from Trishal Upazila in Mymensingh

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Abstract
This study was conducted to determine the levels of trace elements and to profile associated human health risks in the flesh of cultivated Pangus ((Pangasius pangasius), Rui *(Labeo Rohita), Tilapia* and related fish feeds. Fifteen pangus fish, fifteen rui, 10 Tilapia and thirty fish feeds were collected from individual farms of Trishal in Mymensingh. ICP-MS was used to measure metal concentrations. For pangus, the highest metal pollution index was 3.80 and the highest values were found for As (22.89 mg kg^{-1}), Cr (24.94 mg kg^{-1}), Mn (290.48 mg kg^{-1}), and Pb (8.71 mg kg^{-1}) which surpassed the standard value. Estimated daily intake of As, Cd, Cr, Cu, Ni, Pb, Co was found to be lower except for Cr (1.71), and Pb (0.34), which surpassed the maximum tolerable intake. The non-carcinogenic risk (HQ) was <1 except Ni. Carcinogenic risk values ranged from 10^{-6} to 10^{-4} for As, Cr, Cu, Ni, and Pb, which is considered an acceptable range. Twelve metals were also determined from rui. For feed samples, the higher metal concentration (mg kg^{-1}) was found for Cr (31.007 $mgKg^{-1}$), Mn (155.06 $mgKg^{-1}$), Pb (6.65 $mgKg^{-1}$) and As (134.18 $mgKg^{-1}$) and all these concentration crossed the standard limit set by WHO. This investigation confirmed significant variations in heavy metal concentrations where all the metals were found below the WHO permissible limit except for Cr and Mn.

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Evaluation of Tolerance Index of Plants to Mitigate Air Pollution

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Abstract
Urban green plant can provide a cost-effective and eco-friendly technique to reduce air pollution. Tolerant plant species can act as a sink for air pollutants, such plants must be selected based on air pollution tolerance level. This study was conducted to determine the tolerance of plants against air pollution through Air Pollution Tolerance Index (APTI) for the recommendation of suitable plants species for the remediation of air pollution. In this research, the air pollution tolerance index (APTI) and metal accumulation index (MAI) were evaluated to determine both the degree of tolerance or sensitivity of trees to air pollutants. The leaves of 29 common plant species were collected from roadside of Mymensingh-Dhaka highway. Air pollution tolerance index (APTI) was calculated based by analyzing four biochemical properties of plant leaves such as ascorbic acid content, leaf extract pH, relative water content and total chlorophyll content. To determine the Metal Accumulation Index (MAI), heavy metal accumulation of samples was determined using Inductively Coupled Plasma Mass Spectrometry. The range of ascorbic acid content, leaf extract pH, relative water content and total chlorophyll content were found 0.94 to 8.84 mg/g, 4.31 to 6.89, 41.72 to 96.06% and 1.01 to 6.84mg/g respectively. Among the twenty-nine studied species *Syzygium cumini* (Java plum) was found most tolerant species (APTI 19.23). Metal accumulation efficiencies were observed to be highest for *Elaeis guieensis* (Oil Palm) and lowest for *Gardenia jasminoides* (Gardenia). The findings of this research could be used to classify which species should be planted as pollutant sinks for environmental management and planning in big cities with air pollution mitigation.

Transboundary River Pollution - Threats to Water Quality of Haors and Their Impacts on Wetland Ecosystems and Livelihood

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Abstract
The trans-boundary river water stretching over 71% of the earth's surface. Out of 405 rivers in Bangladesh 57 are trans-boundary. In the north-eastern part of Bangladesh, direct discharge of Acid Mine Drainage (AMD) into trans-boundary rivers causes huge losses of fish and crops. Contamination of AMD originating from mines and therefore, leaching of heavy metals are major causes of degradation of water quality in the north-eastern wetland ecosystems of Bangladesh. The purpose of this study is to investigate impact of coal mines on water quality on the basis of physico-chemical parameters such as temperature, pH, electrical conductivity (EC), dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS), and heavy metals viz. Fe, Pb, Cr and Cd. For this purpose, yearly a total of 15 samples were collected with 3 replications from 5 different locations of Jadukata river. The mean values of the analyzed parameters for 5 different sampling sites ranged: pH: 6.63-8.47; temperature: 25.77-26.8 °C; EC 344.51-383.50 μS cm^{-1}; DO: 7.60-8.30 mg l^{-1}; TDS 337.33-454.33 ppm; BOD: 0.70-1.93 mg l^{-1}; COD: 1.20-2.30 mg l^{-1}; Fe: 0.69-0.86 mg l^{-1}; Pb: 0.05-0.07 mg l^{-1}; Cr: 0.04-0.06 mg l^{-1}. Analyzed results show that, most of the values of the considered parameters were higher at Lakmachara sampling point which is the nearest site to Indian border and low at Rajargao which is the farthest from the border, almost all the values

were higher than the permissible limits set by different standards. The gradual descending variations of the values within the sampling sites were mostly due to the effect of AMD which were mixed with the water of Jadukata river. Though the water can be used for irrigation purposes but it is absolutely hazardous for drinking and contributing a gradual degradation of the north-eastern wetland ecosystems of Bangladesh.

Mitigation of Carbon emission through restoring degraded soil ecosystem around the BSIC Industrial area of Mymensingh City Corporation

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Abstract
This research experiment was undertaken nearby the BSIC Industrial area, Mascanda, Mymensigh sadar to investigate the integrated effects of inorganic fertilizers with organic amendments such as vermicompost, Trichocompost, Azolla, compost, and water hyacinth compost and Poultry manure compost to improve the fertility of degraded paddy soil as well as rice yield scaled carbon emissions under suitable cropping patterns. The experiment on treatments were T1: Control (No NPKS, No soil amendments), T2: Recommended NPKS (100%), T3: Recommended NPKS (50%) + Remaining amount (NPKS) from Vermicompost (IPNS), T4: Recommended NPKS (50%) + Remaining amount (NPKS) from Trichocompost (IPNS), T5: Recommended NPKS (50%) + Remaining amount (NPKS) from Azolla compost (IPNS) + BGA. T6: Recommended NPKS (50%) + Remaining amount (NPKS) from water hyacinth compost (IPNS), T7: Recommended NPKS (50%) + Remaining amount (NPKS) from Poultry manure compost (IPNS) for the two cropping patterns T. Aman Rice –Fallow-Boro Rice and Boro rice-Sesbania biomass-T. Aman. Two years data on rice growth and grain yield of the cultivars, soil properties and methane emissions under different cropping patterns were recorded properly. At the end of two years trials, it was observed that the combined application of poultry manure with NPK fertilizers (T7) improved soil properties such as soil porosity, organic C status, soil pH, redox status (Eh), total nitrogen, available P, water extractable iron, free iron oxides and exchangeable cations such as K, Ca, Mg, while a discrepancy observed in regards to methane emissions. Higher rice yield was recorded in cropping pattern Boro rice –Sesbania biomass-Aman rice (CP1) than Aman rice –Fallow- Boro rice (CP2). Considering the overall conditions, the integrated use of inorganic fertilizer with poultry manure compost and vermicompost could be a feasible strategy for sustainable rice yield as well as suppressing seasonal cumulative CH_4 emissions and GWPs from rice paddy ecosystem.

Mitigation of Salinity-induced Growth Inhibition of Maize by Seed Priming with Proline and Glycine Betaine

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Abstract
Nowadays, a variety of morpho-physiological and biochemical changes occur in plants as a result of various environmental pressures, which ultimately leads to a poor crop production. Salinity is a major

barrier to effective seed germination, seedling growth, and ultimately crop yield. Seed priming with various treatment agents can effectively increase salt tolerance. Maize (*Zea mays*) is a significant feed and food crop in many nations, including Bangladesh. The cultivation of maize, like other cereal crops, is seriously threatened by rising soil salt levels. In the present research, we investigated the potentiality of proline and glycine betaine as priming agents to alleviate the salinity-inhibited germination and growth of maize. The present experiment was carried out in hydroponic culture at the Department of Seed Science and Technology, Bangladesh Agricultural University, Mymensingh. Our results exhibited that salt-stress considerably lowered percentage of germination (GP), germination-index (GI), seed vigor index (SVI), shoot length (SL), root length (RL), shoot-root fresh and dry biomass. The results also exhibited that salt stress significantly lessened relative water content (RWC), photosynthetic pigments such as, chlorophyll a, chlorophyll b, and total chlorophyll contents. Besides, salt stress increased H_2O_2 and MDA contents and deceased the antioxidant enzyme activities such as APX, POX, and CAT. Our results exhibited that seed priming with proline and glycine betaine significantly increased the morphological attributes of maize under salinity stress. Data also revealed that proline and glycine betaine priming significantly increased antioxidant enzyme activities and decreased H_2O_2 and MDA contents under salt stress. The present findings suggest that seed priming with proline and glycine betaine ameliorate salt-induced growth inhibition of maize by regulating antioxidant enzyme activities.

Seasoning of the Bangladeshi Timber Species and Sustainable Development

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Abstract

Wood is one of the most abundant and important natural resource in the world. Although, it has been contributed greatly in our daily life in different ways such as construction works, to make furniture, papers, particle boards, cellulose materials and use as fuel etc. But, Bangladeshi wood users have been facing several kinds of difficulties at the time of practical use. The Bangladesh wood scientists and personal from forest department have the responsibilities to solve those problems for the welfare of our people. If we want to increase our total forest area we should increase our wood quality first. Quality wood gives us longer period use of same wood, as a result the pressure on forest would decrease and naturally increase our total forest area. According our investigation it was found that the fiber arrangement of Sal (*Shorea robusta*) and Sundari (*Heritiera fomes*) wood is denser than the other two woods. The tensile strength and percent elongation of Sal and Sundari wood is greater than the others. We had found that the sequence of tensile strength like as, Sundari (*Heritiera fomes*) > Sal (*Shorea robusta*) > Jackfruit (*Artocarpus heterophylus*) > Keora (*Sonne ratia apetala*). Here we can say that the arrangement of crystalline (harmonic ordered) and amorphous (disordered) region is the source of strength. By the crystallinity test we will investigate the cellulose region to explain clearly. The strength measurement of Sundari wood is very high because of its higher density and lower interspace between fibers. To investigate the hygroscopicity of wood a remarkable decrease of weight of wood was observed during the heat treatment. At higher temperature almost, no further change was observed due to evaporation of all volatile materials during that period of heat treatment. We assume that Hygroscopicity of heat-treated wood varied with variation of crystallinity.

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Production, Characterization and Application of Bio-char Derived from Livestock Wastes for Utilization in Soil Fertility and Renewable Energy Development

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Abstract

Biochar is a type of charcoal which results from the thermal treatment (pyrolysis) of natural organic materials (e.g. crop waste, wood chip, municipal waste, or manure) in an oxygen-limited environment. Manures from cattle, sheep, goat, buffalo, chicken and other animals is a good quality biomass that can produce biochar as well as bio-oil during pyrolysis. For this purpose, a reactor has designed for the poultry litter at different operational conditions. Total amount of bio-char and bio-oil have been estimated after the experiment. It was found that biochar and bio-oil yield were 42% and 40% respectively. For the analyses of physical and chemical qualities of those biomass litter and bio-oil, samples have been sent to BCSIR. Color, viscosity, density and other physical parameters will be investigated. However the particles of biochar have been found in range from 30.7 nm to 65 nm, whereas pore size was found in the ranges from 3.94 μm to 5.45 μm. We assume that the application of biochar in our method increases the fertility of the soil and also increases the water holding capacity. In addition, it helps to reduce carbon dioxide emission from the soil.

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Genotypic Effects on External and Internal Egg Quality Traits in Indigenous Chicken of Bangladesh

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Abstract
Egg is a cheap and well-balanced food source of high quality nutrients in the world. Both physical and morphological traits of eggs play an important role in the development of embryo and hatchability. Therefore, present study was carried out at Bangladesh Agricultural University from July 2021 to June 2022 to evaluate the effect of three genotypes on physical, geometrical, and internal egg quality traits in indigenous chicken of Bangladesh. In this study, 37 eggs of three genotypes were used. Physical and morphological data produced from this study were maintained in the separate data sheet during the whole experimental period. After that, the data were analyzed by using the GLM procedure of Statistical Analysis System (SAS) software (SAS Institute Inc., 2009) version 9.1.3 where DMRT also performed for mean separation. The lowest egg weight was found in frizzle (39.42±0.52 g) and highest egg length (55.07±0.31 mm) and width (41.09±0.37 mm) was observed in deshi eggs. The maximum shell thickness was recorded in assel (40.50±0.71 mm) followed by frizzle (35.23±0.92 mm) and deshi (29.98±4.06 mm). No significant effect was found in yolk weight among the three chicken genotypes. Except deshi eggs, almost similar yolk and albumen pH was noticed in assel and frizzle eggs. The significant ($p<0.05$) effect was found in Haugh unit among the experimental group of chicken eggs. The maximum yolk color was found in frizzle (10.04±0.19) proceeded by deshi (7.61±1.03) and assel chicken (7.44±0.11). The positive correlation was noticed between egg weight with albumen and yolk weight. Therefore, it can be concluded that significant variation exist on physical, geometrical, and internal egg quality traits in the three genotypes of indigenous chicken in Bangladesh. The highest egg weight, length, width, volume and surface area were found in eggs of deshi chicken followed by assel and frizzle chicken.

Effect of LDL on Motility, Viability and Plasma Membrane Integrity of Short Term Preserved Spermatozoa of Indigenous Sheep in Bangladesh

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Abstract
Sheep are well adapted to hot and humid agro-climatic conditions and contribute significantly for the income generation of the poor people in Bangladesh. They are easy to rear and more resistant to infectious diseases than goat. However, indigenous sheep is still being neglected in Bangladesh and very little attention has been paid for their improvement. During preservation, ram semen is particularly susceptible to cold shock therefore post-thaw motility of ram spermatozoa and AI conception rate at field level is still very poor. Low density lipoprotein (LDL) is thought to be the main component responsible for the protective role of egg yolk in sperm preservation therefore our aim is to isolate LDL from egg yolk and replacement of whole egg yolk by LDL in diluter to determine its effect on motility, viability and plasma membrane integrity in short term preserved spermatozoa of indigenous sheep in Bangladesh. Now work is continued for the isolation and standardization of LDL.

Three mature breeding indigenous rams aged between 2 and 3 years are being used for semen collection once a week each. The analysis of the fresh semen showed that average volume of ram semen was 0.55 ml, sperm concentration 3272.22 million/ml, mass motility 80.11% and progressive motility 73.44%. On the other hand, the average viability of fresh semen was 80.65% whereas 79.89% spermatozoa were normal. Among the abnormal spermatozoa, head, mid piece and tail abnormalities were 4.98%, 2.23% and 12.56%, respectively. After LDL extraction, different doses of isolated LDL will be used for ram semen preservation and check the motility, viability and plasma membrane integrity up to five days of preservation at 4^{o}C. From this study, effective level of LDL will be found from the observation of higher motility, viability and plasma membrane integrity in short term preserved spermatozoa of indigenous sheep in Bangladesh.

Comparison of Oocyte Collection Methods from Caprine Ovaries and *In vitro* Embryo Culture

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Abstract

This study was designed to elucidate the efficiency of oocyte recovery through different techniques, grading of oocyte and optimization of *in vitro* embryo production system. For this purpose, ovaries were collected from the local. Total 442 Cumulus Oocyte Complexes (COCs) were retrieved from 178 slaughterhouse ovaries aseptically by the techniques of aspiration, slicing and slashing, and collected COCs were categorized according to the compactness of cumulus cells around the oocytes. The number of oocytes recovered per ovary (2.89±0.22) and the percentage of excellent oocytes (grade A: 29.84±4.00) and (grade B: 44.80± 2.32) were significantly higher in slashing technique than that of aspiration (2.16±0.31 and 11.80±0.61, 30.80±3.56) and slicing techniques (2.40±0.15 and 22.62±7.81, 16.10±1.29). The maturation rates of COCs were examined through detection of first polar body and cumulus cell expansion and it was found that significantly higher ($P < 0.05$) rate of Grade A and Grade B COCs reaching to the M II stage. *In vitro* fertilization of the matured oocytes was performed using the frozen semen in a drop of modified IVF-TALP medium at 38.5°C in 5.5% CO_2, for 16-18 hours. At the 16 hours of IVF, the presumptive zygotes were *in vitro* cultured (IVC) for 7 days in a drop of modified SOF-BE2 medium at 38.5°C in a humidified atmosphere of 6% O_2, 5.5% CO_2 and 88% N_2. The cleavage rate of presumptive zygote was found 57.83±7.83% and 74.15±6.80 % regarding two methods (Slicing and Slashing). The highest blastocyst rate of presumed zygotes found in this experiment was 37.50%. This study inferred that the slashing technique is more suitable for harvesting the higher number and superior quality of COCs and the culture condition used in this experiment was found to be optimized as it efficiently supports IVM, IVF and subsequent development of goat embryos.

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Selection of Crossbred Dairy Cattle Using Phenotypic and Genomic Information for Efficient Productivity and Resilience in Tropical Environment of Bangladesh

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Abstract

One of the main objectives of the project is to establish the phenotypic performance database of Holstein-Local (H×L) and Sahiwal-Local (SL×L) crossbred cattle populations of Bangladesh through farmers' participatory approach. Accordingly, selection of farms, farmers and animals was performed. Herdbook based record keeping was adopted. All sorts of objective data have been collected from finally selected 677 H×L and 200 SL×L crossbred cattle. The genotypes of the crossbred animals were ascertained through consultation with the respective animal owner/assigned personnel of the farm along with trace beck their pedigrees. Data were collected through personal interaction with farm owners, visual observation of animals and on spot recording of objective traits. Apart from this, 609 blood samples were collected from these two crossbred populations. DNA extraction and quantification was completed for 478 blood samples. A subset of 250 genomic DNA samples of H×L crossbreds was sent to TNT Research Co. Ltd., (a commercial DNA sequence service provider of South Korea) for 50K SNP genotyping. The genetic evaluation of H×L crossbred breeding bulls was performed based on their semen quality parameters and daughters' productive and reproductive performances. However, only semen quality attributes were considered for SL×L crossbred evaluation due to limited phenotypic dataset. Semen quality and most of the phenotypic performances were found better in 75%H×25%L and 62.5%H×37.5%L crossbred bulls than that of 50%H×50%L breeding bulls. Similarly, daughters' productive and reproductive performances were found significantly better in 62.5%H×37.5%L and 75%H×25%L crossbreds than the 50%H×50%L cows. The average daily milk yield per day was found 7.49±0.08, 8.18±0.09 and 9.26±0.06 liters, respectively in 50%H×50%L, 62.5%H×37.5%L and 75%H×25%L crossbreds. Altogether, bulls were ranked according to their own merit and progeny performances that could be used in breeding bull selection and culling decision program at Central Artificial Insemination Laboratory, Savar, Dhaka

Evaluation of Crossbreeding Effects for Growth and Egg Production Traits in Pekin × Nageswari Crossbred Duck

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Abstract

This study was conducted to evaluate growth performance and egg production potentials of purebred Pekin (P), Nageswari (N) and the resultant P×N crossbreds across three generations. Data on growth, production, reproduction, feed intake and disease incidence were collected from the existing flock (G_3 generation). In addition, previously collected data of G_0, G_1 and G_2 generations were also included in genetic evaluation process of this study. The average live weight of Nageswari was 1367±17.38g at the 12^{th} week of age whereas the average live weight at same age in birds of three crossbred (P×N)

generations was 1703.02±19.76, 1910.46±18.81 and 1826.49±20.63, respectively, which is almost similar to the pure Pekin duck (1908.26±34.18). The difference in growth performance is highly significant from day-old to 20th weeks of age (P<0.001). Positive hybrid vigor was observed in all three G_1, G_2 and G_3 generations for growth traits up to 12th week of age except day old. At 12th week, the positive heterosis varied from 3.86 to 16.64% over the three generations. The P×N crossbred ducks attain puberty two weeks earlier than the parental Pekin duck. Differences in hen day egg production (HDEP%) were significant (P<0.01) among the genotypes up to 40th week of age except 28th week where non-significant differences were observed. The total number of eggs up to 280 days in P, N, and two P×N crossbred generations were 90.54, 92.32, 86.61 and 94.08, respectively. This result reflects the significance of non-additive genetic effects only on growth traits. In conclusion, the genetic evaluation involving multi-generation data essentially helps to establish the performance of the developed P×N crossbred duck.

Standardization of Aging and Frozen Storage Time for the Betterment of Local Chicken Meat Consumers

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Abstract

There is insufficient information in the world literature on the effective aging and frozen storage programs for local chicken meat and in Bangladesh it is highly limited. Thus, in view of high importance of effective aging and further prolonged storage programs for ensuring quality meat for the consumer's health coupled with no facilities available in the traditional processing unit, strategy for development of standard aging and frozen storage time for the betterment of local chicken meat consumers' needs to be investigated on priority basis. To address this, a set of experiments has been conducted and some results are come out. Firstly, traditional and market practices for killing birds has applied and traditional practices shows better cooking yield and shelf life compared to market practices. CIE color variables had no changes with the slaughtering techniques. Next we adopted an experiment with different defeathering times and the results shows that with the advancement of defeathering time, muscle pH, cooking loss percentage and water holding capacity reduced dramatically and muscle started to spoilage. Meat color parameters such as L value, a* and b* values decreased with time laps. We are now planning to set experiments with different aging times like 0h, 24h, 48h and 72h to get the best aging time for meat conditioning. Later on we will identify the best packaging methods as well as how long we could keep frozen. We will test all the proximate composition, economic traits of meat, microbial and rancidity parameters with the above experiment. We hope we could produce a publication with impact factor from the outcome of this project.

Red Chittagong Cattle Conservation and Development

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Abstract

Conservation of the (adapted) indigenous livestock breeds of the developing world and their genetic improvements are necessary both for immediate and for future use. Characterization, Conservation and Improvement of Red Chittagong Cattle of Bangladesh is being pursued since 2004 by Bangladesh

Agricultural University. The main goal of the project is to continue the above mentioned motion of RCC conservation and development with a view to establish it into a small dairy breed appropriate for low-input feeding and management practices of Bangladesh. As outcome of the long-term project, RCC conservation and development was accepted in the Cattle Breeding Policy of the National Livestock Development Policy (NLDP, 2007) and hence RCC semen is being produced and used in the country by government and other cattle breeding service providers of Bangladesh since 2008. Along the quest World Vision Bangladesh became a dependable long-term partner of a "Community Driven Livelihood program with Red Chittagong Cattle" for the benefit of the cattle keepers of Mymensingh from 2009 to 2016. Livelihood of the rural farmers through the conservation and utilization of the valued Red Chittagong Cattle was in the heart of the said community driven program. Thereafter, in collaboration with Bangladesh Livestock Research Institute (BLRI) and the funding of the Ministry of Fisheries and Livestock helped to continue RCC conservation and development work from 2017-2021. The project has been addressing the need of poor farmers to help save their very unique, valuable and world reputed indigenous Red Chittagong Cattle. Eventually, the RCC has become a pathway of their owners' livelihood as it possesses many useful attributes including easily identifiable, small in size, an average milk yield of 3 kg per day (with a range of 2.5 to 7.00 kg milk per day) very little eater, happy with straw based diet, high disease resistance, gives one calf every year, very tasty milk and meat, very high market demand and suits well with the low-input type lifestyle of smallholder rural farmers in the whole country. A total of nearly 1000 pure RCC of different ages, stages and sexes are available in the hands of BAU, BLRI, DLS, BRAC, ADL, PKSF (IDF, Momota, Desha) Green Farming Cooperative, Nahar Dairy Ltd. and private owners. A standard database was developed and information on pedigree and performance were uploaded to National RCC website. In three batches a total of twenty-six potential pure young RCC bulls with known pedigree were identified, purchased and brought to BAU AI Centre for routine recording of their body weight, growth, testicular measurement and semen characteristics. Meanwhile, with test results a total of 12 (twelve) Certified RCC Bulls were dispatched for use to American Dairy Ltd. (ADL), Lal Teer Ltd., ACI Genetics Ltd., IDF and Momota, Chottogram, Desha, Kushtia and a private owner of Dinajpur. Six extra-ordinary pure selected RCC bulls are in use now at BAU AI Centre whose semen are being used to breed pure RCC heifers and cows available around BAU. Alongside, Non-descript Local cows/heifers are being bred with pure RCC semen and graded RCC progeny are being produced in the farmers herds around BAU. In the meantime a wealth of relevant scientific data and journal publications on RCC from the works done by scientists of home and abroad organizations has triggered us to submit application to the national body for registration of RCC as a breed which was filed on 24 December 2021. Finally, on 24 May 2022 the national body registered and declared RCC a dual-purpose breed of cattle of Bangladesh.

Development of Meat Type Crossbred Using Boer and Black Bengal Goat

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Abstract

Development of meat type crossbred using Boer and Black Bengal goat Boer × BB goat breeding program was designed and implemented to produce F_1 and F_2 crossbreds. Three (3) 100% Boer bucks were naturally bred with pure BB does. Till date 140 F_1 kids have born. Records on coat colour, survival, growth and reproductive performances in progeny have been keeping in detail. Data on body weight at birth, 1-, 3- and 6 months considering region (3), sire group (3), birth type (5), dam parity (5), season of birth (4) and kid sex (2) as fixed effects and region×sire, birth season×birth type and

sex×birth type interaction effects were analyzed. Single, twin, triplet, quadruplet and pentaplets were 12.86, 61.43, 19.28, 2.85 and 3.57 %, respectively. Sire effect was significant on birth weight (bwt) ($p<0.01$) and 1m wt ($p<0.001$). Effect of region was significant on bwt ($p<0.01$), 1m wt, and 3m wt ($p<0.001$). Parity of dam and birth type affected bwt ($p<0.01$;$p<0.01$) and 1m wt ($p<0.05$). Season of birth affected body wt at birth and 3 m ($p<0.05$). Fixed factors did not affect ($p>0.05$) body wt at 6 m. Sex of kids did not affect ($p>0.05$) bwt, 1-and 6 m wt but affected 3 m wt ($p<0.001$). Region×Sire influenced body weight upto 3 m ($p<0.05$;$p<0.01$;$p<0.001$).Birth season×birth type affected bwt ($p<0.001$) and 3 m wt ($p<0.05$). Sex×birth type had significant influence ($p<0.05$) only on bwt. Interaction effects were insignificant ($p>0.05$) at 6 months wt. Birth wt, 1 m wt and 3-m wt and 6 mwt of male and female F_1 kids averaged at 1761.78, 1762.83, 4190.09, 4013.33, 9183.09 and 8038.06, 11385.33 and 12303.68 g, respectively. It suggests that F_1 crossbreds weighed nearly 2 times higher than that of BB goat with unaffected litter size. Recording data on F_1 are in progress. F_2 progeny are yet to be produced.

Modulatory Effect of Curcumin on Bovine Oocyte Competence under Endotoxin Exposure

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Abstract
Mammalian oocytes and embryos are delicately sensitive to a variety of offences including exogenous factors, infection, and endotoxin. Various such endotoxins initiate and alter downstream signaling events during mammalian development. Agents that modulate or inhibit the adverse signaling due to endotoxin during infection could be beneficial factor on embryo survival and long-term developmental potential. Curcumin is a hydrophobic polyphenol derived from rhizome of the herb Turmeric, has been identified as a potential anti-oxidant with a wide range of pharmacological effects, including anti-inflammatory and anti-infection activities. We hypothesize, that the modulation of induced endotoxin or infection mediated inflammation by curcumin can alter oocyte developmental competence in vitro. Considering the fact, present study is carried out to determine the relation of effect of curcumin on inflammation induced by LPS challenge as endotoxic regulation in bovine oocyte development. For this, an in vitro bovine model is used where oocytes were in vitro cultured with or without LPS supplemented media together with or without curcumin to check nuclear maturation and transcriptional changes during in vitro maturation. Some oocytes has been freezed to assess the level of transcripts response. Preliminary result shows a significant increase in cumulus cell expansion, oocyte diameter and nuclear maturation of oocyte cultured with curcumin under the exposer of endotoxin. Sufficient culture to collect enough oocyte for the isolation of required amount of RNAs and the data on embryonic development due to inflammation is going on. Upon having required number of oocytes and embryos, inflammatory related gene transcripts and apoptosis markers specially TLR4, TNFα, IL-1β and CHOP will be measured by real-time qRT-PCR. Finally, result of this study will highlight and implicate the potential use of curcumin as a natural herbal byproduct in future to treat infertility and to increase the outcome of assisted reproductive technologies.

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Assessment of Productive and Reproductive Performance of Beetal and Black Bengal Crossbred Genotype under Farming Condition

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Abstract
The present study was conducted with a view to know the productive and reproductive performance of Beetal and Black Bengal crossbred genotype under intensive and semi-intensive farming condition over the period from March to December 2022. The data on productive and reproductive traits were collected from in total 20 goats as a whole while, 17 from BAU surrounding village level and rest of 3 from BAU AI centre. At first, 4 mature Black Bengal does were purchased from local market and brought at BAU AI centre and side by side 20 household were selected at BAU surrounding village based on those who reared Black Bengal goat and provide data after producing an offspring. In total, 60 doses of Beetal goat frozen semen were bought from American Dairy Limited and inseminated the selected does. In the present study, the birth weight of crossbred genotype was significantly higher at village level (male: 1.12±0.53 kg and female: 0.96±0.15) than farm condition (male: 99.01±0.53 and female: 0.87±0.15 kg). The weight at 3-month age of mentioned genotype for male and female kids at semi-intensive condition was 6.72±0.47 and 5.50±0.36 kg, and at farm level, it was 6.13±0.80 and 5.22±0.11 kg respectively. Average daily weight gain from birth to 3-month age for male and female kid at village level was 74.66 and 61.11 g, and at farm level, it was 68.11 and 58.00 g correspondingly. The conception rate of Black Bengal doe by Beetal frozen semen was 33 and 37 percent at village and farm level, respectively. The frequency of litter size at village level for single and twin kid was 64 and 36 percent, and at farm level, 100 percent was single kid. The gestation length at both level was almost similar and it was 145.08 and 145.69 day for male and female kid.

Growth Performance Evaluation of Beetal and Black Bengal Crossbred Genotype under Farming Condition

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Abstract
The present study was conducted at Bangladesh Agricultural University AI centre and Bhabokhali village during the period from March to December 2022. The aim of this study to compare the growth performance of Beetal and Black Bengal crossbred (CB) genotype with Black Bengal goat (BBG) under different farming condition. Initially, 5 mature Black Bengal does were purchased from local market and brought at BAU AI centre and at the same time, 25 households were selected at aforesaid village based on those who reared Black Bengal goat and provide data after producing an offspring. The data on growth performance traits for CB genotype were collected from 20 goats as a whole while 15 from Bhabokhali and remaining from BAU AI centre. Goats were inseminated with the frozen semen of Beetal bucks collected from American Dairy Limited. Data on different parameters were analyzed using Statistical Analysis System (SAS). Average birth weight of kids of BBG and CB was 0.94±0.72 and 1.61±0.13 kg, respectively. In case of single litter the birth weight of BBG and CB kids was 0.96±0.14 and 1.66±0.62 kg, whereas in twin it was 0.91±0.68 and 1.55±0.11 kg, respectively. Birth type showed significant difference ($P<0.05$) between the genotype. A negative correlation was

found between the litter size and the birth weight of kids. The weight of kids at 3-month age was 4.36±0.95 and 7.26±0.78 kg for BBG and CB genotype, respectively. The service per conception was 1.45±0.5 and 1.34±0.48 number in BAU AI centre and Bhabokhali village, respectively.

Status of Livestock Breeding Practices and Popularization of Artificial Insemination in Black Bengal Goat in Bangladesh

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Abstract
The objective of this study was to determine farmers' socio-economic characteristics, existing breeding practices which are practiced by the farmers as well as its availability and frozen semen production and performing of artificial insemination (AI) in Black Bengal goat with frozen thawed semen. For this purpose, data were collected using a well-structured questionnaire administered to 1567 farmers of 19 districts in Bangladesh and frozen semen production performed at the Artificial Insemination (AI) Center under the Department of Animal Breeding and Genetics, Bangladesh Agricultural University.The collected data were compiled, tabulated and analyzedusing SPSS software. Out of 1567 farmers, a major proportion (50.58%) of farmers was middle-aged. Most of the farmers (67.34%) were associated with agricultural activity and have low income per month (49.47%). In terms of breeding practices, the majority of farmers (75.98%) used AI in cattle and found it convenient to service their cows. When it came to goats98.50% conducted natural service. In case of frozen semen production, the motility was evaluated in every step of cryopreservation (after dilution, after equilibration, after freezing and after thawing) by one operator. The mean of the motility after dilution (with Triladyl, Andomed, Tris based diluter) ranged from 81.71%-83.67% and after equilibration at 4-5℃ ranged from 73.29%-75.67%, respectively. The motility of frozen thawed semen was 42.50±1.71, 34.67±1.67 and 28.71±1.55 in Triladyl, Andromed and Tris diluter respectively. After 15 days of frozen semen production the motility was again checked to ensure the quality. It differed insignificantly ($p<0.05$) with frozen semen after 24hrs. Overall non-return rate was found 44% at BAU surrounding villages.

Socio Economic Status of Buffalo Farmers and the Husbandry Practices of Garole Sheep in the Sundarban Delta Region of Bagerhat and Satkhira District in Bangladesh

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Abstract
This Garole sheep is the latest sensations in the world of domestic species by virtue of its prolificacy, lambing frequency, disease resistance and other extraordinary merits rarely or not even observed in other sheep breeds of the world. The sheep Garole is very popular for its bi-annual lambing, high prolificacy rate, high mothering instincts, adaptability to marsh saline as well as hot and humid climatic condition, grazing on aquatic weeds and grass in knee-dip water and resistance to some common diseases. The proposed field survey of the project was executed in the Garole populated areas of Sundarban delta region of Bagerhat and Satkhira district in Bangladesh. Demographic information

of the Garole sheep farmer's and the overall husbandry practices of Garole sheep was performed with pretested questionnaire. Proximate composition of available feeds and fodders fed to Garole sheep in Bagerhat and Satkhira was evaluated with standard methods. The average age of the Garole sheep farmers was 44 years which indicated that farmers are relatively younger in age and put more physical efforts in Garole farming and created their experience and employment opportunity in this field. More than sixty percent educated Garole farmers indicated that farmers can easily get any scientific approach for Garole rearing. Thirty-six, 30 and 20% Garole owners are involved in day labour, agriculture and business, respectively but only 4% are engaged in Garole rearing. Fifty-four percent women's and 46% men's are engaged in Garole rearing. The family members of the farmers in the selected areas ranged from 4 to above 8 with an average of 5.63 and majority (77.93%) of the farmers belonged to medium size family (5 to 7). The land size of the farmers ranged from 0 to 16.6 acres and the average was 3.56 acres and 58% Garole farmers belonged to small farmer's category of 0.50 to 2.49 acres' land. Most of the Garole farmers (74%) are not trained for rearing their buffaloes as family profession but they are influenced by the neighbors. The concentration of buffalo was found higher in Satkhira district than that from Bagerhat. The availably of feeds was the main constraint for Garole rearing in all the locations. About ninety percent of the respondents fed their Garole sheep in a group. The mean average birth weight, weaning weight and weaning age of Garole lamb are 0.95 kg, 4.15 kg and 2.2 months, respectively. The average slaughter age was 15 months. The age of puberty, age at first pregnancy, age at first calving, gestation length, and calving interval are 7.0, 7.5, 12.5, 5.0, and 6.5, respectively. Most of the Garole houses were made of locally available materials like straw, tin, mud and bamboo slips but the averages of 74% don't have housing facilities. Most of the respondents (71%) did not communicate with Upozila veterinarian during the outbreak of diseases of their Garole sheep. Among nine grass samples evaluated in the present study, the CP, EE, ash, ADF and NDF content (g/100g DM) ranged between 10.82-15.65%, 1.15-2.74%, 9.97-18.83%, 17.07-25.83 and 21.63-35.49%, respectively. Among concentrate samples, the DM, OM, CP, EE, ADF and NDF content ranged between 82.88-85.66%, 84.35-87.42%, 9.67-14.57%, 2.19-10.95%, 3.16-15.34%, and 12.23-43.80%, respectively. The findings of the base line survey revealed that, Garole sheep is popular among the farmers due to its well adaptation in prevailing management systems, higher prolificacy, high diseases resistance and higher market price. The information's obtained from this study can be used for future development of Garole husbandry in Bangladesh.

Effect of Flushing of Floors on Ammonia Emission Levels in Medium Scale Dairy Farms at Satkhira District in Bangladesh

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Abstract

Ammonia emission from all possible sources in dairy cow buildings resembling housing systems, manure storage, manure application and outside grazing contribute substantially to environmental pollution. In today's dairy husbandry, differences occur in housing system, floor type and manure collection and manure storage system. The purpose of this study was to make an analytical inventory on time wise 24-hours ammonia emission data in the dairy housing systems and to assess possibilities for its reduction. Data were collected from five medium scale dairy farms (20-25 dairy cows) in August 2022 designed naturally ventilated dairy cow buildings: double row, concrete floor, tin roof and stall fed dairy houses located at Tala upazilla of Satkhira district in Bangladesh. Ammonia emissions from dairy houses were measured using Intelligence of Things (IoT) devices for a period of five consecutive days (about 130 hours). Two times cow dung collection and two times flushing with water were practiced in manure collection and management practices. It was observed that ammonia

emission levels for the evening time (5 pm to 8 pm) were the highest (1.4 ppm). It may be due to no flushing of water and manure collection after 4 pm. It is noted that urine and fecal material, individually, emit minimal amounts of ammonia but combining urine and feces after deposition on a floor surface, which results in ammonia volatilization in dairy housing. The American Association of Railroads says most people can smell ammonia between 0.04 to 20 ppm. Threshold is between 5 and 50 ppm. Therefore, it is concluded that the ammonia emission level in medium scale dairy farms in Bangladesh is sometimes people can get smell but far below than the threshold level and to achieve the emission reduction goals set by the government, additional emission reduction for all agricultural sources must be realized.

A Comparative Study on Leather Quality of Pure Black Bengal Goat and Its Crosses Available in Bangladesh

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Abstract

Black Bengal goat comprises more than 90% of the total goat population in Bangladesh; the remaining breeds include the Beetal, Jamunapari, Sirohi, Barbari and their crosses, which are dispersed throughout the country. Among other good traits, Black Bengal goat is worldwide known for production of better quality meat and leather. The aim of this research was to examine the quality of leather of pure Black Bengal goats and the crossbreds available in Bangladesh. A total of 24 goats skins (6 for male pure, 6 for crossbred male, 6 for female pure and 6 for crossbred female, aged around one year) were collected just after slaughtering from Mohammadpur Bazar, Dhaka. The skins were processed into crust leather and all the analyses were done according to standard protocols. It was found that tensile strength that indicates collagen fiber network was showed the highest in crossbred male goat crust leather. Compared to genotype, the tensile strength was higher in crossbred goats crust leather and for sex, male goat showed the higher than female. In contrast, the values of percentage of elongation, softness, distension and strength of grain those are essential requirements for the manufacturing of high pricing leather goods were shown the higher in pure Black Bengal crust leather than the crossbred crust lather. It is an alarming that, pure Black Bengal female goat leather exhibited percentage of elongation 51.59% whereas crossbred female was showed only 36.84% this is due to the fact that fat content is higher in pure Black Bengal goat skin. Good quality upper and garments leather should have percentage elongation not below 40% according to United Nations Industrial Development Organization. The quality of Bangladeshi goat leather is decreasing due to crossbreeding with low quality skin producing breeds and thus, it is recommended to consider the matter in crossbreeding program.

Production and Characterization of Biochar and Bio-oil from Layer and Broiler Litter

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Abstract

This study was conducted to characterize the biochar and bio-oil produced from layer and broiler litter through pyrolysis. Pyrolysis is a process of anaerobic heating of biomasses where biomass is converted

into high-value products such as biooil, syngas and biochar. For this purpose, a reactor was designed for the pyrolysis of poultry litters (layer and broiler). Result showed that 33 and 35% biochar was produced from broiler and layer litter respectively at 600 °C temperature. The size of the micropore of layer and broiler litter biochar was observed 7.4 and 7.5 nm respectively, under the scanning electron microscope (SEM). The FTIR value of layer and broiler litter biochar ranged between 430-1384 and 416-1083 wavenumber cm^{-1} position, respectively. Bio-oil production was found 21 and 20% respectively from layer and broiler litter. A higher gross calorific value was found in bio-oil obtained from broiler litter (11000 kcal/kg) compared to bio-oil obtained from layer litter (10551 kcal/kg). The density of produced bio-oil from layer and broiler litter was very closed (1.2636 and 1.2634 g/cc, respectively). It may be concluded that poultry manure is a good source of biochar and bio-oil that might be helpful to increase soil fertility and for the supplementation of renewable bio-energy.

An Appraisal of Portable NIR Spectroscopy Coupled with Deep Learning for Meat Safety and Authentication

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Abstract
The aim of this study was to test the ability of near infrared (NIR) reflectance spectroscopy to predict the adulteration in cattle meat and buffalo meat. In total 16 samples were prepared among these 2 samples were pure and 14 samples were adulterated. For detection of adulteration spectra were collected using DLPNIRscanNano Software. Partial least square and principal component regression model for calibration and validation were developed for detection of adulteration through The Unscrambler X software. Accuracies of the calibration models were evaluated using the root mean square error of calibration (RMSEC), root mean square error of cross validation (RMSECV), coefficient of calibration (R^2c) and coefficient of cross validation (R^2cv). Generally, the accuracy (i.e. the closeness between actual and the predicted values) of regression model is considered as excellent when the $R^2 \geq 0.90$. In case of PCR model predicted (R^2cv) was 0.73 and for PLSR (R^2cv) was 0.98 through leverage correction. Conversely through cross validation in case of PCR model (R^2cv) was 0. 65and for PLSR (R^2cv) was 0.65. On the basis of resultit is suggested that the NIR spectroscopy was reasonably efficient method for adulteration detection in cattle meat with buffalo meat.

Effect of Different Levels of Dietary Protein During Late Pregnancy on Performances of Black Bengal Kids and Dams

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Abstract
The present study was aimed to know the effect of different levels of dietary protein at late pregnancy on performances of Black Bengal does and their kids. Three diets containing 3 different levels of dietary protein i.e., low protein (10% CP), medium protein (14% CP) and high protein (18% CP) were randomly assigned to stall-fed 12 female Black Bengal does. During the experimental period the live weight and milk yield of does, and birth weight, growth rate of kids, body measurements (heart girth,

height at wither and body length) of kids were recorded. All data were subjected to one way ANOVA, and the significance of difference among means was determined by Duncan's Multiple Range Test (DMRT). The highest average live weight gain of does was 3.08 ±0.30 kg in high protein group which was significantly ($p<0.05$) higher than others. The average birth weight of kids was higher in high protein group but did not differ significantly among the treatment groups. The average live weight gain of does after parturition did not differ significantly. Milk yield of does at 7^{th} week was significantly ($p<0.05$) higher in high protein group than others. Higher live weight gain was in attained high protein groups than others. Body length of kids was significantly ($p<0.05$) higher in high protein consumed dams than low protein group. Heart girth at 4^{th} and 5^{th} week was significantly ($p<0.05$) higher in high protein group than others, and wither heights at 4^{th}, 5^{th} and 7^{th} week were also significantly ($p<0.05$) higher in high protein group than others. In conclusion, high protein diet enhanced the growth and milk yield of does as well as growth rate of kids.

Early Pregnancy Diagnosis through Expression of *ISG15* in Goat

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Abstract
Early and accurate diagnosis of pregnancy is important for successful herd management of goats. However, most of the currently available methods allow diagnosis only after 30 days of conception. In ruminants, pregnancy results in up-regulation of a large number of interferon stimulated genes in the uterus. One of these genes has recently been found to rise in peripheral blood leukocytes in goats during early pregnancy. The aim of the present study was to diagnose pregnancy of goats by the expression of *ISG15* gene at early stage. On days 20, 30 and 40 following natural mating pregnant does, blood samples were taken from the jugular vein. Blood was also taken from three non-pregnant does known as control animals. Total RNA extraction was performed by the instruction of RNA isolation commercial kit and cDNA synthesis was done following the manufacturer protocol. The expression profile of *ISG15*gene was then analyzed using qPCR and the reference gene (*β-actin*) was used for normalization of qPCR. The relative expression values of the qPCR result were calculated using the $2^{-\Delta\Delta Ct}$ analysis method. The present study showed that *ISG15* mRNA expression in the blood was significantly increased on day 30, and then decreased at 40 days after natural mating. The expression levels did not differ significantly among days 20 and 40 days after mating and non-pregnant goats. This pregnancy related expression of *ISG15* was also confirmed by ultrasonography. So, the results indicate that expression of *ISG15* gene can be utilized to detect the pregnancy in goats.

Roles of L-carnitine on *In vitro* Maturation of Oocyte in Black Bengal Goats

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Abstract
Assisted reproductive technologies (ARTs) such as *in vitro* growth, maturation, fertilization, followed by *in vitro* embryo production are important for rapid genetic improvements of animals. Supplementation of culture medium with various additive plays an important role for *in vitro* maturation. The present study was designed to examine the effects of L-carnitine, an important antioxidant, on *in vitro* maturation goat oocytes. Oocyte-granulosa cell complexes were aspirated from

antral follicles of slaughtered goat. The oocytes were matured in Medium-199 supplemented with fetal bovine serum, sodium pyruvate, 17β-estradiol and follicle stimulating hormone at 38.5ºC under an atmosphere of 5% CO_2 in air for 24 hours. The maturation medium was supplemented with 0, 0.50, 1 and 1.5 mg/ml of L-carnitine. The nuclear maturation was observed after 24 hours of maturation by staining under a differential interference contrast (DIC) microscope. The data were analyzed using "IBM SPSS Statistics 22" for windows to compute one-way analysis of variance (ANOVA) and the significance of difference among means was determined by Duncan's test. The percentage of oocytes reached MII stage were 45.41%, 55.66%, 73.15%, 57.35% in 0, 0.50, 1 and 1.5 mg/ml L-carnitine supplemented groups, respectively. Similarly the percentage of degenerated oocytes were 17.06%, 12.07%, 2.22%, 11.65% in 0, 0.50, 1 and 1.5 mg/ml L-carnitine supplemented groups, respectively. Oocytes treated with 1 mg/ml L-carnitine showed significantly higher maturation rate and cumulus cell expansion rate and low percentage of degenerated oocytes than other L-carnitine treated groups. These results suggest that L-carnitine improved the maturation of Black Bengal goat oocytes *in vitro*.

Value Addition in Composting Poultry Manures Through Struvite Precipitation for Better Compost Quality

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Abstract

Poultry manure contains less amount of Mg in relation to NH4-N and PO43-, that's why addition of Mg enhances the struvite crystallization process during composting. Struvite is the crystal of Magnesium Ammonium Phosphate that combined with six water molecules in equal molar concentration and used as a slow releasing fertilizer. This experiment was carried out to produce struvite enriched compost from poultry manure. For this purpose, a composting pit was designed with an underground network of pipeline was prepared at the bottom of the floor with numerous openings. A 200-psi air compressor was installed and connected with the underground pipeline network to provide air flow from the bottom of the composting pit. The dimension of the pit was 25 ft long, 5 ft wide and 2 ft height along with 42 air flowing opening at the bottom side. The pit was divided into three equal parts for 3 different treatments adopted for composting such T1, composting layer litter with 1.2 M Mg according to PO4 in the manure; T2, composting layer litter with 0.6 M Mg according to PO4 in the manure and T3, control (no Mg addition in the composting process). Saw dust was added with the litter in such a way that the moisture of the compost mix was 65%. A similar amount of Trichoderma suspension was added in all 3 treatments to enhance decomposition and odor minimization. The results showed that the organic matter decomposition, amount of total nitrogen (TN) and total phosphorus (TP) were significantly higher in T1 compared to T2 and T3. Higher TN might be due to nitrogen mineralization along with struvite. Therefore, it might be concluded from the experiment that the addition of Mg enhanced the N and P mineralization in the compost that helps to improve compost quality.

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Quality and Safety of Beef Cattle Feed and Meat in Bangladesh

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Abstract
The study was conducted to know the quality and safety of beef cattle feed and meat in Bangladesh. The study included three different experiments to investigate nutritional quality and in-vitro digestibility of beef feeds and to determine the residue levels of heavy metals in feeds and meat. Evaluation of nutritional composition of commercial feeds available in the market revealed that the dry matter (DM) content ranged between 90 to 92 % and the crude protein (CP) content in some commercial feeds varied from their claims. *In vitro* digestibility of feed ingredients varied from 18.27 in straw to 75.77% in soybean meal. *In vitro* digestibility was negatively correlated with NDF and ADF contents of ingredients and positively correlated with their CP content. Heavy metal residues in feeds were within the limits of maximum residue level (MRL). Higher levels of copper were found in muscles and organs (liver, lung, heart, and kidney). The findings of these experiments call for stringent policy interventions in Bangladesh aimed at surveillance of cattle feeds in the country for their nutritional quality and toxic residues.

Determination of Fatty Acid Profiles of Raw and Cooked Beef and Fat Available in Bangladesh

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Abstract
This study aimed to determine changes in lipid content and fatty acid (FA) composition in raw and cooked beef meat and fat. Fifty beef rib eye steaks (2.5 cm thick) and renal/kidney fat were collected from meat retailer shop of Mymensingh town. Samples were collected from same age and sex groups. Cooking increased the saturated fatty acids but decreased the unsaturated fatty acid significantly ($p<0.01$). SFA and UFA ratio in raw and cooked beef meat was 0.66 and 0.73, respectively whereas PUFA/SFA was 0.14 and 0.12. n-6/n-3 was in raw and cooked beef meat was 15 and 9.54, respectively whereas MUFA/PUFA was 9.76 and 10.43. SFA and UFA ratio in raw and cooked beef fat was 0.57 and 0.78, respectively whereas PUFA/SFA was 0.40 and 0.27. n-6/n-3 was in raw and cooked beef fat was 13.73 and 15.79, respectively whereas MUFA/PUFA was 3.47 and 3.79. Predominant fatty acids both in raw and cooked beef meat were oleic, palmitic and stearic acid. The estimated DI and EI were 59.0% and 66.0%, respectively. Overall, cooking increased the stearic acid and total saturated fatty acid contents of the intramuscular lipid while reducing total PUFA content.

Effect of Feeding Yeast Fermented Moist Feed on the Performance of Broiler

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Abstract
Study was conducted to investigate the impact of feeding yeast (*Saccharomyces cerevisiae*) fermented moist feed on the growth performance and bone mineralization in broiler. Initially corn soya based

starter diet was fermented anaerobically at room temperature (28 degree centigrade) for 48 hour with 2.0% yeast and 50.0% moisture content. Starter feed and fermented feed was analysed for proximate components (Dry matter, Crude protein, Crude fiber, Ether extract, Nitrogen free extract and Ash). Afterword's a total of 180 day old Arber Acres commercial broiler chicks were allotted for study where initial 10 days offered commercial crumble diet. From age 11 to 37 considered experimental period. Birds were randomly divided into 6 dietary groups (30 chicks each) with 6 replications (5 chicks each). The six dietary groups were: 1) Starter dry (SD), 2) Starter moist (SM), 3) Starter dry with 2.0% yeast for 0 hours (SDY-0), 4) Starter moist with 2.0% yeast for 0 hours (SMY-0), 5) Starter dry with 2.0% yeast for 48 hours (SDY-48), and 6) Starter moist with 2.0% yeast for 48 hours (SMY-48) respectively. Feed and fresh water was supplied *ad libitum*. At the end of feeding trial, one bird from each replication was slaughtered for determination of carcass trait and to collect blood for determination of blood profile and bone mineralization. After 48 hours fermentation (SMY-48), crude protein content has increased (21.94% than 20.75%) but fibre content has decreased (6.33% from 7.84%). Body weight gain during experimental period was 771, 830, 992g in SM, SMY-0 and SMY-48 respectively than SD (762g). Feed conversion ratio (FCR-Feed intake/live weight gain) was lower in SM (1.58), SMY-0 (1.57) and SMY-48 (1.57) than SD (1.75). Tibia ash was higher (35% than 29%) in SMY-48 ($P<0.05$). Carcass yield also increased (66 from 63%) after feeding fermented moist diet (SMY-48) ($P<0.05$). Therefore, fermentation of feed using yeast (*Saccharomyces cerevisiae*) causes desirable chemical changes (increased CP content and decreased CF content), which also improve nutritive value of feed and found suitable for feeding the broilers as it is considering live weight gain, increased tibia ash content, carcass weight of broiler and decreased feed conversion ratio.

Indigenous and Crossbred Cows have Different Feeding Regime in a Similar Area

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Abstract

This study was executed to compare the feasibility of fodder and rice production as well as to assess the productivity of crossbred and indigenous cows with or without seasonal effects. A total of 78 farmers were chosen, with 27 and 24 farmers producing rice and fodder, and 19 and 8 farmers raising crossbred and indigenous cows, respectively in Khoksa, Kushtia. Data were collected on rice and fodder production, and crossbred and indigenous cows throughout one year at different seasons using an organized questionnaire. Net return was 4.31 lac BDT for fodder and 1.57 lac BDT for rice production/hectare, while benefit cost ratios (BCR) for the production of fodder and rice were 1.88 and 3.63, respectively($p<0.05$). Compared to the winter season, crossbred cows were given 150% higher green grass and 72% lower rice straw in the rainy season, resulting in a 24.67% and 23.12% greater milk yield and profit, respectively. Besides, milk production of indigenous cows was increased by 38.00% in winter and 20.00% in summer compared to rainy due to access of *ad libitum* green fodder in char area during that time ($p<0.05$). The green fodder production was almost 2.74 times more profitable than rice. The dairy farmers who reared crossbred cows earned about 46.33% higher profit than those kept indigenous cows ($p < 0.05$).

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Improving Nutritive Value of Low Quality Agro-industrial By-products by Anaerobic Fermentation with Rumen Liquor for Use as Poultry Feed

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Abstract
Rice bran (RB) and Wheat bran (WB) are the most abundant and cheap agricultural by-products used as poultry feed in many developing countries. However, their use in poultry feed is limited due to the high fiber, low protein content. The objective of the present study is to develop a method for finding optimum fermentation condition to improve their nutritive value by decreasing fiber and improving protein content and quality. Two kinds of bran, RB (De oiled) and WB was used in this study. Fermentation was conducted with rumen liquor by maintaining an appropriate environment for different duration (12h, 24h, 48h and 72h). Diluted rumen liquor (RL) of 50% and 100% was used for both RB and WB in case of all the duration of fermentation. McDougall 1948 buffer solution was added for maintaining the pH. Fermentation was started with pH nearly 7 for both 50% and 100% RL. For pH, it was found that pH reduced significantly ($p<0.05$) with increasing fermentation time for both RB and WB. Up to 24h, pH remained good enough for microbes. However, after 48h and 72h, pH reduced to a level that is harmful for fiber degrading microorganisms. In case of crude protein (CP), we found that no significant ($p>0.05$) changes were occurred but increased little bit and this is due to the addition of some microbes with the rumen liquor. For fibre, it was found that all the fibre components decreased significantly ($p<0.05$) after fermentation with increasing fermentation time for both RB and WB. From 12 to 48h fibre decreased gradually significantly but no significant difference found between 48 and 72h. Other nutritional changes also occurred in the fermented bran that could be beneficial for poultry. So, it might be concluded that fermented bran could be better option in case of poultry compared to using unfermented bran.

Effect of Dietary Replacement of Soybean Meal by Improved Quality Shrimp Waste Meal on Broilers Performance

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Abstract
This study aimed to replace soybean meal (SBM) by improved quality shrimp waste meal (SWM) in broilers diet without compromising performance, nutrient digestibility and meat quality. To improve the nutritional quality, SWM was treated with formic acid (5.0%). A total of 120 Indian River day-old -chicks were randomly distributed into five dietary groups having three replications (24 chicks in each treatment and 8 chicks/replication) and reared for a period of 35 days. Corn-soybean meal based basal diet was supplied in one group, whereas, other four dietary groups contained formic acid treated SWM by replacing 25%, 50%, 75% and 100% SBM in diet. It was observed that, chitin and ash contents were decreased in formic acid treated SWM and CP content increased compared with untreated SWM. In addition, *in-vitro* digestibility results showed that, CP digestibility increased significantly in formic acid treated SWM than untreated one. According to the feeding trial data, body weight gain of birds fed SWM by replacing 25% SBM was comparable with control group birds. However, body weight gain was decreased linearly along with the increased % of replacing SBM. Worse weight gain was

recorded in 100% SBM replaced group, this may be due to the lowest feed intake in this group. Feed intake in birds fed control and 25% SBM replaced diet was almost similar, which was decreased linearly along with the increased % of SWM in diet. Considering the *in-vitro* data, it may be possible to improve the nutritional quality of SWM through formic acid treatment; as well as body weight gain and feed intake data found in feeding trial, it may be possible to replace 25% SBM by improved quality SWM in broilers diet.

Key Words: broilers, formic acid, performance, shrimp waste meal, soybean meal

The Role of Networking for Generating Dairy Database in South-East Part of Bangladesh: Application of Regional Modelling Approach

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Abstract
Using regional modeling is an excellent strategy to evaluate regional dairy development potential because it links regional milk production results to national milk production. The modeling of regional dairy farming system would entail require substantial input data sets which are scare not only at regional level but also at national level. To address these challenges, the dairy networking approach is a strong tool which has been beneficial for generating the data, knowledge and bring the required output with limited resources and time. IDRN regional model which is extended to district and sub-district level through several rigorous processes such as the development of farm questionnaire (Input Farm Data-IFD), formation of panel, database team and training, data collection, storing and data validation, organization of national workshop for data validation. The project came up with a breakthrough output of establishing IDRN farm networking model with proper calibration of IFCN model at regional level. It also benchmarked and calibrated 25 variables of 1000 dairy farms and 647 variables of TIPICAL farm from the North-western parts of Bangladesh. Contemporary findings are published in the university website and mass media for stakeholder's benefits. Results revealed that the highest proportion of feed ingredients such as wheat bran (47.9%), mustard oil cake (13.5%), rice polish (58.8%), maize (29.6%) and soybean meal (10.9%) were used in dairy feed ration in Cox's Bazar, Bagerhat, Kushtia, Barishal and Bagerhat respectively. These findings are dynamic that means update periodically, sustainable and ready to use for future research. It will certainly help to the holistic dairy development of Bangladesh.

Feeding Dairy Cows with Green Grass Leftovers: It's Effect on Milk Yield and Composition

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Abstract
The present experiment was carried out to evaluate the effect leftover green grass on milk yield, milk composition and dry matter intake in lactating cows. For this research, nine Sahiwal crossbred lactating cows were equally divided into three groups for feeding rations consisting of control group fed with green grass; leftover with green grass and leftover with straw. The milk yield, milk composition and dry matter intake in lactating cows were studied to assess the effect of leftover greens. Results revealed

that daily milk yield, morning milk yield and afternoon milk yield among the treatments was not significant ($p>0.05$). Among the milk constituents, total solids, SNF, protein, lactose and ash content was found significantly ($p=0.010$-0.038) higher in cows of leftover with straw group than that of the control group and with the leftover group these milk constituents were no significance at morning session. Density of milk was not significant among the treatment groups. Fat% in milk was significantly higher in leftover with straw treatment than leftover treatment but non significance with in control group at morning session. At afternoon session, we found milk constituents such as total solids, fat, SNF, protein, lactose, ash and density of milk were not significance among the groups. Beside, result on body weight there was significant between green grass and leftover group. Cows in green grass were significantly higher than cows in leftover group in case of body weight. In addition, dry matter intake there was not significance among the different groups. Dry matter content in leftover grass was higher than green grass but protein content of leftover was less than green grass. As a potential, we can be used the leftover grass in commercial dairy farm mixed with high protein content concentrate become profitable dairy business. Thus we have utilized the leftover green grass.

Effects of Freezing as a Post-Harvest Storage Technique on Quality of Buffalo Milk

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Abstract

The present research was undertaken to evaluate the storage of buffalo milk at -20ºC temperature. For this purpose buffalo milk was collected from Bangladesh Agricultural University Dairy Farm just after milking ascetically. The samples were then allocated either into single freezing or multiple freezing protocols (freezing type). Thereafter, For single freezing, milk physical and composition was determined on five aliquots of each sample in the order of 0, 24, 72, 120, 168 hr at freezing temperature. Physical and chemical qualities of milk samples were determined at different time duration. The quality of raw buffalo milk was found acceptable and fresh just after milking. The milk samples were evaluated chemically by using an ultrasonic milk analyzer. The results indicated that milk fat, protein and lactose content decreased significantly with freezing time. Density and freezing point also decreased. But specific gravity was significantly increased in multiple freezing. However, the decrease was more in multiple frozen samples than single frozen samples. It should be noted that milk samples frozen at -20°C leads to a significant decrease in fat, protein, and lactose content. The loss of constituents was much more pronounced when samples were frozen, thawed, and refrozen (multiple freezing) than when samples were thawed only once (single freezing).

Effect of Maize, Oat and Jumbo on the Nutritional Status, Productive Performance, and Cost of Milk Production in Holstein-Friesian Cross Cows

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Abstract

The study was conducted to investigate the impact of various diets for dairy cows on their nutritional condition, production efficiency, and the cost of producing milk. Thirty Holstein Friesian crossbred

cows with equal milk production, number of lactations, and stage of lactation were separated into three groups of equal size (n=10): oat group, maize group, and jumbo group. Every cow was provided with 3 kg concentrate mixture and allowed for *ad libitum* oat, maize, and jumbo grass. Sample collection, analysis and variables recording were performed at 10th days of feeding. The dry matter intake and body weight for each group of cows showed no significant differences (P=0.457 and P=0.220, respectively). The results showed that the group of cows fed maize had the highest milk production (P=0.00), followed by those fed jumbo. The morning milk quality was found similar among the groups (p=0.051 - 0.208) but in the evening milk, oat group had highest TS, SNF and protein content (p=0.000 - 0.024). The blood biochemical analysis results showed no significant differences in the group pooled blood BHB levels among the groups (P=0.859). The jumbo group had the highest levels of SGPT (P= 0.000), while the maize group had the highest levels of albumin (P= 0.021) and creatinine (P= 0.001). The oat group had the highest levels of glucose (P= 0.000). The most efficient use of feed per kg of milk produced was seen in maize, while oat showed the least efficiency (P=0.000). In terms of cost per kg of milk produced, oat had the highest cost, and jumbo had the lowest among the three groups. In conclusion, maize gave the highest milk production, followed by jumbo, and the milk quality of the oat group was found better than other groups.

Impact of Peripartum Soybean Meal Supplementation on Lactation Performance of Crossbred Dairy Cow

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Abstract

Ten Holstein-Friesian crossbred 21 days pre-partum cow were selected for an on farm 60-day long experiment in a completely randomized design to characterize the impact of soybean meal supplementation in concentrate mixture during pre and post-partum period on growth, nutritional status, welfare, milk yield and quality. Selected cows were equally divided into three groups and received concentrate mixture containing 12% CP and ME 9.5 MJ/Kg DM in pre-partum diet and 15% CP and ME 10.5 MJ/Kg DM in post-partum diet, as control group (without soybean meal supplementation), Pre-partum supplemented group (supplemented with 1 kg soybean meal only in pre-partum period) and Post-partum supplemented group (supplemented with 1 kg soybean meal only in post-partum period). Green German grass after chopping was provided as basal diet and fresh drinking water was supplied adlibitum basis. Result revealed that average body weight (325 – 350 kg/cow), body condition scores (3.25 – 3.42) of the cow found similar among the groups (p>0.05). Cow's nutritional status (Serum glucose, triglycerides, albumin, e-creatinine, urea, phosphorus and calcium) were differed non-significantly (p>0.05) among the experimental groups except serum total protein which was 0.9-1.2g/dL higher in supplemented group than that of the control group (p=0.000). However, with regards to milk production the control cows produce significantly less milk than that of the cows in post-partum supplemented group (2.5 kg milk/cow/day less) and pre-partum supplemented group (2.1 kg milk/cow/day less), respectively. But among the supplemented groups the milk production was found similar (p>0.05). All the milk quality attributes were found similar in all three types of diet (p>0.05), except somatic cell count. The somatic cell count was significantly less in pre-partum supplemented cows followed by post-partum supplemented group and the highest was found in control group (p=0.035). Finally, soybean meal supplementation was found better in terms of daily milk yield and maintaining udder health. It may be recommended that supplementation of soybean meal in dairy cow ration has a positive impact.

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Development of Cost-effective Technology for Making Flavored Stirred Yogurt

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Abstract
This research project was undertaken to develop of a cost-effective technology for milking stirred yogurt that fits the taste of consumers in Bangladesh and to specify appropriate parameters – raw materials, composition, physical properties, organoleptic attributes, microbial standards, shelf-life, labelling, etc. – of stirred yogurt for patent application. In total 24 different batches of 'stirred yogurt' with strawberry flavor, mango flavor, banana flavor and vanilla flavor, 6 batches from each flavor, were prepared at the pilot plant of the Department of Dairy Science. Results indicated that addition of flavors significantly ($p<0.001$) increased the organoleptic properties of yoghurt in comparison to control. However, no physic-chemical properties were affected. Based on sensory profile analysis, it could be concluded that the strawberry flavored stirred yogurt was significantly better ($p<0.05$) as compared to vanilla, mango and banana flavored yogurts. The cost for production of per Kg stirred yogurt from skim milk was Tk. 127, while costing for full cream stirred yogurt was Tk. 147. So, technology of delicious 'stirred yogurt' with strawberry flavor, mango flavor, banana flavor and vanilla flavor has been developed. More research is needed to study the shelf life of the stirred yoghurt.

Effect of Different Roughages in Iso-energetic and Iso-nitrogenous Dairy Cow Ration on Their Nutritional Status, Productive Performance and Cost of Production

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Abstract
Twelve crossbred lactating dairy cows (Holstein Friesian Cross) of same stage of lactation, similar in milk production & body weight were selected to assess the effects of different roughage sources (Napier, Maize, German and Rice straw) in dairy cow ration. Ration has been formulated by consulting available feeding standards (NRC and BSTI guidelines), previous research findings at the same station and animals productivity. Result showed that daily milk yield of the HF crossbred dairy cows were 6.3-7.1 kg/d with 12.1-12.3% TS in morning milk and 13.0-13.3% TS in afternoon milk. Roughage source has considerable impact on milk production and quality. Live weight (Kg), BCS, Dry mater intake (Kg DM/d) and somatic cell count were found similar among the experimental groups. The blood profile were also found similar among the cows ($p=0.165$-0.499), however, BHB concentration was found (1.6-2.0 mmole/L) higher in maize group than that of the other groups ($p=0.000$). Cows consumed Napier diet produced highest (7.07 Kg/d) amount of milk per day which was significantly ($p=0.000$) higher than that of the Straw (6.3 Kg/d) and German (6.8 Kg/d) fed cows and non-significantly higher than the maize (6.9 Kg/d) fed cows, and Napier fed cows produced 0.1-.08 kg more ($p=0.000$) milk per day than the cows fed other diet. Cows in German and Straw group consume 0.06-0.10 Kg more DM to produce each Kg of milk than that of the Napier and Maize group ($p=0.000$). Lowest feed cost/Kg milk yield (BDT) was found in Napier (BDT 42) group followed by

Maize (BDT 44), German ((BDT 48) and Straw (BDT 52) groups. Similar scenario was also found in case of production cost/Kg milk yield (BDT). Therefore, Napier can be placed ahead of others and maize can be placed with Napier or second in position then German and finally Rice straw.

Comparative Analyses on Growth, Laying Performance and Egg Quality of Available Layer Strains in Bangladesh

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Abstract
Various factors have been reported that affect the growth performance of layers, such as genetics, nutrition, environment, and disease. Attaining appropriate growth is essential to ensure profit. To evaluate the production performances and egg quality of four commercial layer strains in Bangladesh, a total of 128 laying pullets including NOVOgen brown, ISA brown, Hy-line brown, and Bovans brown were randomly allocated at 4 different treated groups (one individual strain treated as separate treatment) having 4 replications and 8 birds in each replication. A commercial layer diet purchased from Kazi Farms Group was fed to the experimental birds and identical management was provided to the birds irrespective of their strains. Data on feed intake, egg production, and body weight were recorded and thereafter egg mass and feed efficiency were calculated. Eggs were collected from the respective treatments and subjected to external and internal egg quality analysis. The results revealed that there were no significant differences among the growth performances (weekly body weight, feed intake, uniformity, and survivability) of four commonly available layer strains, and all the strains followed the standard very closely. The results revealed that Hy-Line brown had significantly ($p<0.001$) lower feed intake compared to other strains. On the other hand, NOVOgen Brown had a significantly ($p<0.05$) higher shell thickness among others. Other laying performances such as hen-day egg production, average egg weight, egg mass, and egg quality parameters such as shape index, Haugh unit, albumen index, and yolk color score did not affect significantly ($p<0.05$). Taken together, it may be concluded that there were almost no statistical differences with the growth, laying performance, and egg quality among the strains compared in this study. Also, the layer strains available in Bangladesh are highly competitive and suitable for local climatic conditions.
Keywords: Layer strains, egg quality, growth, laying performance, management,

Effect of Organic Zinc on the Flock Performance and Egg Quality in Laying Hens

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Abstract
Egg quality can be influenced by nutritional variables such as diet composition, electrolyte ratio, and the content and composition of amino acids in the diet. Previous research demonstrated that organic zinc was associated with higher activity of carbonic anhydrase and in turn with improved shell quality. Therefore, the present study has undertaken to improve the laying performance and egg quality of late-laying hens. A total of 96 laying birds of 80 weeks old were divided into six dietary treatments having four replications under each treatment and 4 hens per replication. The laying hens were fed different doses of organic and inorganic zinc. Egg production performance and egg quality parameters were

recorded accordingly. The results revealed that a combination of liquid and dry zinc powder significantly improved the hen-day egg production compared with other dietary treated groups. Other laying performances such as egg weight, egg mass output, feed conversion ratio, etc. were either equal or better than the control group, although data were not statistically different. In addition, the eggshell thickness at 87 and 90 weeks were significantly improved in the control groups. The yolk index at 87 weeks also showed significant variations among the dietary-treated groups. No other significant differences were observed among the different doses of zinc tested in this experiment. Taken together, it may be concluded that organic in both liquid and powder form are essential to improve laying performance and egg quality in laying hens.

Effect of Synbiotic, Probiotic and Neem Leaf as Alternatives to Antibiotic in Broiler Diets

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Abstract
This study was conducted to compare the effect of probiotic, synbiotic and neem leaf as alternatives to antibiotic in broiler chicken diets. The experiment was performed for a period of 28 days with a number of 500 day-old straight run broiler chicks. Birds were divided into five dietary treatment groups with 4 replications having 25 birds in each. The dietary groups were; control (Basal diet), synbiotic, probiotic, neem leaf powder (NLP) and antibiotic group. The experimental diets were consisted as broiler starter (day-old to 14 days) and broiler grower (15 to 28 days). The supplementation of synbiotic, probiotic, NLP and antibiotic in the broiler diets had significant effect on growth performance. Diets supplemented with synbiotic showed significantly ($p<0.05$) higher body weight and body weight gain at the end of the experiment compare to the control and antibiotic group. NLP and probiotic supplemented groups also showed significantly higher ($p<0.05$) body weight and body weight gain compared to control and showed almost similar performance compared to antibiotic group. Better FCR ($p<0.05$) was also noticed in synbiotic group (1.60) compare to the control (1.79), antibiotic group (1.65), NLP group (1.69) and probiotic group (1.70). There were no significant differences in meat quality characteristics among the dietary groups. The cost of production per kg of live broiler was slightly lower in synbiotic group compared to control and antibiotic groups. With regards to profit, synbiotic groups showed higher profitability than other groups. The result indicated that supplementation of synbiotic, probiotic and NLP in broiler diet had a positive effect on growth performance and profitability. The findings of this study suggest that the synbiotic, probiotic and NLP could be potential feed additives in broiler diet and synbiotic could be considered as a better antibiotic alternative for broiler production.

Possibilities of Making Fiber Enriched Chicken Sausage with Addition of De-oiled Rice Bran

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Abstract
The study was conducted to evaluate the effect of de oiled rice bran as a source of dietary fiber on the sensory, physicochemical biochemical and microbiological properties of chicken sausages. For this purpose, sausages were prepared into 4 different groups. They were as follows: control; broiler breast

meat sausage without rice bran, broiler breast meat sausage with 5% rice bran, broiler breast meat sausage with 10% rice bran, broiler breast meat sausage with 15% rice bran. All parameters were analyzed at 0, 14th and 28th days of storage period. DM, Ash, Crude fiber, EE and pH showed significantly different among the different sausage batters. All the parameters except pH was significantly lower in control group compare to different rice bran sausage batter group. During the analysis of sausages, all proximate parameters were significantly different among different sausage treatment groups. DM, Ash and EE contents were significantly higher in rice bran groups compare to control, while CP content and pH were significantly higher in control group. DM and CP% increased, while EE% and pH decreased with increasing the storage period. The lightness (L*) value was higher, while redness (a*) and yellowness (b*) values were lower in control sausage compare to rice bran group sausages. Free fatty acid, TBARS and all microbiological values (TVC, TCC and TYMC) were significantly lower in control group compare to rice bran sausage groups. Peroxide value, TBARS value, TVC, TCC and TYMC increased with increasing the storage period. Sensory evaluation indicated higher acceptability of sausage with 5% rice bran incorporated group compare to other sausage group.

Establishment of Model Mini Poultry Processing Plant for the Production of Hygienic and Safe Broiler Meat for BAU Community

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Abstract

Food safety has become an extremely important and ensuring products safety is an international public health concern as well as in Bangladesh. The presence of pathogenic and spoilage microorganisms in poultry meat and its by-products remains a significant concern for suppliers, consumers and public health officials worldwide. It is important to prevent the hazards and to provide a safe and wholesome product for human consumption. Therefore, the goal to set up a poultry processing plant of small scale of operation is to produce material at a price which customers can afford, which is hygienic, wholesome, attractive and saleable, of consistent appearance and quality, and with a realistic shelf life. A designed questionnaire is developed by related expert. Technical person in related to poultry science was engaged for collecting data from the local market through direct interview to get information about processing procedures of poultry in standard processing plant and local market. Data reveled that slaughter house condition such as space, light, drainage systems were insufficient as well as hygienic condition was poor in most of the market. Sellers were not aware about spread of diseases and environment pollution from their slaughtering unit. Establishment of a mini model processing unit is under construction at BAU poultry farm. Assessment of microbial load {Total viable count (TVC), total coliform count (TCC), total salmonella count (TSC) and total campylobacter count (TCpC)} in processed broilers (local vs processing unit meat) will be done in the 2nd year of the project for hygienic and safe poultry meat production.

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Nata-De-Coco Scrapings: A Promising Water Supplement for Increased Production and Longer Egg Laying Life in Hen

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Abstract
An experiment was conducted on a flock of 109-week-old laying hen to investigate the effects of feeding Nata-De-Coco Scrapings (Nata-Scrap), which is composed of bio cellulose, fatty acid, acetic acid and bacterial metabolites, on the body weight maintenance, egg production and egg qualities, gut microbial profiles, and egg production related anatomical and physiological fitness of the hens towards longer productive life. The doses of the Nata-Scrap were 0, 10 and 20 ml/litre drinking water. The gut microbial profile, serum calcium (Ca) and phosphorous (P) levels, and egg production related anatomical and physiological fitness of the hens were monitored through sacrificing them at 118 weeks of age. Equal survivability rate was observed in the hens irrespective of the doses of the Nata-Scrap used and all the hens had gained their weight at the end. Compared to the control, significantly ($p<0.05$) higher egg production was observed in the Nata-Scrap groups irrespective of the doses of the Nata-Scrap and age of the hens. Most of the egg quality characteristics were significantly affected at feeding the Nata-Scrap, except egg weight. In case of egg shell colour, the % of deep brown shelled eggs was the highest in the Nata-20 group followed by Nata-10 and the control. The serum Ca ($p>0.05$) and P ($p<0.05$) levels were higher in all the Nata-Scrap fed hens. The loads of the pathogenic bacteria were lowered at the Nata-Scrap fed hens along desirable anatomical and histological changes in the oviduct and vital organs. The Nata-Scrap feeding had surpassed the production cost only by 0.10 and 0.20 taka per hen per day in the Nata-10 and Nata-20 doses respectively. It was be concluded that the feeding of Nata-Scrap at a rate of 10 to 20 ml/litre in drinking water can prolong egg production life in 109-week-old hen, at least by 10 weeks, along with an enhancement in the egg production rate and egg quality characteristics at reasonable additional cost.

Nutrient Optimization for Meat Type Japanese Quail

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Abstract
This study was conducted to observe the growth rate of meat types Japanese quail by nutrient optimization (energy and protein). Experiment was done for a period of 42 days with a number of 500 chicks. Birds were divided into nine dietary treatment groups each having 50 birds per treatment. The dietary groups were; T1= ME 2800 kcal/kg and protein 22%, T2= ME 2800 kcal/kg and protein 23%, T3= ME 2800 kcal/kg and protein 24%, T4= ME 2900 kcal/kg and protein 22%, T5= ME 2900 kcal/kg and protein 23%, T6= ME 2900 kcal/kg and protein 24%, T7= ME 3000 kcal/kg and protein 22%, T8= ME 3000 kcal/kg and protein 23%, T9= ME 3000 kcal/kg and protein 24%. The experimental diets were consisted of broiler starter (0-14 days) and hand mix feed (15-42) days). Quail growth performances, dressing parameters, meat yield, and internal organ development such as liver weight, heart weight, gizzard weight, and profitability were tested in this experiment. Results showed that, at the end of the experiment higher body weight and body weight gain were observed in treatment T8 and

T9. Higher feed intake was in group T8 whereas, better FCR was found in the T9 group compare with others. There was higher dressing percentage in T5 group of birds than other groups of birds. The highest breast meat and thigh meat yield were in T9 group compare with others. High quality protein with adequate amino acid balance is one of the most important prerequisite for quality diet. The dietary protein requirement of quail is influenced by metabolizable energy contents and the ingredient used in diet formulation. It is concluded from the results that higher energy and protein content in feed gives quail more heavily. It is suggested that energy and protein content in quail feed should be 3000 kcal/kg and 24%.

Prevalence of Tetracycline Residue in Milk of Mymensingh City in Bangladesh: A Food Safety Issue

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Abstract
The presence of tetracycline in milk can causes potential health hazards along with the development of antibiotic resistance (Hassan *et al.*, 2014). The presence of antibiotic residues in raw and pasteurized milk has been studied worldwide. Therefore, the current study designed to determine the tetracycline as antibiotic residue in milk by the advanced analytical technique called High Performance Liquid Chromatography (HPLC). The milk samples were collected form randomly selected local whole sale market of KR market, Swadeshi Bazar, Notun Bazar, Kachijhuli Bazar, and Pouroshova Bazar area. The samples were prepared and to determine the tetracycline residues in milk High Performance Liquid Chromatography (HPLC) method was used. Our result reveal that the milk samples from KR market, Swadeshi Bazar, Notun Bazar and Kachijhuli Bazar did not contained tetracycline residues. On the other hand, the raw milk samples of Pouroshova Bazar were contained tetracycline residue that were lower compared to the Maximum residue limit (MRL) of milk (Codex, 2015). The overall prevalence of tetracycline in raw milk was 13% of local markets. In conclusion, the prevalence of tetracycline residues in raw milk in Mymensingh area is very low. Further research is needed to completely understand the prevalence of tetracycline antibiotics in raw milk.

Assessment of Heavy Metal Contamination in Locally Available Vegetables in Mymensingh

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Abstract
Vegetables are main source of nutrients all over the world because they are high in important nutrients, antioxidants, and metabolites. On the other hand, vegetables are easily contaminated with heavy metals due to rapidly increasing urbanization and emission of heavy metal contaminated fumes from the industries. Consumption of these contaminated vegetables may pose serious hazard to human health. This study deigned to find out the concentrations of Cd, Cr, Cu, Pb, and As from locally available vegetables (Tomato, Potato, Carrot, Brinjal, Chili, Papaya, Sweet gourd, Cucumber, Green banana and Red amaranth) that are frequently consumed by the local population in Mymensingh. Samples were

randomly collected from Kamal Ranjit (KR) Market and heavy metal concentration of samples were analyzed by using Atomic Absorption Spectrophotometer (AAS). The average content of Pb were 0.103, 0.028 and 0.253 mg/kg dry weight (dw) in Tomato, Carrot and Brinjal respectively; Cd were 0.086, 0.13, 0.048 and 0.113 mg/kg dry weight (dw) in Tomato, carrot, Brinjal and Red amaranth respectively; Cr were 0.940, 0.847, 0.456, 1.15 and 1.90 mg/kg dry weight (dw) in Potato, Tomato, Carrot, Brinjal and Red amaranth respectively and; Cu were 2.74, 2.80, 2.62, 2.53 and 2.23 mg/kg dry weight (dw) in Potato, Tomato, Carrot and Brinjal respectively. The heavy metal present in all vegetables were below the recommended legal limits established by the FAO/WHO. In conclusion, Vegetables in the study areas are safe for consumption but they must be eaten in moderation due to possible hazard and risks derived from metals ingestion. Further research is needed to completely understand the prevalence of heavy metals in locally available vegetables in Mymensingh.

Assessment of Tetracycline Residues in Locally Available Raw Milk in Mymensingh City

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Abstract

The presence of tetracycline in milk can causes potential health hazards along with the development of antibiotic resistance (Hassan *et al.*, 2014). The presence of antibiotic residues in raw and pasteurized milk has been studied worldwide. Therefore, the current study designed to determine the tetracycline as antibiotic residue in milk by the advanced analytical technique called High Performance Liquid Chromatography (HPLC). The milk samples were collected form randomly selected local whole sale market of KR market, Swadeshi Bazar, Notun Bazar, Kachijhuli Bazar, and Pouroshova Bazar area. The samples were prepared and to determine the tetracycline residues in milk High Performance Liquid Chromatography (HPLC) method was used. Our result reveal that the milk samples from KR market, Swadeshi Bazar, Notun Bazar and Kachijhuli Bazar did not contained tetracycline residues. On the other hand, the raw milk samples of Pouroshova Bazar were contained tetracycline residue that were lower compared to the Maximum residue limit (MRL) of milk (Codex, 2015). The overall prevalence of tetracycline in raw milk was 13% of local markets. In conclusion, the prevalence of tetracycline residues in raw milk in Mymensingh area is very low. Further research is needed to completely understand the prevalence of tetracycline antibiotics in raw milk.

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Improving Farmers' Income and Livelihood through Green Grass Production in Major Milk Pocket Areas of Bangladesh: A Socioeconomic Study

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Abstract
The study was conducted to assess the impact of cultivating green grass on farmers' income and livelihood in major milk pocket areas of Bangladesh. A total of 180 farmers were interviewed following stratified random sampling technique from Sirajganj, Pabna and Rangpur districts. A combination of descriptive, mathematical and statistical techniques was used to analyze the data. Green grass is one of the major ruminant foods and its nutritive value is very high. Regarding farmers' perception, green grass production emphasized on cost minimization in cattle feeding, potential use of fallow land and sharing of work within household members. Financial profitability of green grass production was measured in terms of gross return, gross margin, net return and benefit cost ratio. It was found that benefit cost ratio (BCR) of green grass production was 1.84 and it was comparatively profitable than the competing crop. Partial budget analysis was used as a planning and decision-making framework to compare the costs and benefits of green grass production and its alternative crop i.e., *Boro* rice production. Estimates of Logit model indicates that age of household head, annual income from grass production, households' training and experience in green grass production were the significant factors influencing farmers' decision to adopt green grass production. Through green grass production, majority of the farmers' experienced improved states of their socioeconomic status and livelihood capitals in terms of human capital, social capital, financial capital, natural capital and physical capital. SWOT analysis indicated less requirement of labour and other inputs as strength, low price of product as weakness, high demand in domestic market as opportunities, and uncertain flood as threat. The study recommended that high yielding fodder varieties should be considered for seed production, preservation and processing facilities should be improved and necessary training should be provided by government and non-government organizations.

Soybean Production in Bangladesh: Potentials and Problems

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Abstract
Considering the increasing demand for edible oil in our country, it is extremely needed to increase the total production of oil crops through increasing the area of cultivation. Although soybean cultivation in Bangladesh is quite limited, there is an ample scope of increasing its cultivation in local environment. This study was undertaken to estimate the financial profitability and assess the potentials and problems of soybean production in Noakhali and Lakhsmipur district of Bangladesh. Ninety farmers were interviewed based on stratified random sampling using a structured questionnaire to collect primary data. The study depicts that majority of the respondents belonged to the age group of 30-64 years old and they had a medium size family. Around forty percent of the total respondent were illiterate and most of them were in small farm size category. It was found that time of cultivation, minimum tillage, cropping pattern and soil fertility were the main factors that influence farmers' adoption towards

soybean production. Financial profitability analysis shows that soybean production was profitable and Benefit cost ratio (BCR) was more than one. Logistic regression model revealed that cultivating short duration crops, practicing crop diversification, use of fallow land, zero/minimum tillage, risk minimization and income creation had significant influence on farmers' decision to adopt soybean production. SWOT analysis indicates appropriate climate and soil fertility as major strengths, higher price of seed and fertilizer as well as low price of output as weakness, high local demand for soybean and wide export market as major opportunities, and lack of training as well as disease and insect infestation as the major threats. To overcome the problems related to input, production and marketing of soybean as well as to make this farming more profitable and potential, policies recommended are: to reduce price of seed and fertilizer, to increase price of output and to improve transport facilities, respectively.

Profitability and Efficiency of Rice and Sugarcane Production in Bangladesh: A Comparative Study on Solar and Non-solar Irrigation Systems

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Abstract

Bangladesh agriculture particularly the boro season crops is highly depends on irrigation systems which is energy dependent. Irrigation systems mostly dominated by diesel operated system followed by electricity operated system. However, under the changing climate, increase in diesel price and non-availability of electricity, renewable energy based irrigation system is expanding throughout the country. Solar irrigation may be used for irrigating the marginal lands to enhance crop production and to increase cropping intensity. Therefore, for large scale adoption, diffusion and sustainability it is very important to examining the prospects of adopting solar irrigation system and its feasibility compare to other systems. Since the technology is new and very few studies are conducted, it is necessary to analyze whether its profitable as well as efficient under solar irrigation compare to alternative irrigation systems which will help to understand the prospect of this technology and what should be done for large scale adoption diffusion in Bangladesh. To achieve the objectives, the study uses primary farm household survey data collected through structured questionnaires. Data were collected from different irrigation systems owner as well as users from western and norther regions of Bangladesh. Gross margin and data envelopment analysis (DEA) were employed to determine the profitability and efficiency under alternative irrigation systems for producing rice and sugarcane. Results shows that producing rice and sugarcane under solar irrigation is more profitable compare to diesel irrigation. DEA results also reveal that solar irrigation based sugarcane and rice production is more efficient than diesel irrigation. Based on the findings of the study some recommendations are made.

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Status of Women Empowerment and Its Role on Household Food Security of Rural Farm Household in Bangladesh

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Abstract
Women empowerment is broadly seen as a tool for household food security and these two associated concepts are widely used in the literature. Being an agricultural country, where the agriculture sector is predominantly depending on the rural agriculture of Bangladesh, the study was aimed to measure the status of women empowerment, explore its determinants, estimate the level of household food security and discover the linkages between the domains of empowerment and food security of rural farm households. A primary data from 350 farm households were collected through the direct face to face interview following random sampling technique. The study applied the modified pro-WEAI to estimate the women empowerment and result showed that less than 1% women were empowered in rural farm households. While exploring the determinants of empowerment through the Poisson regression, it was evidenced that women's years of schooling, household size, farm types and presence of migrated members were positively and distance of farm from home was negatively associated with the empowerment. The Household Food Insecurity Access Scale (HFIAS) was used to measure the food security status of the rural farm households. The study revealed that only 18% of the households were food secured and rest of the households was food insecure at different levels. In path analysis, three domains of empowerment named; access to decision on financial services, input in productive decision (farm) and ownership of land and other assets were negatively and mobility was positively associated with household food insecurity. The study concluded that both the status of women empowerment and food security in rural farm households was very low and policy needs to be formulated to achieve food security through empowering rural women.

Waste to Energy Generation" at Bangladesh Agricultural University Campus: Possible Scenarios to Generate Energy and Organic Fertilizer

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Abstract
This study is examined the status of solid waste generation, potential waste to energy generation and technology selection of waste management at Bangladesh Agricultural University Campus area in Mymensingh. About 63 households including teachers, officers, employees and two male student and one female student halls and a market named K. R. Market were selected for data collection. Data collection was conducted in winter and summer seasons of 2022. The inhabitants including teachers, students, officers, employees of this university generate 5.21 to 5.92 tons of organic waste per day and 0.18 to 0.23 tons of inorganic waste per day in 2022. This study will be able to present the waste to energy conversion technologies such as waste incineration, pyrolysis, gasification and anaerobic digestion to convert the waste into energies. It is found that 2.7 MWh, 1.56 MWh, and 4.6 MWh and 0.78 MWh electricity could be produced by using the incineration, pyrolysis, gasifier and anaerobic

digestion process at BAU campus and .023 t CH4/t SW and .828 t CO2/t SW emission will have reduced due to practice of the above four technologies. About 8% biochar from gasifier, 25% ash from pyrolysis, and incineration process will be generated as well as practiced for soil improver in same campus. A pilot based Solid waste anaerobic digested treatment plant can be established at BAU campus for energy production and remaining organic fertilizer would be used for increasing the soil fertility. Waste is being treated as asset, now-a-day to the society; many cities are developing the business model on waste to value, while waste should be treated as valuable product not like a liable to the society. Waste to energy is included two type's benefits: direct and indirect benefits. Direct benefits are of renewable energy (gas and electricity) generation and organic fertilizer production for soil improving. Indirect benefit included reduces GHGs emission, employment and income generation, increase crop production, improve women health etc. Lack of regulations or standards for waste disposal, lack of proper awareness, improper choice of technology and inadequate financial support are the major constraints for waste management at Bangladesh Agricultural University Campus Area in Mymensingh.

Variation Between Farm-gate and Retail Price of Fish and Its Effect on Fishers' Livelihood in some Selected Areas of Mymensingh

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Abstract

This study was conducted to estimate the profitability of tilapia and pangas farming in four major carp fish farming areas of Mymensingh district. Moreover, it estimated the fish price variation between farm gate and retail markets and its impact on livelihood of fish farmers. Primary data from randomly selected 100 pond fish farmers and 25 fish traders of each Fulbaria, Muktagachha, Phulpur and Trishal Upazilas were collected based on the high concentration of fish farmers in these Upazilas. Three main analytical techniques viz. descriptive statistics, activity budgets and functional analysis were employed to achieve the objectives. Major findings of the study are that family size of pangas farmers is higher than tilapia farmers. Family size of tilapia farmers of Fulbaria Upazila was the highest among the Upazilas and it was higher than the national average. Highest percentage of tilapia farmers of Phulpur Upazila were found illiterate (68.56%) and the lowest was in Muktagachha. Majority of the tilapia and pangas farmers of the selected Upazilas were running their farming having pond area of 0.51 to 1.5 ha. It was evident that per hectare total costs for tilapia and pangas farming were Tk 18,57,275.00 and Tk 17,01,522.00, respectively. Per hectare net returns from tilapia and pangas farming were Tk 9,98,725.00 and Tk 13,14,728.00, respectively. Undiscounted BCR for tilapia and pangas farming was 1.54 and 1.77, respectively indicating the enterprises profitable from the view point of individual farmer. Results of the functional analyses showed that fingerling, feed, fertilizer, lime and medicine costs had significant impact on tilapia and pangas farming. The study revealed that there is a considerable gap between farm gate and retail price of tilapia and pangas fish. Finally, some policy recommendations based on the findings of the study were suggested for the improvement of tilapia and pangas farming in Bangladesh.

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Traditional Profession, Livelihood and Multiple Deprivations: A Study on the Cleaners Community of Mymensingh Municipality, Bangladesh

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Abstract
The most marginalized minority in Bangladesh is the cleaners community. In addition to being denied access to necessities, they are excluded from larger society. The study aims to find the traditional profession, livelihood situation of cleaners community and to explore multiple deprivations that cleaners communities encounter on a daily basis. Primary data were collected purposively from 60 randomly selected cleaners from the Mymensingh City Corporation. Descriptive Statistics and qualitative methodology were employed to analyze the data. The findings show that all household of the sweeper are being deprived from socioeconomic advantages, comparatively with general community. The major findings of the study showed that about 35% of the respondents belonged to the age group 35-44 years, 65% had primary education only, 92% people have been working as cleaners in Mymensingh city and 100% sample cleaners belongs to Hindu religion. Most of the sweeper's households are burden by excess expenditure over income. Maximum household have loan burden and a very few have savings and only three percent have investment which shows their vulnerability. Using in-depth interviews and analyzing documents, this study shows that the cleaners are being separated from mainstream society which results in numerous deprivations. It contends that cleaners community don't have sufficient access to income, accommodation, social networks, education and labour market creating a life full of hardships for them.

Changes in Women Economic Empowerment and Its Impact on Household Livelihood: A Socio-economic Study of Harijan Community in Cumilla District

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Abstract
The Harijan caste, which is one of 44 Hindu castes, is the most marginalized in society and have long been socially oppressed, economically disadvantaged, culturally subjugated, and politically impotent in Bangladesh (Chowdhury, Islam and Uddin 2009). This community has long been subjected to severe social and economic discrimination. Among them women from Harijan community earn less than male and have experienced no improvement in their situation despite the efforts of women organizations and consecutive government commitments. In our targeted place, Cumilla district, Harijan women are working in Cumilla Medical College Hospital, Cumilla University, Cumilla City Corporation, Bangladesh Academy for Rural Development (BARD), and different institutions as sweeper. Beside they cultivate vegetables in their yard and rear different livestock specially pig. This research have helped us to find out the changes in women economic empowerment and their contribution to the

current household livelihood trend of this community, and also helped to provide some core recommendations to upgrade their socio-economic status. Household data was collected through personal interviews during the month from April to June 2022. The Women Economic Empowerment Index attempts to do so, examining 60 households for which data was available. Log-log regression model has been used to find out the impact of some explanatory variables on sweeper women's income. The explanatory variables are age of the respondent, family size of the household, experiences of sweeping, year of schooling of the respondent, involvement in farming activities and receiving urban facilities. Most of the variables in the model had significant impact on sweeper womens' income. To assess the impact of sweeper women's income on livelihood, DFID recommended livelihood framework has been used. All kinds of livelihood assets have increased after women being empowered economically. Overall human capital, social capital, financial capital, physical capital and natural capital have increased than the last 20 years. Women of Harijan community are at the bottom of social stratification. Patriarchal mind set of society make them more vulnerable. They become victim of many crimes. Situation is changing now a days by breaking the wall of their traditional society. Participation in various income generating activities in urban areas is helping their family economically and to make their voices in the family and society. Vibrant policies should be developed concentrating on their engagement in economic activities in order to increase their socioeconomic empowerment.

Adoption of Climate Resilient Crop Varieties in Selected Environmentally Vulnerable Areas of Bangladesh

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Abstract

Bangladesh is one of the countries in the world which is worst affected by climate change. The adoption of agricultural technologies that can withstand climatic stress is crucial for maintaining food security of the country. Therefore, it is essential to comprehensively investigate the varietal adoption addressing all the climatic stresses in Bangladesh. This research aims to investigate the adoption of climate resilient crop varieties (submergence tolerant, salinity tolerant, drought tolerant, heat and blast tolerant) covering five different environmentally vulnerable areas (Satkhira, Sunamganj, Jamalpur, Chapainawabganj, Meherpur, Thakurgaon) of Bangladesh. A total of 1,200 farmers was surveyed of which 800 were rice farmers and 400 were wheat farmers. And among them 600 were adopters and 600 were non-adopter farmers. Moreover, several focus group discussion (FGDs) and Key Informant Interviews (KII) were done. Socioeconomic characteristics of farmers, logit regression analysis, Problem Confrontation Index, gross margin, net return, Benefit-Cost Ration (BCR), Cobb-Douglas production function, and Asset Index are employed to achieve the objectives. Moreover, t-test, Chow test will be estimated to see the differences between adopter and non-adopter farmers. Major climate resilient varieties that have been found in the study areas include Binadhan-11, Binadhan-12, BRRI Dhan-51, BRRI Dhan-52, Binadhan-17, Binadhan-19, BARI Gom 30, BARI Gom 32, BARI Gom 33, etc. The profitability analysis shows that most of the resilient varieties are profitable in terms of gross margin and Benefit-Cost Ratio (BCR). Farmers mostly depend on dealers for the seed and fertilizers. They are satisfied with the yield and resilient level of these varieties but mentioned the problems of training and lack of information. They suggested training, seed availability and showcasing field to popularize these varieties.

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Impact of COVID-19 on Food Security and Livelihood of Indigenous Garo Community in Bangladesh

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Abstract
The COVID-19 pandemic, as well as its social and economic effects, is drastically altering the path toward achieving the Sustainable Development Goals (SDGs), particularly for the world's 476 million indigenous and forest peoples. The present study will particularly focus on the impact of COVID-19 on indigenous people (Garo, in particular) of our country which is defined as a crucial need by the United Nations. The poverty rate among indigenous people is significantly higher than the national average of 20.5 percent. The immediate socioeconomic impacts of the pandemic hit indigenous communities the hardest. Though the COVID 19 has a greater impact on indigenous people, little research has been conducted on it. This study therefore aims to address indigenous peoples' food security, livelihoods, economies, and resilience in response to COVID-19 impacts. The study will perform a cross-sectional survey across study areas in Modhupur upazila of Tangail district and Haluaghat and Dhobaura upazila of Mymensingh district. A total of 450 (150 from each upazila) households will be interviewed following a random sampling technique. In addition 6 focus group discussions (FGDs) and 15 key informant interviews (KIIs) will be done. Some case studies will also be carried out to capture the whole scenario immensely. A detailed survey questionnaire has been prepared for data collection. Household Dietary Diversity Score (HDDS) and Household Food Consumption Score (HFCS) will be used to measure the food security status. Sustainable Livelihoods Framework (SLF) developed by DFID will be used to explore the livelihood status of the targeted community. To address the risk and vulnerability, and adaptation strategies taken by the Garo community to combat the COVID-19 impact will be explored. The results of this study will assist relevant authorities in taking steps to ensure the well-being of this group of people affected by the pandemic.

Mangrove Resource Extraction in the Sundarbans' and its Linkages with Non-Mangrove Income

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Abstract
The Sundarbans mangrove forest in Bangladesh is facing threats from several factors like agriculture and shrimp farming, pollution, increasing demand of forest resources, climate change-induced factors like sea level rise, changes in freshwater flow from rivers, erosion, as well as other hydro-meteorological effects. The forest provides livelihoods for millions of people, but their over-reliance on the forest's resources can result in degradation. This study focuses on the Sundarbans mangrove forest in Bangladesh where changes brought about by people can endanger the way of life for the area's inhabitants. The study examined the socioeconomic characteristics and livelihood practices of people who reside close to the Sundarbans using a thorough and meticulous research procedure. A sample of 234 households involved in resource extraction from the Sundarbans from Shyamnagar Upazila of Satkhira District were collected. In addition to examining the practices of resource use, the study examined the effect of non-mangrove income on resource extraction. The influence of the explanatory factors including non-mangrove income sources on total mangrove income was examined using the

OLS regression technique. The findings show that households rely on a range of livelihood strategies, including fishing, crab collecting, honey collecting, golpata collecting, etc. It was also observed that higher levels of household income does not necessarily lead to lower levels of mangrove resource extraction in absolute terms. However, the scope of non-mangrove income from sources like involvement in aquaculture, wages from labor activities can potentially reduce the dependence of communities on mangrove resources for their livelihood. The study also observed the shocks and problems locals in the Sundarbans region confronted. Suggestion was made regarding promotion of alternative livelihood opportunities to reduce dependence on mangrove resource extraction as a means of policymakers and practitioners to advance towards sustainable development that fosters both community welfare and the preservation of mangrove ecosystems.

Poverty and Livelihood Analysis of Former Enclave (*Chitmahal*) People in a Selected Area of Bangladesh

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Abstract
Poverty and livelihood analysis of former enclave (*Chitmahal*) people is very crucial for formulating development policies in these areas. This study was conducted to assess the socioeconomic characteristics, measure the poverty level, and determine the change of livelihood, and estimate the satisfaction level of the respondents on rural institutions in the study area. A total of 100 households was selected randomly from two enclave villages of Debiganj upazila under Panchagarh district in Bangladesh. Data were collected through direct face to face interview by using semi-structure interview schedule. Tabular analysis, Direct Calorie Intake (DCI) method and the DFID sustainable livelihoods framework and scale (1-5) methods were used to analyze the data. The major findings of the study were that the average age of the family head was 43.78 year while the mean household size was 4.76. Educational attainment of the family head was 4.77 years of schooling. About 13% of the respondents had low (up to Tk. 60,000) household income, 27% had medium Tk.(60,001-100,000) and 60 had high Tk.(>100,000) household income. About 57 % of the households lies in ultra-poor, 21% of the households were in hard core poor and 7 % of the households are in the category of absolute poor. At the same time, 15% of the sample households were found non-poor. All five types of assets were positively changed after becomes a Bangladeshi citizen specially the human and social assets. The average satisfaction on the social institutions was sometimes/moderate. Social institutions need to be more functioning for reducing poverty and improving living standard of the households in the study area.

Shifting from Paddy Production to Aquaculture: An Economic Study in a Selected Area of Bangladesh

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Abstract
Shifting rice cultivation to aquaculture is a burning issue of agricultural land use policy in Bangladesh. The study was conducted to identify the reasons for transforming from paddy farming to fish culture

and relative profitability of fish and rice cultivation randomly selected 50 sample farmers from Bhaluka upazila of Mymensingh district in Bangladesh. Primary data were collected through field survey. To determine the net return of fish and rice production, profitability analysis was applied. The findings revealed that 70% of the respondents belonged to the age group of 30-64 years, 46% of the respondents' primary occupation was fish farming and 24% respondents' primary occupation was agriculture. Average annual income and expenditure were Tk. 2333234 and Tk. 2025860, respectively. Average fish plot size and rice plots size were 280 decimals and 68.84 decimal respectively. About 90% of the respondents said that the main reason for shifting rice cultivation to fish culture was more profit in fish culture than rice cultivation. Per hectare per/six months gross margin and net return were Tk. 545994 and Tk. 487494, respectively for fish culture and per hectare per/season (six months) gross margin and net return were Tk. 16404.00 and Tk. 7064.00, respectively for rice cultivation. The BCR of fish culture and rice cultivation was 1.86 and 1.07, respectively (Full cost basis). Low profit and scarcity of labour in harvesting period were the main problems faced by the rice farmers. Diseases and high feed cost were the main problems faced by the fish farmers. Profit making rice prices and supply of paddy harvesting machineries need to be ensured by the government and other agencies to make profitable agribusiness by the rice farmers.

Assessing Supply Chain Performance and Governance Structure of Fisheries Sector in Bangladesh

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Abstract
The structure of the fish supply chain in Bangladesh seems more complex because of its perishable nature, unorganized market, and governance structure. Good governance and systematic management of the supply chain can help reduce the complexity of the distribution channel in a positive way. Efficient supply chains can reduce the operating costs of the traders, boost customer service, and improve the financial position of all stakeholders. Thus, the objective of the study is to assess the existing fisheries supply chain performance and governance structure of Bangladesh. With the aforementioned objectives in mind, a total of 600 samples will be collected from different fish producing and market-dominant regions of Bangladesh. For choosing market intermediaries, a list of different types of intermediaries has been collected from the market authorities in each study area. Special emphasis has given on Dhaka fish market. Data is being collected (350 sample has been surveyed) from respondents using well-structured questionnaires and oral interviews with the direct interview method. The study will map the key processes and flows of the fisheries supply chain. Six (6) indicators such as efficiency, effectiveness, quality, capability, reliability, and flexibility will be used to assess the performance of the supply chain in different market structures. The study will also estimate the governance index of different governance elements such as rule of law, transparency, traceability, participation, effectiveness, efficiency, equity, and accountability that exist in this market. Principal Component Analysis (PCA) and Structural Equation Modeling (SEM) will be employed to find out the factors that influence the stakeholders' performance and the interrelationships among the factors, respectively.

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Econometric Investigation of Agro-food Processing Industries in Bangladesh: Prospects and Constraints

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Abstract
The agro-food processing industry is the fastest growing industry in Bangladesh which creates vital linkages and synergies between the two pillars of the national economy- industry and agriculture. This project was carried out with the objectives of evaluating current status of food product industries, determining influential factors affecting the industries, potentiality assessment and providing some policy measures for the sustainability of the industries. Both primary and secondary data have been collected. 1826 of secondary data was collected from the Survey of Manufacturing Industry (SMI)-2019 and 25 of Key Informant Interviews were conducted with the personnel affiliated to the industries. Descriptive statistics, ANOVA, Multivariate regression analysis and SWOT analysis were applied to achieve the project objectives. Majority of the food industries of Bangladesh is micro and small scaled. The manufacturing of grain mill products industries has occupied the lion share among the industries. Fish processing and preserving industries have run consistently with the highest on average industrial costs and output level. Multivariate regression analysis has shown that among different sizes and locations of the industries, medium and large scaled and EPZ industries have higher gross output and value addition than micro, small sized and non-EPZ industries. Jointly owned public and private industries surpass other industries in terms of gross output and value addition. Research and development have a beneficial impact on overall production. According to the SWOT analysis scarcity of skilled labor, storage and preservation systems, power supply, transportation facilities and waste management system are major constraints whereas its enormous potentiality found in terms of ingredients, labor and SME loans availability, domestic market demand. The study has recommended the policies namely workforce training, institutional support and collaboration, infrastructure development, development of preservation and storage systems and environmental consideration can assist to attain Sustainable Development Goal.

The Knowledge, Attitudes and Practices Study Regarding Antenatal Care, Breast Feeding and IFA Supplementation to Access the Present Status of Rural Women having Neonate About Anemia at Gouripur Upazila, Mymensingh

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Abstract
Anemia causes long term public health problem amongst the women and children in Bangladesh, especially for the pregnant women. However, IFA supplementation remains as the one of the few interventions available to combat anemia during the critical period of pregnancy. Our focus was to study IFA and fortification coverage at union-level health facilities to understand related knowledge, attitudes and practices of rural women having 0-11 post-partum with live birth in study area at Gouripur Upazila, Mymensingh. According to the 2011 Bangladesh census, Gouripur had a population of 323,057. Males constituted 49.44% of the population and females 50.56%. Average literacy is

36.9%; male 40.8% and female 32.8%. According to BDHS-2014, 64 percent of women in Bangladesh receive ANC from medically trained provider while 31 percent of women with live birth have four or more antenatal care visits during the course of their pregnancy. Purposive sampling method has been followed as sampling techniques and a range of quantitative and qualitative techniques and tools were used for this survey study. Data were collected by face to face interview with an open and closed ended questionnaire. Descriptive tools and graphical presentation are used to analyse the data through MS Excel and SPSS software programs. Specific objectives of the project are to estimate ante natal care (ANC) level, estimate IFA supplementation level, to assess knowledge, attitudes and practices of women having neonate regarding anemia and IFA supplementation, place of delivery and breast feeding and to assess knowledge of mothers regarding causes and consequences of anemia and benefits and dosage of IFA supplementation, timing of first breast feeding and cord clamping. The key findings of the study are about 69% mother are aged 25-29 years and 15% are in adolescent age group. About 96% mothers have attended school or pre-school. 71% of the respondents availed ANC services for four or more times and about 90% of the total respondents were reported to have taken at least three key services during their visits in the past. Approximately 93% respondents received IFA supplements and out of them the estimates for receiving at least 90, 150 and 180 IFA supplements were around 78%, 52% and 31% respectively. Around 90% of respondents were reported to have consumed any number of IFA supplements throughout their previous pregnancy. Among them 39% have reported for any side effect due to consumption of IFA supplements during their last pregnancy. About knowledge related to anaemia 95% were able to describe one sign or symptom of anaemia. About 90% of the respondents were able to mention any benefit of consuming IFA tablets and around 52% of the respondents were exposed to behavioral change intervention from health facilities around 46% from mass media. The respondents who obtained the counseling from a health worker and those who have received the same by seeing communication material were found to be around 71% and 64%, respectively. About 92% of the respondents were reported to have home visits from health workers and around 91% of them were able to state at least one of the key ways of getting nutrition that was needed during pregnancy. The postpartum mothers (0-11 months) who reported to have received message from health workers on at least one aspect of IFA was around 71%. About 68% of the total respondents were reported to have received timely initiation of breastfeeding. Around 88% of the respondents could name one benefit or reason to put the newborn to breast within one hour of birth and around 93% of them could mention the correct time of putting the newborn to breast which would be either immediately or within 1 hour of birth. The study has been found a good estimate of all parameters regarding IFA supplementation for anemia status of the study area. For further improvement of anemia status, need to strengthen the knowledge, attitude and practices of IFA consumption to both mother and household members before conception and during early stage of pregnancy.

Production Risk and Technical Efficiency of Poultry Production in Bangladesh

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Abstract

In Bangladesh, commercial poultry production has been growing rapidly since early 1990. It is a promising dynamic sector with enormous potential for poverty reduction and income generation for the rural households. Poultry meat has a great demand as compared to other meat, because of its low price and the religious taboos in case of pork and beef. Despite its impressive growth and demand,

production is highly volatile across farms and location, indicating that output risk may be a problem in poultry farming. This study quantifies production variability of poultry farming by means of two main sources: production risk and technical inefficiency. Few studies of the combined effect of production risk and technical inefficiency on crops and aquaculture have been conducted in different countries but there is no study on poultry production. Therefore, the aim of this study was to investigate production risk and technical inefficiency in poultry farming in Bangladesh using a stochastic frontier production model. The empirical analysis was based on cross-section data from 200 poultry farms. Main findings are that significant production risk and technical inefficiency exist in poultry farming. Capital is found to be a risk-reducing factor while feed is identified as risk-increasing factors. In inefficiency function, extension services and training are identified as important determinants for the variation in inefficiency. Both extension services and training are significantly increase technical efficiency of the farmers. Government policy should focus on increased extension services and training for poultry farmers.

Survey on Chicken Meat Products Available in Bangladesh: Issues and Policy Responses to Extend Its Markets Disregarding Any Pandemic Situation

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Abstract

This study aims at assessing the impact of chicken meat products and its market on employment generation and income earning by food industries, fast food shops and restaurant owners and employees. The project has been started in February 2022 in Dhaka and Chattogram. Based on information from specialized meat companies, fast food shops, special restaurants and super markets through surveys, it tries to assess impact of chicken meat products on employment and income generation, preference for chicken meats by consumers. Poultry sector contributes 37% of total meat production in Bangladesh. This sector contributes about 22-27% of the total animal protein supply in the country. Chicken meat products are produced by varieties brand name of different companies and these products are available in their own respective outlets or super shops of big cities. In fast food shops or departmental stores, products are made by their own technologies. Fried chicken, chicken burger, chicken sandwich, chicken roll, chicken cutlet, chicken kebab, chicken samosa and chicken singara are very popular in fast food shops whereas chicken sandwich, chicken burger, chicken roll, crispy and spicy chicken fry are very common in departmental stores. In restaurant, the most common items are grill chicken, chicken curry, chicken paratha, fried chicken, fried chicken wing, fried chicken drumsticks, chicken with cashew nut, sliced chicken with capsicum, sweet and sour chicken, fried boneless chicken, boneless chicken gravy, masala chicken curry and chicken chilli dry. The process of making variety of chicken products and branding are going on by different producers. Important chicken meat products available in the market are sausages, nuggets, meatballs, spring roll, samosa, singara, cutlet, kebab, burger, sandwich, sharma, lollipop, wonton, grilled chicken, fried chicken. These products are available in ready to eat and ready to cook forms. There are 28-30 Companies those are producing frozen foods (Chicken) like ready to cook and ready to eat. They are Pran, RFL, Kazi Farms, Golden Harvest, BRAC Chicken, Aftab Foods, AG Foods, Rich Food, CP, AG Agro, Paragon, Bengal Meat, EON, Country Natural, Quality Foods, Jhatpot, Nourish, Lamisa, Urosia, etc. In Chattogram city, some of the companies like Roja, Tava, Mafco, Essentials, Busket, Swapno are producing chicken meat based frozen foods. Golden Harvest started production and marketing of frozen food (Chicken) products from 2006 in the country. The markets of safe chicken meat products

are gradually being expanded over the years. Packaged frozen food products are now being produced and marketed considering consumers' preferences and demands. Several millions of trained people are engaged in the above organizations to produce and sell of chicken meats and earn a handsome amount of money and improve their livelihood. The meat products produced by 14 big companies is 459 tons per month and average return and profit earned are respectively BDT 470 crores and BDT 147 crores in the year 2022. Average profit earned by fast food shops in a year is BDT 432884 and average profit earned by restaurant owners is BDT 1465497.

Baseline Survey to Evaluate the Role of Buffalo on the Economy of Bangladesh

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Abstract

Buffalo is a versatile domestic animal uses in agricultural production system and helps the human livelihood by providing milk, meat and value added product in Bangladesh. According to the Agriculture Census 2019, the Buffalo population in Bangladesh is 378411 and buffalo is the 2nd highest milk producing animal in Bangladesh. The purpose of this study are assessing the current status of buffalo farming in Bangladesh; evaluate the socio-economic condition of the farmers involved in buffalo farming. The primary data of sample size 1013 of buffalo farmers has been collected from sixteen (16) districts. The study reveals that the percentage of Large (>10), Medium (6 to 10), and Small (<6) buffalo farm are 26.65, 25.47 and 47.88 respectively. About 88% percent of existing buffaloes are found indigenous type throughout the country while rest of them is cross breed type. Most of the farmers follow the extensive to semi-intensive farming methods. Natural breeding is the major source of breeding (above 96.4%) only few percentages used artificial insemination because 77.2% farmer's claim not enough availability of artificial breeding. However, above 30 percent thought that artificial insemination is available. Most of the farmer's opinioned that the success rate of artificial insemination is very low due to the nature of breeding time of buffalos. Therefore, the development of natural bull can be a good option for breed development. The study found different categories of buffalos namely milking (64.9%), heifer (14.22%), bull calf (10.23%) and bull (10.65%) in the study areas. The study found that buffalo farming is a profitable. The average yearly rearing cost was around Tk. 151297 which includes feed cost, medicine cost, labor cost and others. The average yearly profit was around Tk. 321886. And average yearly milk production from per farm was 3175 Kg. The demand of buffalo meat, milk, leather and milk products are increasing day by day in national and international market of Bangladesh.

Comparison of Fish Marketing System in Selected Areas of Mymensingh District

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Abstract

The study was undertaken to understand the marketing system, marketing margin, efficiency of selected fishes in some areas of Mymensingh district. The investigation was carried out for a period

from October 2021 to December 2021 in different markets of Mymensingh district in Bangladesh. Three categories of fishes (Shing, Pabda and Rui) were selected. A total of 40 farmers and 152 fish traders were selected purposively and primary data were collected through face-to-face interview method. The descriptive statistics, least significant difference, and multiple regression model was used in this study. The marketing channel of selected fishes consist of fish producer, Aratdar, Aratdarcum wholesaler, Bepari, Hawker, retailers and after that the ultimate consumer. The highest marketing cost incurred by Bepari where transportation cost (7.55 Tk./kg) is the highest cost among all the cost items. The study revealed that there exist significant difference of marketing cost of retailer with Aratdar (for all types of fish), Aratdar cum wholesaler (for Pabda and Shing), and Bepari with Aratdar, Aratdar cum wholesaler (for all fishes), Aratdar with hawker in all types of fish. The net marketing margin is high for Shing fish in all intermediaries except Bepari. The study also found that there exists significant difference of marketing margin of Aratdar with bepari, Hawker, Aratdar cum wholesaler, retailer for all types of fishes. Marketing margin of retailer is significantly different between Pabda and Rui fish, Rui and Shing fish, Shing and Pabda fish. In Shepherd's method, marketing efficiency was the highest in channel 1 in case of Shing fish. Marketing efficiency was the highest in channel 1 than channel 2, 3 in all types of fish by Shepherd's method. Average marketing efficiency was maximum in Shing fish than other fishes by Shepherd's method. Moreover, the study found that marketing cost significantly and positively influenced the gross marketing margin. And, marketing margin is significantly influenced by the Shing fish than Rui. The study found different types of marketing problems faced by producers and intermediaries; among them high price fluctuation was found one of the major problems faced by market actors, and they suggested to provide timely market information and reduction of price fluctuation.

Changing Livelihood Pattern and Cultural Assimilations of Indigenous Garo Community in Tangail District

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Abstract

The Garos are one of the most vulnerable distinct ethnic indigenous groups in Bangladesh who are still trying to get constitutional recognition. The research study is to assess the changing livelihood pattern and cultural assimilation in selected household. This study has conducted on the indigenous Garo community living within the Madhupur areas of Tangail district and consisted of 180 sample household. Primary data were collected from the respondents through a sample survey with the help of an interview schedule and following descriptive statistics to analyzed data. It was found that in selected area, very few traditional rituals were followed by Garos for establishing their marriage and cultural norms. After marriage, now a days the male Garos are not interested in moving to his wife's parents' home; rather they are living in an independent home. Study shows that 114 couples have built their house away from the husband's or wife's parents, 46 are staying in the bride groom's house but are independent, 43 couples are staying in the bride's house but are independent, 61 are living away from the bride groom's house. Annual income has changed in 56.74 percent of livestock and poultry rearing household, 92.08 percent has changed in fruits and vegetable producers. Financial capital like Cash in hand, cash in bank and savings were increased 71.6 percent, 53.5 percent and 38.5 percent respectively in livestock and poultry rearing households. Where fruits and vegetables producers showing Cash in hand, cash in bank and savings were increased **73.5** percent**,** 58.0 percent and 41.5 percent respectively. The value of average Women Empowerment Index (WEI) is 1.79 which is lower than the

average value of 2. Most of the respondents suggested that, if employment opportunity increases and ensure proper education; then their socioeconomic status will be faster. The specific lifestyle of the Garo population must be preserved through proper documentation and Governmental recognition.

Women's Entrepreneurship: A Gateway Towards Empowerment and Psychological Well-being

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Abstract
Women in developing countries try hard to break the impediments by launching numerous entrepreneurial ventures. Exploring what traits women follow to become entrepreneurs is crucial to encourage their entrepreneurship. This study explores how Bangladeshi women entrepreneurs' personality traits and trust between entrepreneurs and employees influence their business performance and the impact of such performance on their empowerment and psychological well-being. Data were collected through a survey using a structured interview schedule from 161 randomly selected women entrepreneurs running micro-and-small businesses like parlours, food and baking, tailoring and trading of boutiques in the Gazipur district of Bangladesh. Empirical results based on a structural equation modelling reveal that personality traits and trust positively predict women entrepreneurs' business performance, and such performance contributes significantly to their empowerment and psychological well-being. Women's empowerment positively impacts their psychological well-being. Based on empirical evidence, this study concludes that women entrepreneurs' desired empowerment and decent mental health can be achieved and sustained through entrepreneurship. Therefore, women can pursue their dream through entrepreneurship, which can promote their empowerment and psychological well-being on a high note. They need to be aware of personality traits early in their education to pursue their entrepreneurial career and become empowered. Government and non-government organisations should arrange need-based training programmes to learn how to incorporate personality traits within themselves and to what extent they should trust their employees to make their businesses successful.

Impact of Nutritional Status on Academic Performance of Female Residential Students in Bangladesh Agricultural University

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Abstract
Poor dietary practices of the hall cafeteria may have a negative influence on female student's nutritional status and also on their academic success. The general objective of the study was to investigate the interrelation of female residential students' academic performance with their nutritional status in Bangladesh Agricultural University. Data has been collected from female students studying in BAU, from different female student dormitories. According to the BMI classification by World Health Organization (1995), 68 percent of the students are in normal range (18.5-24.9kg/m^2), while 24(12) percent were in the overweight category (25-29.9 kg/m^2), and 38(19 percent) were underweight (<18.5 kg/m^2). Calculating body fat percentage (BFP), 71(35.5%) students persist from poor (22.8-27.1%) BFP range, while 49(24.5%) students belong to this fair BFP category (19.5-22.7%), and 50(25%) students are in the dangerously high BFP range (27.2%-30%). Among the iron enriched food items the

intake of egg is very common–daily intake for 82(41) students. As daily intake of calcium enriched food items the intake of green leafy vegetables, milk, egg and fish is the highest –daily intake are for 53(26.5), 22(11), 82 (41) and 28(14) students. As daily intake of vitamin A enriched food items the intake of tomato is the highest –daily intake and 5-6 days intake are for 29(14.5) and 34(17) students repectively. As daily intake of vitamin C enriched food items the intake of lemon and tomato is the highest –daily intake are for 28(14) and 29(14.5) students respectively. Around 62 percent female students regularly go to outside to have sunlight. As daily intake of protein enriched food items the intake of eggs and lentil are the highest –daily intake are for 82(41) and 57(28.5) students respectively. Monthly income of the family (p=0.031) and monthly income of the student(p=0.005) with Body Mass Index (BMI)(p=0.025) has significant association with academic performance of the students.

Smart Phone Usage Among University Students in BAU: Impact on Physical, Psychological Well- being and Academic Performance

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Abstract
Smart phones are a way to engage in interesting activities such as browsin the internet, playing games, conducting research and taking and sharing photographs. Smart phones make our lives easier, but on the other hand, it ties us. Whenever a habit is converted into an obligation, it becomes an addiction and smart phone use is possibly the biggest non-drug addiction of 21st century. The principal objective of the study is to investigate the extent of using smart phone among the students of BAU and find out the effect on physical and emotional wellbeing as well as relation with their academics. A sample of 200 students have been selected from six faculties of Bangladesh Agricultural University. Students have been asked to fill out a self-administered questionnaire included a) questions on variables related to socio-demographics, academics, smartphone use, lifestyle behaviors, physical and psychological problems for overuse of smart phone; b) and a 26-item Smartphone Addiction Inventory (SPAI) Scale (Lin et al., 2014). The highest 45.5% students use smartphone in the night and they mostly spend their time on social media (38%). Students use the smartphone for study purpose (26.5%) and they can't concentrate in their study also (21.5%) for overuse of smartphone. They feel eye strain (18%), headache (26%), back pain (7.5%), neck pain(11.5%), muscular contraction (8%), finger dysfunction(4%), obesity(8.5%),memory loss(16.5%). There are also some psychological problems as stress(24%),anxiety(17.5%), loneliness(9.5%), depression(17%),social isolation(14%), low self-esteem(5%),insomnia(13.5%). The collected data have been analyzed using Statistical package for social sciences (SPSS) version 22.0. Different statistical techniques (e.g. descriptive statistics) have been applied to analyze the data.

Assessment of Farmers' Satisfaction on Extension Advisory Services under COVID-19 Context in Rural Bangladesh

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Abstract
The objective of this research was threefold- (i) to examine the nature and extent of public extension services and supports received during and before COVID-19; (ii) to measure the level of satisfaction

with the extent and quality of services, and (iii) to examine the expectations of the farmers. A total of 400 farmers were interviewed and eight (8) FGDs were performed adopting mixed method. Comparative analysis, paired t test, thematic content, and SWOT analysis were carried out. Findings showed that on an average cultivated land was 114 decimals. Majority (56%) of the respondents had completed their primary level of education and have had 26 years of farming experience. Yearly household earning was estimated at Tk. 390 thousand in Dinajpur district while it was Tk. 490 thousand for Mymensingh district. Some sorts of variations were found in nature and extent of services provided by DAE in two regions. About 41 percent respondents reported that they received some sort of services during COVID period while it was 47 percent in the previous year of the COVID pandemic. Relatively more farmers of Mymensingh district had received extension advisory services than that of Dinajpur district. Majority of the farmers were satisfied with the services provided by the extension agents but a bit lower level of satisfaction reported during COVID period. Paired t test re-confirmed that among 20 statements regarding satisfaction, 9 statements were found statistically significant implies that farmers were unhappy with the services of DAE during pandemic. The most important expectations mentioned by the farmers are to get timely inputs particularly fertilizer, better price of their produces, good variety of seeds, soil testing facilities, and finally respect and honor during training session. Therefore, extension agent should consider their expecting and bring those supports and services to increase trustworthy relations and ensure sustainable farming.

Agricultural Development Philosophy of Bangabandhu and Its Impact on Food Security in Bangladesh

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Abstract

Introduction: Bangabandhu's vision was clear, challenging and reality based. He decorated the agricultural policies basing on the farmers and their economic conditions. The leader put special importance in practicing integrated agriculture. This paper aims to synthesis the agriculture and food security policy in terms of Bangabondhu's development philosophy. Methods: Study has followed survey research with the qualitative and quantitative analytical techniques approach. The Charland area in Mymensingh district has selected with 300 farm households through random sample technique. Findings: The findings show that involvement on crop production about 43.66% of the respondents, where 31% involved in vegetable production, and 25 % poultry rearing. Average yearly income was 264000 tk, 167000tk and 189000 tk respectively cereal crop, vegetables and poultry rearing activities. Crop producer average income was higher among the all groups. In an average 49% respondents reported that as others sources of annual income from livestock is 55900 tk, 36% belongs to homestead fruits gardening and 21 % are engaged with Government services. The findings show that about 53% of female headed households adopt and use more indigenous implements in land preparation compared to 28 % of male headed households. It is also revealed that male-headed households are the greater adopters and users of newly adopted equipment in land preparation 55% male and 36% of female headed households do same. The above data revealed that 67 percent respondent noticed soil quality is deteriorating due to modern technology though more food are produced, 88 percent agreed with the statement of efficiency in production increase remarkably. Conclusion: Perception of farmers towards a new technology is a key precondition for adoption to occur. Therefore, to enhance technology adoption by farmers, it's important for policy makers and developers of new technology to understand farmers need as well as their ability to adopt technology in order to come up with technology that will suit for them.

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Impact of Income Generating Activities on Livelihood Diversification of the Charland Women in Bangladesh

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Abstract
This study examined the level of livelihood diversification and the factors of livelihood diversification of charland women in Mymensingh district. The primary data were collected from four villages of Mymensingh Sadar by adopting simple random sampling procedures. A face to face interview was conducted to collect data of total 120 respondents in which semi-structured and pre-tested questionnaire were used. Descriptive statistics, Simpson diversification indexing and Multiple regression analysis were employed for analyzing the data in accordance with the objectives of the study. The socioeconomic attributes of different respondents indicate that characteristics of sampled respondents differ from each other in respect of their age, gender, literacy rate, land holdings, credit access etc. However, in charland a considerable number of women have diversified their livelihood at different levels through several income generating activities. Findings of the study indicated that (17.5%) having medium livelihood diversification and (10.8%) had high livelihood diversification though (60.8%) of the women had no diversification. Multiple regression model was used to analyze the determinants and find that several factors either positively or negatively affect the extent of livelihood diversification. Education, extension contact, ICT technology user had positive and significant effects on women's livelihood diversification. A context specific comprehensive development program is needed to create opportunity in the charland areas to improve women's livelihood resilience.

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Safe Management of Litters in Poultry Housing Systems in the Rural Area

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Abstract
This study elucidates the present scenario of poultry litter management practices and development of a technique for safe management of litter at farmer's level. Survey-based data were collected through pre-tested questionnaires from some purposively selected 42 poultry farms erected within the areas of Mymensingh, Gazipur, Netrokona, and Jamalpur districts. A large amount of poultry litters were generated from broiler and layer farms daily. Most of the farmers dumped this litters into open places (50%) which caused a serious environmental and health hazards. A self-aerated composting technique was designed and developed to effectively manage and mitigate the environmental and health hazards evolving from poultry litters. A compost heap was prepared with rice straw, water hyacinth, and poultry litters with the proportion 1:2:4 respectively by weight at the optimum C:N ratio of 30:1 incorporating the provision for air entraining into the bulk compost heap. Temperature and moisture contents at time interval of three days, and pH, C/N ratio, volume, and microbial properties at time interval of seven days were observed throughout the composting period of 60 days. Analysis was accomplished taking representative samples from the compost heap using the random sampling technique. The quality of compost in terms of nitrogen, phosphorus, potassium, and organic carbon was evaluated in accordance with the Indian and Australian Standards. This technique is found environmentally safe, functional and cost-effective. The developed self-aerated composting technique would be an alternative option for safe management of poultry litters for the farmers in the rural areas.

Preparation of Hyigeinic Compost from Agricultural Wastes at Farmer's Level

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Abstract
This study elucidates an attempt to prepare hygienic compost by using agricultural wastes at farmer's level. The method employed here is the *self-aerated* composting technique that offsets the hazards of turning the compost bulk at regular interval during the composting process. A compost heap was designed and erected having a shape of truncated pyramid with 2m×2m at base and1m height. Agricultural wastes like, rice straw, cow-dung and grass were used as raw materials with the proportion 1:2:4 respectively by weight for the compost with the optimum carbon nitrogen (C-N) ratio of 30:1 incorporating the provision for air entraining into the bulk compost heap. The thoroughly mixed material was spread over a 2m x 2m floor up to 30cm in height. Four pieces of bamboo were placed 1m apart horizontally over the materials forming a grid and another four pieces were placed vertically at cross over points of horizontally placed bamboo. The rest of the mixed materials were stacked so that the overall height of the heap was 1m. The top surface of the heap was covered with a 2.5cm thick clayey soil layer to preserve warmth and moisture content. The bamboo pieces were pulled out when the compost bulk was found self-restraint to withstand the hole left by them. Composting process was continued for a total period of 60 days. Temperature at time interval of three days, and pH, C/N ratio, volume, and microbial properties at time interval of seven days were observed throughout the composting period of 60 days. Analysis was accomplished taking representative samples from the

compost heap using the random sampling technique. The quality of compost in terms of nitrogen, phosphorus, potassium, and organic carbon was evaluated in accordance with the Indian and Australian Standards. This technique is found environmentally safe, functional and cost-effective. This study suggest that, the developed self-aerated composting technique would be a better option for safe management of agricultural waste by converting it into hygienic compost for the farmers in the rural areas.

Design Up-gradation of Riser for the Buried Pipe Irrigation System

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Abstract

Buried pipe fulfills many functions, especially for irrigation purpose. But when it comes to irrigation, we face many challenges of buried pipe such as corrosion, installation problem, failure due to dynamic loading, low discharge and many other losses. The study was aimed to identify the challenges and probable solutions of buried pipe riser design, construction, operation and maintenance. The study was accomplished by collecting data from farmers, field staffs and management authorities through pretested questionnaires and field investigations in some selected areas at Netrokona District. The challenges of buried pipe were analyzed by investigating three deep tube-wells supplying water through buried pipes having 25 risers. Among them, one deep tube-well having five risers located at BADC area, Netrokona, one deep tube-well having 15 risers located at Kailati, Netrokona Sadar and one deep tube-well having five risers located at Netrokona Sadar. It was observed that the major problem of buried pipe is leakage of water. And the main causes behind this are the improper outlet design of buried pipe. Other problems are- cracks in underground pipe, cracks in concrete structure around the outlet, rust in riser outlet patches, jointing problem, theft of different parts etc. and these occurs due to improper design and mismanagement of buried pipe irrigation system.

Propose a Multipurpose Pump House for Barind Area of Bangladesh

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Abstract

A pump house with all facilities that help to meet basic human needs is a crying need for our farmers and operators to lead a healthy life, cope with weather and climatic change, mitigate loss during natural calamities, and serve the nation and the family with an expected period. Aim of this study was to identify the challenges and expectations of traditional pump house stakeholders' and to propose a multipurpose pump house for Barind area of Bangladesh with computer aided design layout. The research work has been done by interviewing the stakeholders'. In Barind area, the irrigation process is supervised by Barind Multipurpose Development Authority (BMDA) and every pump belongs to a pump house. To lift up water from profound aquifer it requires heavy pumping elements and BMDA built pump house for its safety. The resident of this area face a great deficit in drinking water. For this

reason BMDA built overhead tank to store safe drinking water and the dweller made water supply point by own funding. There are mainly two types of pump house such as pump house with operator's room and pump house without operator's room. The size of engine room is 10ft*12ft, 12ft*14ft and operator's room is 8ft*4ft.There is no sanitation facility with pump house so the farmers can not avail the opportunity to use toilet. There is no shelter house during thunderstorm. So the fatality rate increases day by day. A pump house has been proposed providing with a toilet, lightning arrester, water supply point and a multipurpose room. Primarily, it has appeared that the initiation expenditure of a modern pump house is very high. Nevertheless, it supports bringing a momentous change in the sustainable development of farmers and pump operators working environment in the Barind area of Bangladesh.

Design and Fabrication of a Motorized Soybean Grader Machine

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Abstract
Grading soybeans by size is a critical step in preparing soybeans for seed and commercial use. Soybeans are sold ungraded on the market in Bangladesh. Both producers and consumers would benefit if soybeans were sold after grading. Because mechanical graders are not available, soybeans are graded by hand when necessary. This method is time-consuming, expensive, and inefficient. As a result, the current study was undertaken to design and fabricate a horizontal swing-type grader for village-level operations, which will provide a practical means of grading marketable soybeans by size. The grader is made up of a hopper, grading unit, AC motor, and outlet tray that are all mounted on a frame. To keep costs low, the grader was constructed from locally available materials. The grading unit consisted of a stainless-steel sieve, hopper, and outlet tray made of mild steel sheet and a mild steel angle bar frame. As a prime mover, a 1 hp single-phase electric motor was used with a 16:1 gearbox to reduce the rpm. Several performance characteristics, such as system efficiency, capacity, and power consumption, were determined at different sieve angles. The results showed that the optimum setup was at an inclination of 12° with a delivery rate of 357.5 kg/h, giving a system efficiency of 71.38 %. The machine's power consumption was found to be reasonable at around 229 W-h. Further improvements to the device should be made to improve its efficiency and cost-effectiveness.

Inspection of Paddy Seed Viability using Hyperspectral Imaging Technique

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Abstract
Conventional methods used to evaluate seeds viability are destructive, time-consuming, and require chemicals, which are not feasible to implement to process plants in seed industry. In this study, the effectiveness of hyperspectral imaging technique used to differentiate between viable and non-viable paddy seeds was investigated. Hyperspectral images of both viable and non-viable seeds were collected in the range of 400-800 nm. To differentiate between viable and non-viable seeds, a multivariate classification model was developed with partial least square discrimination analysis (PLS-DA). The calibration and validation set derived from the PLS-DA model classified viable and non-viable seeds with an accuracy of 90.21 and 89.02%, respectively. The results demonstrate the

possibility of using hyperspectral imaging technique to separate seeds based on viability, which could be used in the development of an online sorting technique.

Optimization of Agricultural Lands for Different Crops for Sustainable Groundwater Use under Climate Change Condition in the North-West Region of Bangladesh

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Abstract
Quantification of crop-water requirement and irrigation water demand considering crop-usable effective rainfall and analyzing their spatial and temporal variability in the water-scarce North-West (NW) region of Bangladesh are important in improving groundwater management towards its sustainable use. This study estimated irrigation water demand of 9 major crops (Boro, Aus, Aman, maize, wheat, mustard, potato, mungbean & sugarcane in Rajshahi but tobacco in Rangpur division) and 15 cropping patterns from local hydroclimatic data based on SWBcropwat model over the period from 1985 to 2015. Also estimated are the groundwater abstraction of the region and their trend with MAKESENS model. The monthly total rainfall showed significant ($p \leq 0.05$) decreasing trend in July except for Dinajpur and Nilphamary districts. The monthly total evapotranspiration also declined with significant trend except for July, September, and October. Crop evapotranspiration decreased significantly except for Aman rice. Groundwater withdrawal showed significantly increasing trend in Kurigram, Lalmonirhat, Nilphamari and Thakurgaon districts but decreasing trend in Bogura and Joypurhat districts. Groundwater withdrawal decreased insignificantly (from 7339 Mm^3 to 6702 Mm^3; 8.7%) in Rajshahi but increased significantly (from 4192 Mm^3 to 4986 Mm^3; 19.0%) in Rangpur division. These results are crucial for selecting irrigation acreage and sustainable agricultural planning for the NW region of Bangladesh.

Effect of Pretreatment on Drying Mango in BAU Developed Solar Dryer

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Abstract
Drying could be efficient and cheapest method of storing and reducing highly perishable fruits and vegetables. A BAU solar dryer, which works on natural convection mode, was used and tested for drying mango of 4 mm thick sliced "Fazli" mango. Two treatments were used for drying mangoes. One type was prepared by dipping the slices of mango in 0.5v/v lemon juice solution for 10 minutes, and the another was without any pretreatment (control). Both the samples were dried in the dryer and open sun. The spatial and temporal distribution of temperature and drying performance of the dryer were investigated. Nine Point hedonic scale test was used to evaluate the quality of the dried mango. Panelists gave their hedonic opinion and all data were averaged to get the final result. In August, the highest temperature was recorded 66.83˚C inside the dryer when ambient temperature was 40.93˚C. The drying air temperature inside the dryer was 2 to17˚C higher than the ambient temperature. Within 15 sunshine hours, the dryer brought the moisture content from 84% to 18% when the open sun

brought from 84% to 19.5% wet basis. The average solar radiation was about 641.09, 428.89 and 640.57 W/m^2 during the three trials (from 9 am to 5 pm). The drying efficiency was 10.26%, 9.26% and 7.72% during the first, second and third trials, respectively depending on solar radiation and temperature of the dryer. The dryer control samples overall acceptability was higher than all the other samples. The dryer could be tested for drying other fruits and vegetables. However, drying efficiency could be increased by adding hybrid heating system in the dryer in the near future.

Prioritization of Adaptation Options for Improved Cropping Pattern Transformation under Climate Change in Northwest Bangladesh

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Abstract
The evolving challenge of climate change is expected to reduce the future water availability and thus, will likely put more pressure on existing agricultural systems in Bangladesh. The Northwest region of the country is particularly more vulnerable to climate change due to limited water availability during dry season and high agricultural water demand and drought. Adjustment of cropping pattern may be plausible intervention to reduce annual water demand for crop agriculture. It is important to identify the factors that influence cropping pattern transformation and find-out their interconnection. Also, the comparison of water demand of major crops under recent and future climate scenarios is vital for the anticipatory planning for cropping pattern transformation. This study has identified interlink among different factors that affect optimum and practical cropping decisions and listed suitable adaptation options for improved cropping pattern transformation. This study is currently estimating the crop water requirement and potential irrigation requirement of major dry season crops during base period and future time periods (2050s and 2080s) for moderate (RCP 4.5) and rapid (RCP 8.5) climate change scenarios. Results indicate an increase in crop water requirement and potential irrigation requirement of crops for fixed growth duration. Potential irrigation requirement of *Boro* rice would increase by 15% and 20% for moderate and rapid climate change, respectively in 2080s compared to base period for fixed growth duration in Bogura. Currently, this study is also collecting experts' opinion to identify most suitable cropping pattern and prioritize identified adaptation options. The finding of this study would assist decision makers for long-term agricultural planning.

Soil Hydraulic Properties and Field-Scale Hydrology as Affected by Long-Term Rice Cultivation

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Abstract
Recurring puddling for long-term rice cultivation forms a plow pan at a particular soil depth, which alters soil hydraulic properties, field-scale hydrology, and nutrient persistence. We assessed the impact of crop rotations on root-zone soil hydraulic properties and field-scale hydrology. Soil core samples were collected from three positions of rice–rice, rice–fallow, nonrice, rice–nonrice crop rotations, and rice field ridge for each 10-cm layer up to 100-cm depth at two locations (loam and silt-loam sites). Soil hydraulic parameters were estimated using a pedotransfer function based on the measured bulk density (BD) and soil texture. A mathematical model named HYDRUS-1D predicted infiltration,

percolation, and surface runoff with the estimated hydraulic properties for three extreme rainfall events, i.e., 10, 15, and 20 cm during a 3-hour period. A plow pan was found at 20–30 cm soil depth for all the crop rotations but not for the field ridge. The plow pan of the rice–rice rotation had the highest BD (1.53 g/cm) and the lowest hydraulic conductivity (Ks) (17.56 cm/day), but the top 10-cm soil layer had remarkably lower BD (0.93 g/cm), higher Ks (131 cm/day) and higher saturated water content (Θs) (0.48 cm^3/cm^3), which helped store water and facilitate subsequent percolation through the plow pan layer. Phosphorus mainly remained in the 10-30 cm soil layer. Following an extreme rainfall event, the rice–rice rotation showed higher water percolation than the other crop rotations. By keeping fallow for several years, the higher infiltration and Θs of the topsoil of the rice–rice rotation diminished significantly. At both sites, the field ridge of rice fields had higher infiltration and percolation and lower runoff than other rotations. The study reveals that the field ridge area can be the main water loss pathway. These findings will facilitate making water management decisions.

Extraction of Polyphenols from Banana Peel and Encapsulation of Polyphenols *via* Freeze Drying

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Abstract
Banana peel holds 35% of total fruit's weight and is the main by-product that could offer potentially valuable substances for the production of functional food. The aim of this research is to determine total polyphenol compound and antioxidant properties of banana peel extract and microencapsulate with coating materials to investigate physico-chemical properties (moisture content, bulk density, tapped density, water activity, hygroscopicity, solubility etc.) and storage stability of polyphenol enriched milk powder. Banana peel supplies bioactive substances such as TPC, TFC. The result indicates that ripe banana peel provides (143.663±0.086 mg GAE/100g) TPC, (156.139±0.042 mg rutin/100g) TFC and unripe banana peel supplies (118.232±0.172 mg GAE/100g) TPC, (132.762±0.073 mg rutin/100g) TFC. Antioxidant activity (DPPH) of banana peel was 73.925 and 80.405% for unripe and ripe banana peel extract respectively. Composition of banana peel was also determined and the result was moisture (7.44-8.54%), ash (11.38%), protein (8.41%), fat (9.44%) and carbohydrate (62.23%). Physico-chemical properties of microencapsulated banana peel extract by freeze drying and spray drying was also investigated. The result showed that freeze dried banana peel extract contained moisture (2.82±0.43%), bulk density (0.44±0.02g/ml), tapped density (0.61±0.01g/ml), water activity (0.39±0.02), hygroscopicity (0.029±0.35g/g solids) where spray dried banana peel extract contained moisture (3.29±0.2%), bulk density (0.49±0.05g/ml), tapped density (0.57±0.02g/ml), water activity (0.37±0.01), hygroscopicity (0.043±0.29g/g solids). The solubility of microencapsulated milk powder was initially 88.06±0.13% and 76.87±0.29% for freeze drying and spray drying respectively. This result showed that the solubility decreases over time. Efficiency of microencapsulated milk powder was measured and the result indicated that freeze dried powder (88.06%) had higher efficiency than spray dried powder (76.87%). Storage stability, reaction kinetics and purity determination of banana polyphenol is ongoing.

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Extraction of Polyphenols from Mango Peel and Encapsulation of Polyphenols with Milk, Maltodextrin and Gum Acacia

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Abstract
Mango peel is the main by-product that could offer potentially valuable substances for the production of functional food. The aim of this research is to extract total polyphenol compounds and assessment of their antioxidant properties from mango peel and encapsulation of mango peel polyphenol (MPP). MPP was encapsulated with milk, gum acacia, maltodextrin and investigated the physico-chemical and storage stability of MPP encapsulated milk powder. Ripe mango peel provides (64.37±0.26mg GAE/g) total polyphenol (TPC) and encapsulated milk powder gives (62±0.26) mg GAE/g) TPC. Antioxidant activity (DPPH) was 52.563% for mango peel extract and 57.693% for encapsulated milk powder extract. Concerning physico-chemical properties of microencapsulated powder milk extract, spray dried powder contained moisture (2.78±0.015%), bulk density (0.48±0.011g/ml), tapped density (0.58±0.011g/ml), flowability (21.19±0.08), cohesiveness (1.25±0.007) and hygroscopicity (0.039±0.0007g/g solids), whereas cabinet dried powder contained moisture (4.47±0.058%), bulk density (0.47±0.006g/ml), tapped density (0.59±0.011g/ml), flowability (20.15±0.007), cohesiveness (1.15±0.007), hygroscopicity (0.025±0.0007g/g solids). The solubility of microencapsulated milk powder was initially 82.83% and 78.77% for spray drying and cabinet drying, respectively and the value decreased over time. Concerning color, the lightness (L*), yellowness (b*) and redness (a*) were decreased for both the samples. Efficiency of microencapsulated milk powder was measured and spray dried powder (85.08±0.82%) had higher efficiency than cabinet dried powder (77.56±0.44%). Finally, spray dried powder was more stable in terms of TPC retention than cabinet dried powder. At the outset, the TPC was about 74 and 62 mg GAE/g for spray dried and cabinet dried milk powder, respectively. The degradation kinetics of TPC in the encapsulated milk powder during storage and purification of TPC is going.

Design and Development of Multi-Whole Grain Nutrition Bars

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Abstract
Nowadays, health-conscious consumers attend to nutritional, health, and easy-to-use products. Demand for healthy snacks is significantly increasing. Our study aimed to develop multi-whole grain nutrition bars and assess their quality. Developed bars were analysis for nutritional, textural, and sensory quality. The bars contained oats, almond, peanut, seasame, black cumin, quinoa, coconut oil, raisins, and skim milk power. Proximate analysis was performed following the AOAC method. The mineral content and antioxidant properties of the bars were determined by using emission spectrophotometry and the 2,2-Diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging modified method, respectively. The samples showed good nutritional quality, with significant amount of protein (16.25 ± 1.55%), fat (8.50 ± 0.75%), and calcium (5.50 ± 0.75 mg/100 g) content. However, the sample demonstrated significant amount of ash (3.02 ± 0.50 mg/100 g), magnesium (110.25 ± 4.25 mg/100 g), potassium (145.79 ± 4.75 mg/100 g), and phosphorus (325.20 ± 2.35 mg/100 g) content. Antioxidant activity (43.35 ± 0.10% DPPH inhibition), total phenolic content (9.87 ± 0.50 mg GAE/ bar), and textural properties (48753 ± 179.50 g.sec hardness and 17.75 ± 3.25 sec fracturability) were found in the multi-

whole grain nutrition bar. Sensory analysis found that the multi-whole grain nutrition bar was attributed as the best formulation than market peanut bar. he multi whole-grain bar demonstrated good quality. Hence, all the used whole grains have a potential to be used in bar formulations. Further studies are needed to determine the shelf life and *in vivo* metabolism of multi-whole grain nutrition.

Efficacy of Natural Additives on the Quality and Shelf-Life of Some Selected Fresh Cut Fruit and Vegetables

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Abstract
Fresh fruit and vegetables are very much perishable and richest sources of phytochemicals and bioactive compounds. The importance of fresh-cut produce lies in its major characteristics of freshness, convenience, nutrient retention and sensory quality while providing extended shelf life. This research aims to find out the effectiveness of natural additives on the quality and shelf life of fresh cut fruit (mango and strawberry) and vegetables (carrot and potato) in terms of moisture content, toatal soluble solids (TSS), vitamin C, acidity, surface color and textural properties like bioyield stress. Natural additives such as aloevera gel and ascorbic acid were treated with fresh cut fruits and vegetables at refrigerated temperature. Aloe vera gel and ascorbic acid successfully increased the shelf life of fresh cut mango (Fazli variety). The TSS content and percent weight loss during storage were significantly higher in control fruit compared to aloevera gel and ascorbic acid treated fresh cut fruit. The textural properties (N) of treated cut fruits were negligible changed throughout the 12 days storage period (60 to 58 N), whereas control cut fruit showed a drastical lowering of firmness value (60.04 to 35.19 N). L^* value and hue angle were decreased mostly in control cut fruit, whereas other treated fruits are not changed in terms of hue angle and L^* value. Fresh cut carrot and potato samples were treated with aloevera gel @ of 10%, 20% and 30% at refrigerated temperature for 6 days. 10% aloevera treated potato and carrot showed best results in terms of increment in TSS, % weight loss and loss in moisture content, acidity, firmness value and external color (L^* value and hue angle) in comparison with 20% and 30% treated samples. The control sample deteriorated most for both in carrot and potato. So natural additive like aloevera gel could be applied to fresh cut mango, carrot and potato to extend the shelf life.

Seasonal Effects of Municipal Waste Disposal on the Water Quality of Old Brahmaputra River in Mymensingh City

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Abstract
A study has been carried out to assess the seasonal effect of municipal sewage pollution on water quality of the Old Brahmaputra River in Mymensingh City. For this purpose samples were collected from six different stations of the river in monsoon (June, 2022) and pre-monsoon (March, 2022) season. Different water quality parameters such as pH, electrical conductivity (EC), total dissolved solids (TDS), dissolved oxygen (DO), biochemical oxygen demand (BOD), total hardness (TH), Na, K, Cl, SO_4, PO_4, HCO_3 and heavy metals were examined. The study showed a slight variation in water quality parameters at different stations of the river. The pH, DO, TDS, TH, and SO_4 had higher values in the monsoon than the pre-monsoon. On the other hand, values of EC, BOD, Na, K, Cl, PO_4, and

HCO_3 were higher in the pre-monsoon than those of the monsoon. Zn and Cd concentrations in the monsoon ranged from 0.031-0.039 and 0.005-0.007 mg/l, respectively and Mn, Cu and Pb were found bellow detection limits. The obtained river pollution index (RPI) value was 3.75 for both seasons indicating "moderately polluted" river. The water quality index (WQI) based on the method developed by the Department of Environment (DoE), Malaysia was 64.7 and 62.4 in the monsoon and pre monsoon period, respectively indicating "slightly polluted to very polluted" river. This means that the river water is not suitable for public water supply, doubtful for recreational purpose, has limited potential for aquaculture but is suitable for irrigation. It can be concluded that there is no significant seasonal variation of water quality and pollution level of the Old Brahmaputra River. Water quality degradation was detected in some points of the river, which might be due to the direct discharge of municipal effluents into the river. To maintain the overall water quality and healthy ecosystem of the river, necessary initiatives should be taken to raise awareness regarding the water quality problems and river management through education, monitoring and research.

Application of NIR Spectroscopy for Classification and Quality Evaluation of Mango and Papaya

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Abstract
Fruits quality is a significant parameter to satisfy the consumer demand which depends on traditional destructive methods for evaluation. Those destructive analysis techniques are not just only time-consuming also requires highly skilled manpower, large space area, and cost of chemicals. Recent evaluation of machine learning and handheld near inferred (NIR) spectroscopy promotes the non-destructive analysis of food which reduce waste and allow repeated measurements on the same item over time. In this study, handheld NIR is used for developing a non-destructive quality evaluation and classification method of Mango and Papaya. NIR data is measured from one square-inch surface area of each mango and papaya sample using LinkSquare near spectrometer with wavelength range from 400nm to 1100nm. Vitamin C, color value (L, a*, b*), total soluble solids (TSS), and total acidity (TA) of each sample are used as reference value which obtain from destructive analysis. To predict the quality parameter, partial least square regression (PLSR) is used and further classification among different fruits are performed by principal component analysis (PCA). Different preprocessing techniques like standard normal variate (SNV), normalization, and smoothing are used to reduce the noise of the spectral data. The predicted results are evaluated using and mean square error. For TSS, Vitamin C, TA, color value (L, a*, b*), value of was found upto 0.92%, 0.98%, 0.73%, 0.98%, 0.99% and 0.98% on train dataset for both mango and papaya.

Preliminary Assessment of Different Commercial and Local Milk Available in the Local Markets of Mymensingh

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Abstract
The purpose of this study was to evaluate the organoleptic, physicochemical, and microbial quality of different commercial and local milk samples, as well as the presence of any adulterants. Three different brands of ultra-high temperature (UHT) milk, three different brands of pasteurized milk, and three

different raw milk samples were obtained and tested for various quality tests. A testing panel of 15 panelists evaluated the organoleptic properties of milk samples to determine consumer preference. The milk samples were subjected to physicochemical, adulteration, and microbial analyses using various standard methods. Most organoleptic properties of UHT and pasteurized milk samples differed significantly at $p \leq 0.05$, whereas raw milk samples were equally acceptable to the panelists in most cases. Raw milk had the highest moisture content (91.01%), while UHT had the lowest (88.10%), and other components included 0.67%-0.79% ash, 3.19%-3.47% protein, 3.16%-3.55% fat, 4.36%-4.65% lactose, 0.14%-0.23% acidity, 6.06%-8.85% solid not fat, 9.30%-12.60% total solid, and 1.026%-1.033% specific gravity. Raw samples failed all adulteration tests, while commercial milk samples passed only the added sugar test. Total standard plate count and coliform count tests revealed no detectable microorganisms in commercial milk samples, despite the presence of a significant amount in raw milk samples. Despite some variations in some parameters of the three milk categories, this study concluded that UHT and pasteurized milk were of excellent quality.

Design and Development of a Low Cost Ethylene Chamber for Fruit Ripening

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Abstract

This study was conducted to develop an ethylene producing chamber and to observe the effects of artificially generated ethylene on the ripening kinetics and quality of ripened banana and degreening of orange. Ethylene was generated by laboratory arranged method (generator by acid dehydration of ethanol and catalytic hydrolysis of ethanol. Ethylene generated by acid dehydration of ethanol and catalytic hydrolysis of ethanol was applied to raw banana for 30 sec in an air tight ripening chamber. The treated samples were stored at room temperature $(28\text{-}31)^0$C and observed the ripening kinetics and quality parameters of ripened banana on every alternate day. Physico-chemical characteristics such as-surface color, Total Soluble Solids (TSS) and ascorbic acid were observed at every alternate day up to 13 days. Sensory evaluation was carried out of ripened banana using different treatments. In this experiment, catalytic hydrolysis of ethanol treatment proved to be the most effective in fastening ripening of banana although the use of acid dehydration of ethanol treatment was also effective in bringing about ripening change. Both treatments were effective in increasing the overall ripening rate of fruits and also enabled the fruits to retain maximum TSS, ascorbic acid and acceptability of the fruits. Ethylene generated from fabricated ethylene chamber was also applied to locally available green orange. It successfully produces surface color yellow of orange. In conclusion, ethylene generator could be a promising and convenient alternate for ripening banana and degreening of local variety of orange commercially.

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Design and Development of an E-advise System for Combine Harvester using Data Mining and Machine Learning Algorithms

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Abstract
The effectiveness of agricultural mechanization depends on the efficient management of agricultural machinery. Inefficient management of agricultural machinery may increase the costs of agricultural operations and decrease their profitability. One of the crucial tasks of farm machinery management is to diagnose machine anomalies and fix them within the shortest possible time. Since the owners of the machinery are usually located in remote places and are usually not able to solve problems/anomalies, they often hire experts who are not generally available in remote places. It is difficult for farmers and entrepreneurs to visit experts in-person due to distance, cost, time and inadequate communication facilities. Furthermore, mechanical harvesting using combine harvesters has been accelerated rapidly in Bangladesh in recent years. The number of experts is also insufficient to give advice and services to all farmers and entrepreneurs regarding on-farm problems of paddy/wheat harvesters. The stated problems can be resolved by a telematics/e-advise system, which can be useful both online and offline, 24/7. Therefore, it is necessary to provide farmers/entrepreneurs a smart real time monitoring system for combine harvester for progressive improvement and sustainable harvesting of paddy and wheat in Bangladesh. In the study, the prospects and constraints of an e-advise system for combine harvesters have been thoroughly assessed for the Bangladesh context. Automatic and quick diagnosis of combine harvester anomalies and providing real-time decisions to farmers and entrepreneurs using smart phones and IoT-based e-advise systems have also been developed and tested in the field. The study reveals that the e-advise system is an appropriate smart technique for the sustainable use of combine harvesters in Bangladesh.

Development and Evaluation of Weeder-cum-Fertilizer Applicator for Reducing Crops Cultivation Cost

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Abstract
Most of the cultivated lands use for production of rice as a main crop in Bangladesh where intercultural operations including fertilizer application, weeding, etc. also carry out manually (over 90%). For cost effectiveness, human drudgery free and safe environment based rice cultivation, it is necessary to focus on mechanized eco-friendly intercultural operations. In the study a dual purposes manually operated weeder-cum-USG applicator has been designed and developed to remove weed and subsequently deep placement of USG in soil of rice field. The applicator was designed using AutoCAD software. According to the design and availability of engineering materials in the local markets, fabrication of the applicator was done in the Lusa Engineering Workshop, Bramanbaria and Engineering Workshop, Department of Farm Power and Machinery, Bangladesh Agricultural University. In the applicator, weeding and USG deep placement can be done simultaneously which can reduce time and increase the effectiveness of USG. During the operation it takes power from the front wheel and power transfers to crankshaft of the applicator. The crankshaft helps the plunger for reciprocal movement and also helps to metering and control USG supply evenly by the regulator. A

hoper attached with regulator receives USG and discharges through a pipe and ball-headed plunger pushes USG into the soil which is the main goal of the applicator.

Automated Image Acquisition System for Paddy Leaves using Machine Vision Technique

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Abstract
Paddy is the most widely consumed staple food for a large part of the world's human population, especially in Asia. Previous studies have shown that Bangladesh's average yield loss due to paddy leaf diseases is 9.9%. For detecting leaf diseases, the conventional methods are human vision-based approaches mainly used. But it has several drawbacks such as time-consuming, laborious, accuracy and precision depend on personnel, costly and sometimes destructive. But the real-time image processing is a technique that aims to duplicate the effect of human vision by electronically perceiving and understanding an image within a short time. This work aims to construct an automated image acquisition system for paddy leaves for estimating the leaf disease severity level using image processing technique. The automated image acquisition prototype was designed and developed for paddy leaves in one row. The prototype comprised of two planetary gear motor for the wheel, motor driver, one web camera for image acquisition, Arduino Uno microcontroller board, Raspberry Pi, a battery and a laptop for control the system. All of these components were assembled on a mild steel-based frame to operate in paddy fields. In the next step, the automated image acquisition system will be tested to estimate the paddy leaves disease severity level using image processing technique.

Post-Harvest Loss Reduction and Value-Addition of Fresh Water Fish

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Abstract
Freshwater fisheries face huge post-harvest loss every year from harvest to retail distribution due to lack of technical knowledge, improved handling, preservation and distribution. It is, therefore, imperative to reduce post-harvest loss of fish by improved devices in different operations. So, as a part of the study, a simple, low energy aerator-cum-oxygen accumulator was constructed for live fish transport. A 12-volt 3 ampere DC motor operated 1100 GPH bilge pump was modified with venturi principle to construct the aerator. 45 Rohu fish (*Labeo Rohita*) with 378gm of average weight were put in a 650-liter tank for evaluation of the device. In six hours of operation, before and after the experiment with the device installed, dissolved oxygen was found 9.3 mg/l and 6.2 mg/l, where pH level was 7.8 and 7.1, respectively. Without the device, dissolve oxygen decreased from 6.5 mg/l to 2.2 mg/l and pH from 8.30 to 9.70. Besides, the fish mortality rate was zero with the aerator while it increased up to 11.11% without it. Another study was undertaken to reduce fish spoilage by developing a pedal-driven ice crusher. To analyze its efficiency and effectiveness, the machine was tested and compared with hand-beaten ice crushing. The crushing capacity of the ice crusher was found 23 kg/min which is 39% more compared to traditional wood hammer beaten crushing technique taking

lesser time (37%) to crush each block. It provides a good range of ice flakes which drastically reduces fish worsening. In terms of human safety and comfort, the pedal ice crusher is more user-friendly. Hand beaten ice crushing causes serious musculoskeletal disorder and muscle soreness where subjects are less likely to have serious muscle damage except for upper legs while using the developed machine. The machine is 22% more cost-effective (0.63 tk/block) which ensures economic benefit.

IoT-based Solar Irrigation System towards Smart Agriculture

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Abstract
Internet-of-Things (IoT) is ever-present, ranging from home solutions to turning wheels for the fourth industrial revolution. It can be of incredible assistance in improving the creation and yield in the farming division by easing the farm operations. This study aims at developing an IoT-based irrigation system powered by solar energy. It consists of solar-enabled base station with raspberry pi-4 for the controlling of the pump operation. A 20 W solar panel was used to power the system and 12V 7.5Ah battery to store the energy. This source was enough to run both the Raspberry Pi 4 and 12V, 12.2 W DC irrigation pump. Several data collecting substations were also developed to collect the field data. ESP8266 was implemented to transmit the data to the base station by MQTT method. Considering a 75% discharge at maximum the battery could power the motor for at least 2 hours at night, where battery at data collecting substation was enough to power the system. The irrigation operation was controlled based upon soil moisture, air humidity, and temperature data. The lower threshold value for starting the pump operation was set at 45% soil moisture content where it would stop fulfilling the trained conditions (80% soil moisture content, in this study). A website was developed to monitor the real time field data, where the pump operation can also be controlled by the user interface. Several conditions for irrigation were implemented in the system to run the irrigation pump. The system will help reducing dependency over conventional energy sources, along with minimizing irrigation water loss.

Development of Trans-Impedance Amplifier Based Pest Control System for Post-Harvest Loss Reduction in Stored Paddy

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Abstract
The Trans-Impedance based Ultrasonic Pest Repeller is a device developed to control the population of rice weevils in stored rice using high-frequency sound waves. A method of pest control that is both safe for the environment and harmless to humans. Instead of using chemical pesticides, it uses a piezoelectric transducer to produce ultrasonic waves in the 20–60 kHz range, which have been found to be effective in repelling pests like rice weevils. Rice weevils are a common pest that can infest stored rice. These pests can cause significant damage to the rice grains, resulting in losses in quality and quantity. This research aimed to develop a reliable ultrasonic pest repellent for rice weevils. A prototype device was designed and built that produces ultrasonic waves within a frequency range recognized to deter insects. These devices use high-frequency sound waves to repel or disrupt the behaviour of rice weevils, preventing them from feeding and reproducing. This method employed a high-frequency acoustic deterrent in the 40 kHz range to repel Sitophilus oryzae, a common pest of

stored grains. The system was constructed using a combination of an Arduino-based microcontroller, a waterproof ultrasound sensor, and a temperature and humidity sensor. After its construction, an algorithm was created using the C++ programming language to operate the hardware system. To evaluate the efficacy of the ultrasonic pest repellent, laboratory experiments were conducted in the Precision Laboratory at Bangladesh Agricultural University. The device's ultrasonic waves were applied to rice weevils in the lab, where their behaviour and mortality rates were observed under various temperature and humidity conditions. A system consisting of multiple webcams was used to observe and track the movement of weevils in chambers with and without radiation. The results showed that the ultrasonic pest repeller successfully reduced the presence of rice weevils in the radiation chamber compared to the non-radiation chamber, with a significant decrease in weevil populations over time. Overall, this study provides valuable insights into the potential of ultrasonic technology as a sustainable and effective solution for controlling rice weevils in storage facilities.

Development of Sensor-based Vertical Crop Production Mechanism for Ensuring food and nutrition security

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Abstract
Increasing population, urbanization, and continued climate change have contributed to reducing arable land stocks per person in Bangladesh. Urban vertical farming, which uses technology and automation to optimize land utilization, is a good example of future food production solutions. Vertical crop production is an emerging field of agriculture that utilizes vertical space to grow crops, allowing for higher yields in smaller areas. However, managing the irrigation and growth conditions in a vertical system can be challenging. To address this issue, this study proposes the design and development of an IoT-based multilevel irrigation system and real-time data monitoring system for vertical crop production. The proposed system incorporates various sensors, including soil moisture, temperature, and humidity sensors, to collect real-time data on the growth conditions of crops. The collected data is then processed and analyzed using machine learning algorithms to optimize the irrigation process and improve crop yields. The system also includes a multilevel irrigation system that can provide water and nutrients to plants at different levels. Furthermore, the system incorporates remote monitoring and control capabilities, enabling farmers to monitor their crops and make necessary adjustments from anywhere. This feature increases the efficiency and sustainability of vertical crop production, making it a valuable tool for modern agriculture. The study proposed the design and development process of the proposed system, including the selection of sensors, the development of the irrigation system, and the integration of the machine learning algorithms. The study also evaluates the performance of the system through a series of experiments conducted in a vertical crop production setup. The results demonstrate that the proposed system can effectively monitor the growth conditions of crops and optimize the irrigation process to improve crop yields. The system's remote monitoring and control capabilities also proved to be highly useful in managing the system efficiently. In conclusion, the proposed IoT-based multilevel irrigation system and real-time data monitoring system for vertical crop production offers a sustainable and efficient solution to manage the irrigation and growth conditions in a vertical crop production setup.

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Effect of Water Stress at Different Development Stages on Maize Yield

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Abstract
A field experiment was conducted at Field Irrigation Laboratory of the Department of Irrigation and Water Management, Bangladesh Agricultural University, Mymensingh and Chapai Nawabganj to determine the effect of water stress imposed at different development stages on vegetative growth, grain yield and water productivity of maize. A randomised complete block design with three replications was used. Four known growth stages e.g. vegetative (V), tasselling (T), cob (ear) formation (C) and milk (M) stages were identified and a total of 6 (including rain fed) irrigation treatments were applied. The effect of water stress at any stage of development on plant height, grain yield, number of ears/plant, grain yield/cob and 1000 kernels weight were evaluated. Results of the study show that all vegetative and yield parameters were significantly affected by water shortage due to omitted irrigation during the sensitive tasselling and cob formation stages. Highest grain and biomass yield were obtained for the treatments applying water at two or three growth stages including tasselling stage. Tasselling stage was found to be the most critical stage for water stress. Irrigation should be scheduled for tasselling stage (T) and cob formation stage (C) in case of water scarcity. The higher water productivity data were obtained for irrigation in tasselling stage. Observed field variables such as weather data, soil, irrigation application and cropping period were calibrated in Aquacrop to determine potential yield of maize. Simulated results varied considerably from observed data indicating data error or some adverse field conditions which is not included in Aquacrop.

Development of a Mathematical Model to Calculate Optimized Distance between Furrows in Raised Bed Water Saving Techniques for Rice and Non-rice Crops Cultivation

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Abstract
An experiment was conducted at the Field Irrigation Laboratory, Bangladesh Agricultural University, Mymensingh, for investigating the effects of bed width on soil water content, growth and yield attributes of rice and wheat cultivated under raised bed (RB) water saving irrigation technique. With split plot design that was laid out in the experimental field, effects of conservational raised bed (RB) and conventional irrigation methods on rice and wheat growth and yield attributes were investigated. Three RB treatments namely RB25, RB45 and RB65 having bed width of 25, 45 and 65 cm, respectively, were tested. For rice and wheat, continuous flooding (CF) irrigation and conventional (CTRL) irrigation were used as control treatment, respectively. Three replications were used for each treatment. It was found that RB45 treatment can save 30% of water without compromising any yield for rice and wheat. Measured soil water content (SWC) at different depths of soil profile in the middle of each raised bed showed that upper soil layer (0-60 cm) is subject to rapid dryness due to more active

evapotranspiration whereas SWC remains well wetted in the lower soil profile throughout the growing period. Darcy's infiltration model showed a relationship between the measured and calculated infiltration rates with mean R^2 values of 0.3536, 0.294 and 0.3651, respectively for RB65, RB45, and RB25 treatments. Though RB65 treatment required the lowest amount of water, its yield was found lower than that of RB45 treatment. The RB45 treatment produced the highest water productivity and grain yield. Sufficient water could not be reached to the central portion of 65 cm wide RB which caused its lower productivity. For RB25 treatment, although the beds were well wetted but lower net cultivable area (i.e. RB area) due to higher number of furrows was the prime reason behind its lower water productivity. This study concludes that for a particular field condition, it is necessary to grow rice with optimum bed size to get maximum yield and water productivity.

Quality Assessment and Environmental Consequences of Dairy Farm's Wastewater Irrigation in Rice and Wheat

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Abstract
An experiment was conducted at the Field Irrigation Laboratory of the Bangladesh Agricultural University (BAU) to investigate the consequences of dairy farm's wastewater irrigation on wheat production during 14 December 2022 to 26 March 2022. Six treatments were applied in the experiment, which were combinations of irrigation application techniques and types of irrigation water. The treatments were- T_1: Conventional irrigation method with fresh water, T_2: Conventional irrigation method with mixed water (fresh water: dairy wastewater= 1:1), T_3: Conventional irrigation method with wastewater, T_4: Alternate wetting and drying (AWD) irrigation method (50% of required moisture) with fresh water, T_5: AWD irrigation method with mixed water (fresh water: dairy wastewater= 1:1) and T_6: AWD irrigation method with wastewater. These treatments were experimented in individual lysimeter having area of 1.2×1.2 m and soil columns of 1 m. Although applied raw wastewater contained high amount of total viable count (TVC), *E-Coli* and Salmonella, leached water collected from lysimeter showed only TVC. The highest TVC of leached water (5.2×10^7 CFU/ml) was found in treatment T_6 at 70 days after sowing (DAS). After harvesting, the highest residual TVC was found (5×10^6 CFU/g) from the top soil of treatment T_3 and T_6. The highest grain yield (4.77 t/ha) and water productivity (2 ± 0.19 kg/m^3) of wheat were found for treatment T_3. The lowest grain yield (2.83 t/ha) and water productivity (0.93 ± 0.07kg/m^3) of wheat were obtained under the treatment T_1. The highest value of plant height (96.06 ± 9.77 cm), spike length (11.44 ± 1.29 cm), number of spike/m^2 (1930), and number of spikelet/spike (36.17 ± 4.27) were obtained in treatment T_3. The lowest value of growth parameters was found in treatments with fresh water irrigation. So application of wastewater increased nutrient content in soil which contributed to growth and yield. Sodium adsorption ratio, soluble sodium percentage, residual sodium bi-carbonate, total hardness and magnesium adsorption ratio of dairy wastewater were suitable for irrigation. It is clear that dairy farm's wastewater can be used as an alternative source of irrigation but it should be used with proper management practices to maintain proper soil health.

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Technologies for Improved Water Use Efficiency in Maize Production in Water Stressed Area of Bangladesh

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Abstract
Improved technologies to increase grain maize yield under rainfed systems are urgently needed, considering the low grain yield in water stress areas of Bangladesh. Supplemental irrigation and tillage methods are considered valuable available farming technologies. The aim of this research was to examine the impact of full and supplemental irrigation (full irrigation (FI), 75% of FI and 50% of FI), and three tillage methods (zero tillage, strip tillage and conventional tillage) on maize grain yield. Results revealed that the highest plant height 227.7 cm) was perceived in full tillage treatment and the lowest plant height was found in T3 (no tillage) treatment. The yield of maize in the different type of tillage techniques varied significantly. The highest yield (8.25 t/ha) was found in conventional tillage method and the lowest yield (6.257 t/ ha) was observed in the zero tillage treatment. In case of 1000-grain weight and no. of grain/cob, no statistically significant differences obtained among various tillage practices. The combined effects of tillage practices and irrigation did not significantly influence on the most of the yield contributing characters. The highest maize yield (8.680 t/ ha) was found from full irrigation and conventional tillage combined treatment and the lowest yield (6.950 t/ha) was observed at 50% FI and zero tillage combination, but it had no statistically significant difference among treatments. Water use efficiency of maize varied from 0.135 (t/ha/cm) in the 50% full irrigation treatment to 0.067 (t/ha/cm) in full irrigation practices.

Groundwater Recharge Potential and Pollution Risks from Paddy Field as Affected by Geologic Formation

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Abstract
Rice cultivation with groundwater irrigation is often blamed for threatening the quality and quantity of groundwater in Bangladesh. We investigated the groundwater recharge potential in rice fields, nutrient content in vadose zone layers, and the seasonal nutrient dynamics in the aquifers. A test drilling was done at the study site, and one observation well was installed in each of the potential aquifers. Soil textural class and nitrogen (N) and phosphorus (P) concentrations in soil samples collected from each 3-m soil layer were determined. Three pumping tests were performed to assess pumping drawdown and aquifer properties. The groundwater level was recorded and groundwater samples were collected from each aquifer at 15-day intervals to find the seasonal variation of water level and nutrient concentration. The results revealed that an unconfined aquifer is overlaid by a confined aquifer in the study area. During the pumping tests, 0.8-1.1 m drawdown occurred in the deep confined (pumping) aquifer, but elastic subsidence caused a decrease in depth to the water table of the shallow unconfined aquifer. There is a huge groundwater recharge potential (38–74% of total water input and up to 63 cm) from irrigated rice fields. The nitrogen leaching rate varied 1-6.7 mg/L, and the P leaching rate ranged 0.05-0.63 mg/L. Water-saving irrigation practices reduced the leaching loads of nutrients but not the

peak leaching concentrations. Concentration of N in both aquifers was higher at the end of the Aman season (monsoon season), whereas P concentrations peaked during the dry season and early monsoon. The nutrient persistence was relatively higher in geologic layers with higher clay content. The results will help formulate an irrigation and nutrient management plan to protect the groundwater resources.

Rating of Power Plant Disposed Water for Irrigation at Different Available Power Plants in Bangladesh

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Abstract
A study was conducted to evaluate the extent to which power plant disposed water is suitable for irrigation. Thirty water samples were collected from the main, secondary, and tertiary irrigation canals of Ashuganj and Ghorashal power plants. These irrigation schemes are mainly used for rice cultivation. Collected water samples were tested for the following parameters pH, electrical conductivity (EC), total dissolved solids (TDS), Ca, Mg, S, K, S, Cl, CO_3, HCO_3. Based on the chemical parameters, sodium adsorption ratio (SAR), soluble sodium percentage (SSP), residual sodium carbonate (RSC), magnesium adsorption ratio (MAR), total hardness (TH), Kelly's ratio (KR), permeability index (PI), potential salinity (PS) and alkalinity hazards were calculated for the analysis. Soil samples from the irrigated fields of both sites were also collected and analysed to see the impact of the disposed water on-field soils. The Ghorashal powerplant's disposed water is perfectly suitable in terms of acidity with minimum pH of 6.1 in contrast to Ashuganj powerplant's. In terms of EC, TDS, SAR, SSP, RSC, TH, KR, PI, and PS the water from both the study areas is suitable for irrigation. Maximum EC is found 356.92 µS/cm which is desirable along with the average SAR for Ghorashal is 0.932 and the mean RSC value is -1.140 meq/L for Ashuganj powerplant disposed water. Though the highest MAR was found to be 63.58, both of the areas have an average value below 50. For Ashuganj powerplant's disposed water, only KR and PI showed a strong correlation with other parameters and the rests combinations are moderately correlated. Likewise, the water from the Ghorashal powerplant showed a strong correlation with other parameters for PI and KR, but the rest correlations are below moderate level. From the above analysis, it can be concluded that disposed water from the studied powerplants is suitable for irrigation.

Estimation of Water Requirement and Crop Coefficients of Boro Rice under Humid and Warm Climate: Experimental and Analytical Approach

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Abstract
Climatic variability influences crop-water demand and crop production. Water shortage under climate change is a great challenge for the coming decades to increase food production in Bangladesh. To cope with the future climate stress condition low input agriculture needs to be established in Bangladesh.

For sustainable management of irrigation water on crop land specially in rice field under the scarcity of water in dry season is crucial for developing a climate resilient production system. This study has estimated the water requirement and crop coefficients of Boro rice in Mymensingh to improve water productivity under changing climate. A field experiment in a modern lysimeter combining with analytical approach was set in this study to estimate water requirement (ET) of Boro rice with three treatments. The treatments were: (i) control - conventional irrigation practice, water application after the disappearance of ponded water; (ii) continuous saturation; and (iii) Alternate Wetting and Drying (AWD) - irrigation applied after 5 days of ponding water disappearance. The stage-wise crop coefficients (K_c) of Boro rice was calculated both analytically and experimentally. The reference evapotranspiration (ET_o) has been estimated from daily climate data. The adjusted K_c of Boro rice were found 1.05, 1.11, 1.16, and 0.82 for initial, development, mid-season and late season stages, respectively for all the treatments. The average ET_o were found 1.79, 2.33, 3.40 and 3.64 mm/day; and average analytical ET were 1.88, 2.57, 3.95 and 2.99 mm/day for initial, development, mid-season and late season stages, respectively for all the treatments. There is no significant differences among the three treatments in analytical water requirement of rice. Currently, this study is working on experimental water requirement and crop coefficient estimation of Boro rice.

Comparison of the Quality of Mustard Oil Extracted by Two Different Pressing Techniques

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Abstract

The stud aims to compare the quality of mustard oil produced by two different pressing techniques, ghani and expeller during storage at different temperatures and to modify the mechanical expeller to get better quality oil. Mustard seeds were pressed using both techniques (ghani and mechanical expeller), and the resulting oils were stored at three different temperatures (room temperature, 4°C, and 37°C) for 12 weeks. The quality parameters analyzed included acid value (AV) and peroxide value (PV). The results showed that the AV and PV of mustard oil increased with increasing storage temperature and time. The oil obtained from the expeller scored more in terms of AV and PV in all storage temperatures compared to ghani oil, but ghani oil stored at room temperature showed less PV compared to the two other temperatures. This may be due to the heat generated during the pressing. A series of thermocouples were placed at various locations of the expeller to measure the temperature during the extraction process. The results showed that the most heated area in the expeller was the discharge end, with an average temperature of 80°C. The temperature gradually decreased along the length of the expeller, with the lowest temperature of 58°C observed at the feed section. The results also showed that the temperature distribution in the expeller was non-uniform. After that, the oil sample was collected from each repeated pressing and the temperature was recorded for each repeated press to justify if there is any relation with temperature rise. The temperature of different parts of the expeller chamber was recorded during repeated pressing of the mustard seed at different locations using thermocouples. The results showed that the temperature of the expeller chamber increased with the repeated pressing of the mustard seed. The temperature of the expeller was found ranging 34.2°C to 39.9°C for the first press. The most heated area was found to be the part next to the oil outlet. This could be attributed to the increased frictional forces and the accumulation of residual seed cake in this area. The results showed that the quality of oil extracted from mustard seeds was better in the first press and gradually degraded with repeated pressing. The free fatty acid content and peroxide value of the oil increased with each pressing, indicating an increase in oxidative degradation. The color of the

oil also became darker with each pressing, indicating the presence of more impurities. These findings suggest that repeated pressing of mustard seeds may not be suitable for obtaining high-quality oil.

Encapsulation of Orange Peel Polyphenol in Oil in Water Emulsion

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Abstract

Orange peel as a fruit waste is a rich source of phenolic compounds. In this research, three different solvents were used to optimize the polyphenol extraction from orange peel. The aqueous orange peel polyphenols (OPP) were encapsulated. The ratios between OPP and gum acacia were 1:10, 2:10 and 3:10. Encapsulated OPP was supplemented in buttermilk. The encapsulation efficiency (EE) was evaluated for capsules while physicochemical and microbial parameters of buttermilk samples were evaluated during refrigeration storage (fresh, 5, 10 and 15 days). Results showed that, the ethanolic extract of orange peel demonstrated the highest extraction yield (25.57%), total phenolic content (130.6 mg GAE/100g), and total flavonoid content (85.26 mg/100g) and DPPH contents (79.32 ± 1.05%) in comparison to other solvent extracts. Increasing the amount of added OPE: gum acacia greatly enhanced the buttermilk's phenolic contents and antioxidant activity. The higher EE (95.2%) was observed when using OPP: wall materials at the ratio of 3:10. In this case, increasing the proportion of OPP caused the polyphenol-enriched buttermilk to have a lower pH, total viable count, and total coliform count and a higher titratable acidity and total soluble solids. But the addition of OPP had no appreciable influence on the sensory qualities of buttermilk (color, flavor, texture, and overall acceptability). The highest chance of success lay in using microcapsules to transport orange peel extract in buttermilk (OPE: wall material at a ratio of 3:10). This study evinced that a natural beverage made from buttermilk and microencapsulated OPP could be utilized as dairy drinks with high nutritional content and high acceptance.

Development of Non-destructive Techniques for Detection of Internal Defects and Fertility of Chicken Eggs Using Visible-near Infrared Spectroscopy and Computer Vision Combined with Artificial Intelligence and Image Processing

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Abstract

As many as 81,425 poultry farms have been registered as of August 2019. Of them, 54,411 are broiler chicken farms, 18,954-layer chicken farms and 7,829 duck farms. The annual egg output surged to 17.11 billion pieces in the fiscal year (FY) 2018-19 with Per capita egg consumption reached 104.23 in 2020. The eggs are used in the food industry because of their various functional properties such as foaming, binding, gelling, etc. Egg internal quality is very important for the egg product industry to avoid internal defects and microbial spoilage of egg products. The study was aimed to identify internal defects (blood spots, broken yolk & fecal contamination) in eggs using image processing and Vis-NIR

spectroscopy. Eggs with blood spot, fecal contamination and broken yolk were prepared. The spectra and color image of both control and prepared samples were acquired using spectrometer and digital camera. There was significant differences ($P< 0.01$) in spectral transmission of control eggs and eggs with blood spot, broken yok and fecal contamination in the visible region of the spectrum. There was no significant difference in the color image of control eggs and eggs with broken yolk. The color image of fecal contaminated eggs differ from control eggs from day 2. Multivariate analysis was performed with the spectral data and color image of control and prepared egg samples for classification of eggs with blood spot, fecal contamination and broken yolk. The results showed that Vis-NIR spectroscopic technique could detect eggs with internal defects. While computer vision technique can detect eggs with blood spot and fecal contamination but not the broken yolk eggs. Vis-NIR spectroscopy and computer vision techniques combined with multivariate analysis has the potential to detect inter defects of chicken eggs.

Development of Online Database for Medicinal Plants and Automatic Identification Using Machine Learning Based Android App

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Abstract
Medicinal plants are becoming increasingly popular due to their various remedial properties and less side effects. They play a major role for drug production in pharmaceutical industries. One-fourth of prescribed drugs are manufactured from the extracts of medicinal plants. But due to urbanization, most of the forests, trees and even small plants are eliminated to construct roads, buildings, and industries. Therefore, many valuable medicinal plants are becoming extinct from our planet. To save these plants, we have to be able to identify them. But most of us cannot classify the medicinal plants due to the lack of knowledge and expert opinions. Besides, it is difficult to manually classify a medicinal plant due to their various shapes and varieties. Therefore, an android app needs to be developed based on machine learning algorithms which will be able to identify a medicinal plant automatically. But to achieve higher classification accuracy in automatic plant identification app, an online database including a large number of images has to be developed. Therefore, in this project, we aim to develop an online database of medicinal plants having a large number of images having different lighting conditions and complex backgrounds. Based on this large database, we will also train machine learning algorithms. Then we will integrate these algorithms in an android app to classify the medicinal plants. This android app and large online database will be immensely help to identify the valuable medicinal plants and save them from extinction. The app will also contain information including the advantages of these medicinal plants. Therefore, users of this app will also be motivated to grow these plants in their gardens and homes. This project will thus greatly help to build a green planet by conserving and preserving the medicinal plants.

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IoT and Computer Vision Enables Intelligent Crop Recommendation System Extracting Soil and Environmental Features

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Abstract
In today's automated aspects of agriculture, it is essential for farmers to have up-to-date knowledge about plant selection, cultivation and maintenance to produce more crops. There is considerable knowledge, techniques and methods that are done manually in agriculture. There is no optimal system for growing any crop that can be recommended to the farmer by identifying environmental characteristics. We implemented our proposed technique using MATLAB 20a, and we compared it with state-of-the-art classification algorithms such as Support Vector Machine (SVM) and K-Nearest Neighbor (KNN). If k=1 the object is assigned to the class that is closest to it. Soil type photos were classified into five categories using two techniques (black soil, cinder soil, peat soil, yellow soil and laterite soil). Accuracy and confusion matrix are two criteria used to evaluate system performance. We extracted 14 features from each soil image: average red hue, average green hue, average blue hue, average hue, average saturation hue, average value hue, average horizontal contrast, average vertical contrast, average horizontal power, average vertical power, average Horizontal homogeneity and mean horizontal homogeneity. The classification accuracy of SVM model is 100% for cinder soil, laterite soil and peat soil, while it is 87.5% for black soil. Thus, the overall accuracy of the SVM model is 99.9%. The confusion matrix of the K-nearest neighbor classifier, we observed that the classification accuracy of KNN for 81.8%. It is clear from the data collected by the sensors that this proposed system has 95% accuracy. Accuracy will increase significantly over time as significant amounts of data are collected and the system is self-trained in about a year. Tests conducted over a period of 4-6 months proved the reliability and accuracy of the system. This system will surely be a torch bearer as the whole world is waiting for a new agricultural advisory system.

Microsatellite DNA Marker Analysis Underlying the Effect of Broodstock Size on Larval Growth Performance of Minnow, *Labeo ariza* in Bangladesh

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Abstract
Bhagna, *Labeo ariza* are listed as endangered in Bangladesh. For these reasons, it is necessary to conserve and rehabilitate through breeding and culture practices. It is slow growing pattern in culture pond as well. However, an experiment was conducted to investigate the effect of brood stock size group on the larval growth performances of *Labeo ariza* using microsatellite marker such as Lr3, Lr22, Lr24 and Lr27. Primarily, larger brood stock size (180-290g) produced larger eggs and bigger fry while moderate brood stock size (70-130)g produced medium size eggs and moderate fry, and small brood stock size (35-50g) produced smaller eggs and fry. The mean size of eggs produced and the size of brood stock was however not significantly different ($p > 0.05$). In addition, larger eggs resulted in larger fry. The survival rate of fry after starvation increased with increase in parent brood stock size. There was no significant difference ($p> 0.05$) in the physiochemical parameters. During molecular study, two among the four loci namely Lr24, Lr27 were found polymorphic in all the three groups. Lr3 locus was found to be polymorphic in two groups viz medium and large size of broodstock. However, the highest mean percentage of polymorphic loci was observed in large broodstock size group. Based on this study it was recommended that for larger eggs and fry production, brood stock of *Labeo ariza* should be selected for seed production in fish hatchery operation in Bangladesh.

Molecular Analysis Underlying the Effect of Vitamin-E Supplemented Diet on Gonad Maturation of Indigenous Climbing Perch, *Anabas testudineus*

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Abstract
Anabas testudineus is a small indigenous species and valuable item of diet for sick and convalescent in Bangladesh. Regards, we collected wild sources of indigenous climbing perch populations and developing its in captive condition using Vitamin E supplemented diet under cage culture system. However, the objectives of this proposed research project are to detect the growth performance, gonadosomatic index, maturity stages, mRNA level of selected genes expression of *A. testudineus* using different concentration of Vitamin-E such as T_1 (50 mg/kg vitamin E), T_2 (100 mg/kg vitamin E), T_3 (150 mg/kg vitamin E), T_4 (200 mg/kg vitamin E), T_5 (250 mg/kg vitamin E) and T_0 (without vitamin E) in supplemented diet for dose optimization. Present revealed that one-way ANOVA among the treatments revealed that T_2 (100mg/kg vitamin E) performed significantly better length than other treatments (p value 0.001 which was $p<0.05$). In the T_2, the mean value of length was the highest comparing with other treatments. For weight, one-way ANOVA among the treatments also revealed that T_2 (100mg/kg vitamin E) performed significantly better than other treatments (p value 0.003 which was $p<0.05$). In the T_2, the mean value of weight was the highest comparing with other treatments. For

GSI, one-way ANOVA among the treatments revealed that T_2 (100mg/kg vitamin E) performed significantly better than other treatments (p value 0.017 which was $p<0.05$). In the T_2, the mean value of GSI was the highest comparing with other treatments. For gonadal maturation of *A. testudineus*, almost mature gonad was observed. Likely, RT-PCR primer for gene expression study was developed through foreign collaboration. Based on this result it is clearly recommended that further study is required for gonad maturity and RT-PCR of gene expression experiment.

Modeling Climate Change Impact on Agriculture and Developing Mitigation and Adaptation Strategies for Sustaining Agricultural Production in Bangladesh

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Abstract

Embryonic and larval development of tilapia *(Oreochromis niloticus)* is very critical to climate change in early life of fish. This study was conducted for a comparative assessment of embryonic and larval development of tilapia in traditional hatchery and re-circulatory thermostatic systems. Daily changes in embryonic and larval development were measured through microscopic observation and image analysis in the laboratory. The government's meteorological department provided daily climate data and the water quality parameters from both systems were measured every day using appropriate devices. Water temperature was varied with room temperature at traditional hatchery system while it maintained at 28.50^{o}C in re-circulatory thermostatic system. Total 200 un-hatched eggs were stocked in every three trays of both systems. Egg diameter of gastrula, segmentation and pharynula stages were measured higher (2261.47±81.66 µm, 2646.24 ±17.98 µm & 2710.90±16.60 µm) in re-circulatory thermostatic system than traditional hatchery system (2261.07 ±81.52 µm, 2645.47±18.24 µm & 2710.01±16.45 µm), respectively. For both systems egg colors, egg size, black pigments, germinal ring, eye shape, tail and heartbeat were determined through microscopic observation. The highest hatching and survival rates were found under re-circulatory thermostatic system (95% and 97%) than traditional hatchery system (85% and 81%). About 6 hours less hatching time was required under re-circulatory thermostatic system than traditional systems. At the end of 30 DAH, larval length and weight under re-circulatory thermostatic system were found higher (15.736 ±0.424 mm 0.0528 ±0.0040 g) than traditional hatchery system (15.518 ±0.415mm & 0.0503 ± 0.0041g), respectively. Larval growth pattern for both systems were found exponential trend. According to PCA, all selected morphometric changes showed significant correlation among the variables in almost cases. The characteristics changes of larval development under re-circulatory thermostatic system and traditional hatchery systems were found remarkably similar except some deformities denoted under traditional hatchery system. The changes of yolk-sac, body pigmentation, dorsal & caudal fin shape, eye size and head length & wide were determined from 1 DAH to 30 DAH. After absorbing the yolk-sac, ready-made feeding was started. The water temperature was varied from 30.50^{o}C to 35.50^{o}C in traditional hatchery system. The highest air temperature and humidity were 33.87 ^{o}C and 69.94% while the lowest 29.63 ^{o}C & 45.62% respectively in traditional hatchery system. According to CCA, climatic factors (air

temperature & humidity) and water quality parameters (water temperature, pH and DO) showed significant correlation each other. Further research might be conducted in broader aspects for hatchery production since there was no established such comparative study in Bangladesh. It can be more effective for seed production at fish hatchery level.

Development of Sustainable Mass Seed Production Technology for Golda Shrimp (*Macrobrachium rosenbergii*) and Production of Quality Broodstock in Captivity

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Abstract
Having all the favorable conditions, golda farming in Bangladesh has been constrained by low availability or unavailability of good quality seed termed as post-larvae (PL). Prawn hatcheries in Bangladesh have been encountering problems in PL production since 2012 and most of the private golda hatcheries have already been closed. Proper identification of the problems and their comprehensive solution has not been achieved yet. Dependency on unpredictable wild sources for berried prawn (egg bearing mother) is another key constraint of golda hatchery industry in Bangladesh. For the development of broodstock, golda PL was stocked in a nursery pond at Fisheries Field Laboratory Complex of FoF-BAU. The juvenile/pre-adult prawns were harvested and stocked in two ponds to develop good quality broodstock with a stocking densities of 50 and 40/decmal in Pond#1 and Pond#2 respectively. An experiment was conducted to optimize the dose of nucleotide on growth and immune response of golda shrimp. We tested four concentrations of nucleotide- 0.05%, 0.1%, 0.15% and 0.2% and assessed the growth and Total Hematocyte Count (THC) among the groups. We have produced good quality prawn (*M. rosenbergii*) ranging in sizes from 5 to 43 g and an average weight of approximately 15.61 g. The survival rate in the nursery pond was satisfactory (40% upto 70 days of stocking and 65% from day 71 onward until harvest after six months in March). Among the four levels of nucleotides tested, 0.1% and 0.2% nucleotide supplementation produced better results in terms of growth and survival respectively.

Effects of Dietary Macroalga *Sargassum* spp Extract on Growth, Feed Utilization, Hematological Indices and Non-specific Immunity of Tilapia, *Oreochromis Niloticus*

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Abstract
A study was carried out to assess the potential of *Sargassum* spp extract as a feed additive for Nile tilapia, *Oreochromis niloticus*. Four types of experimental feeds were prepared by mixing of 0, 0.5, 1.0, and 2.0% of hot water extract of *Sargassum* with commercially available Mega feed and considered as Feed-1 (control), Feed-2 (T-1), Feed-3 (T-2), and Feed-4 (T-3), respectively to investigate the growth performance, feed utilization, and non-specific immunity of *O. niloticus* challenged with *Aeromonas hydrophila*. Healthy mono-sex *O. niloticus* fingerlings with the average

length of 4.42±0.34 cm and weight of 1.37±0.29 g were randomly stocked for 60 days in cisterns at a density of 20 fishm^{-3} and fish was fed with the diets twice a day at 5% of body weight for two months. Sampling was done twice a month for examining the growth of fish. Liver, stomach and intestine of fish were collected for histomorphometric analysis. Results showed that average final body weight (24.27±1.40 g), percent weight gain (1773.77±320.7 %), specific growth rate (4.86±0.29) and survival rate (92.5±3.53%) in T-3 fish were significantly ($P<0.05$) higher than control and no significant ($P<0.05$) difference were found among T-1, T-2, and T-3. Food conversion ratio was found lowest in T-3 and highest in control. The HSI, RLG, and RBC count was also found significantly ($P<0.05$) higher in T-3 compared to control; whereas, highest glucose level was found in control fish. The clinical signs and post-mortem changes were also found less in the experimental fish fed seaweed supplemented feeds. The enhancement in growth rate, hematological parameters, less mortality against bacterial challenge test observed in the treated fish suggested that, *Sargassum* spp. could be supplemented to the *O. niloticus* diet at optimum level of 2% to improve immunity without any adverse effect on growth performance.

A Study on Chromosome Number of National Fish, Ilish (*Tenualosa ilisha*) of Bangladesh

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Abstract

karyotyping is basic but important tool to undertake various breeding and selection programmed. Very few species of Bangladesh have undergone chromosome analysis. Therefore, a chromosome study has been done to national fish, Ilish (*Tenualosa ilisha*) using gill tissue samples. Four live small fish were collected from Arial kha river, Barisal and injected intramuscularly with 0.05% colchicine solution at the dose of 1ml per 100 g body weight of fish. After 1 hour the fish were sacrificed and gill tissue was collected for chromosomal spreads preparation. The dissected gill was kept within a hypotonic solution of 0.56% KCl for 20 minutes. Then the sample was fixed by using carnoy's solution at 4^0C for 1 day. The tissues were ground for 1 minute using a 3 mm diameter glass rod. Ten minutes after grinding, the cell suspension was taken up into a capillary tube and dropped from 30 cm height on to a clean glass slide placed on a hot plate (45^oC) and 2-3 circles were made in a slide. Prepared slides were air dried and stained with 5% Giemsa for 20 minutes. Then permanent slides were prepared using DP-X mount. Chromosome spreads were identified around the edge of the circle under 40 x magnifications and the number of chromosomes were counted under 100 x (oil immersion) magnification using a compound photographic microscope. The total numbers of chromosomes of Ilish were counted $2n$=42.The result of the present study may provide new information in scientific community as well as further improvement of breeding and production of this species.

Cryogenic Sperm Banking of Indian Major Carps (*Catla catla, Labeo rohita* and *Cirrhinus cirrhosus*) and Exotic Carps (*Hypophthalmichthys molitrix, Hypophthalmichthys nobilis* and *Ctenopharyngodon idella*) for Commercial Seed Production and Brood Banking

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Abstract
The study was conducted to standardize sperm cryopreservation protocols of Catla and Grass carp and to produce seeds of Rohu, Catla, Mrigal, Silver carp, Bighead carp and Grass carp using cryopreserved sperm in public and private hatcheries in four regions of Bangladesh. Broodstocks of Rohu, Catla, and Mrigal were developed by rearing fish of Halda and Padma river-origin and the broodstocks of Silver carp, Bighead carp and Grass carp were developed by rearing newly imported China-origin fingerlings. Different parameters of sperm cryopreservation protocols of these species were optimized. The activation of sperm motility was tested in different concentrations of NaCl solution, and the highest sperm motility and swimming duration of Catla (95.3±1.5% and 37.61±0.6 min) and Grass carp (96.33±0.33% and 21.9±1.13 min) were observed in 0.4 % NaCl solution. Cryoprotectants (DMSO and methanol) at 5% and 10% concentrations with extenders (Alsever's solution and egg-yolk citrate) produced better motility during 5- and 10-min incubation. Diluent composed of Alsever's solution plus 10% DMSO at 1:9 sperm diluent ratio produced highest equilibration and post-thaw motility of sperm for both species. Sperm equilibrated for 10 min produced highest post-thaw motility (91.7±1.7%) in Catla, whereas highest post-thaw motility (85.0±2.9%) was recorded in Grass carp during 15 min equilibration. Sperm of Rohu, Catla, Mrigal, Silver carp, Bighead carp and Grass carp were cryopreserved, and breeding was conducted in 17 hatcheries to produce seeds using cryopreserved sperm. The average fertilization and hatching rates were recorded from cryopreserved sperm as 39.80±2.75% and 32.31±2.65% in Rohu, 38.09±3.17% and 31.03±3.10% in Catla, 37.74±3.14% and 30.18±2.52% in Mrigal, 42.10±4.52% and 33.10±3.94% in Silver carp, 40.60±1.23% and 32.90±1.42% in Bighead carp, and 28.21±5.80% and 21.41±5.27% in Grass carp respectively. Cryopreserved sperm-originated seeds showed higher growth than those of hatchery-origin fresh sperm due to introduction of quality germplasm from cryogenic sperm bank.

Broodstock Development, Induced Breeding and Cryogenic Sperm Banking of Critically Endangered Indigenous Mohashol *Tor tor*

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Abstract
For standardization of cryopreservation protocol of *Tor tor*, sperm was collected from hormone-induced males and the fresh sperm concentration was recorded as 3.34×10^{10} cells/ml, motility 94.67±2.6% and pH 9.0. In activation of sperm, the highest motility was estimated as 94.3±0.7% at 0.4% NaCl and zero at 1.0% NaCl solution. Similarly, the highest swimming duration of sperm was recorded as 49.04±0.2 min at 0.4% NaCl and it became zero at 1.0% NaCl. In toxicity test, the motility of sperm decreased with increasing cryoprotectant (DMSO and methanol) concentration (5%, 10% and 15%).

Sperm suspended with Alsever's solution showed the highest motility as 93.67±1.9% at 10% DMSO during 10 min incubation, whereas highest motility was recorded as 56.67±1.7%, from Alsever's solution plus 10% methanol during the same incubation In combination of egg-yolk citrate, 10% DMSO produced the highest motility as 41.67±1.7% at 10 min of incubation. Alsever's solution with 10% DMSO produced the highest equilibration (94.3±2.3%) and post-thaw ((90±2.9%) motility at 1:9 sperm dilution. On the other hand, egg-yolk citrate with 10% DMSO produced highest equilibration motility (80.0±2.9%) at 1:4 dilution that reduced to 71.67±3.3% during post-thaw motility observation. For cryogenic sperm banking, sperm was processed with Alserver's solution plus 10% DMSO and stored in a liquid nitrogen Dewar. In cryostorage, the initial post-thaw motility of sperm was estimated as 90±0.00% that gradually reduced over the period and after 12 months it turned into 81.00±0.58%. Several attempts were taken to breed the fish using hormone treatment, but females did not respond though males produced enough matured sperm. As the females of *Tor tor* were not ovulated upon induced with hormones, hybridization trials were conducted with other fish species such as *Tor putitora, Labeo rohita, Catla catla, Ctenopharyngodon idella, Cirrhinus cirrhosis, Mylopharyngodon idella* using cryopreserved sperm of *T. tor* but no fertilization was obtained.

Towards Understanding Nematode Infestations in the Spotted Snakehead, *Channa punctatus*: Morphological and Molecular Approaches to Determine the Causal Agents

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Abstract

The present study evaluated the infestation, seasonal biology and ecology of *Eustrongylides* sp. (Nematoda: Dioctophymatoidae) in *Channa punctatus* collected from Mymensingh, Bangladesh, to determine the prevalence, mean intensity and seasonal variation of the parasite. The experiment was carried out from August 2020 to July 2021. In this study, a total of 414 specimens of *C. punctatus* were collected from different fish markets of Mymensingh city and the larvae of *Eustrongylides* sp. were recovered from the abdominal cavity, musculature and ovaries of *C. punctatus*. Light microscopy (LM) was conducted to demonstrate the surface anatomy of the worm. Phylogenetic analysis was done to find out closely related ITS rDNA gene sequences. A phylogram was generated using ITS rDNA sequences in MEGA 6.06 software. The prevalence of *Eustrongylides* sp. was found maximum in October (91.11%) and the lowest in May (0.06%) whereas, the highest prevalence (54.5%) was observed in autumn season and the lowest (28.6%) was in winter. The maximum mean intensity was found in October (4.2) and the lowest was recorded from May (1), whereas, the highest and the lowest mean intensity was recorded in summer (8.82) and autumn (1.83) seasons respectively. The prevalence was observed higher in large length group and the value was 62.1%. On the other hand, the lowest (26.5%) was in small length group. Mean intensity was also observed higher in large length group. The maximum prevalence (56%) and mean intensity (1.60) was observed in female during autumn season. On the contrary, the minimum prevalence (51.9%) and mean intensity (1.28) was in male during autumn. Molecular analyses ensured that *Eustrongylides* sp. and *E. excisus* were present. No mutation was observed within this species. This is the first report on seasonal variation of larval stage of *Eustrongylides* sp. from *C. punctatus* in Bangladesh which provides a basic information for further detailed epidemiological and molecular study.

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Antibiotics in Aquaculture of Bangladesh: Abuse, Efficacy and Quantification

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Abstract
The present study was carried out to investigate abuse, efficacy and quantification of antibiotics in aquaculture activities in Mymensingh district. Data were collected through questionnaire interview with different representatives of pharmaceutical companies, drug retailers, drug depots and fish farmers. It was found that total 20.28 tons of solid and 28.66 tones of liquid antibiotics were sold per with a total estimated price of Tk. 8.8 Crore. Seven groups of antibiotics having 25 different active compounds with 82 trade names were found to be provided by pharmaceutical companies. The groups included β-Lactams, macrolides, sulfonamides, aminoglycosides, tetracycline, metronidazole and fluoroquinolones. The highest amount of solid antibiotics were sold by ACI group followed by Eskayef, Square, Renata and Al- Madina. Abuse of antibiotics were evaluated through analyzing some aspects like training of farmers on applying aqua medicines, taking specialists' opinion before using antibiotics, use of recommended dose, understanding about residual effect, receiving of prescription from specialist, using safety measures, knowledge about disposal, maintaining withdrawal time, practicing good aquaculture practices, storage conditions, knowledge about shelf life and idea about extra-label use of antibiotics. Abuse of antibiotics were evident during the study. It was found that a number of farmers never received any training and about 53% of the farmers never received prescription from qualified person before using antibiotics. About 40% farmers were found unable to calculate appropriate dose needed before use. Overall 93% farmers were found to apply over dose and dosage without following any guideline. Poor drug storage facilities were noticed both in farms and shops. Majority (83%) of the farmers had no idea about withdrawal period, residual effect, and disposal of non-used antibiotics. Record keeping by both farmers and retailers were found very poor. This study also assessed sensitivity and efficacy of selected antibiotics against some emerging bacterial fish pathogens.

Effects of Dietary Probiotics Supplementation on Growth, Hematology and Gut Morphology of Striped Catfish, *Pangasianodon hypophthalmus*

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Abstract
Probiotics, an environment friendly alternatives to antibiotics that play an important role to sustain the aquaculture development. Salinity is regarded as one of the most crucial environmental parameters and salinity mediated stress adversely affect the aquaculture production. The aim of the present study was to evaluate the effects of probiotics supplementation on growth performance, hemato-biochemical parameters, gut morphology of striped catfish, *Pangasianodon hypophthalmus*. *P. hypophthalmus* fingerlings (8.10 ± 0.20 g) were evenly distributed into 24 glass aquaria with three replicates that were divided into four different salinities (0 ppt, 4 ppt, 8 ppt and 12 ppt) with and without probiotics supplementation for 56 days. Multi species probiotics containing *Bacillus* spp. (1×10^9 CFU/mL) and *Lactobacillus* spp. (1×10^{11} CFU/mL) were used as 1.0 mL/L at the alternate day. Growth parameters

(weight gain, WG; specific growth rate, SGR); hemato-biochemical parameters (hemoglobin, Hb; g/dL and blood glucose, mg/dL); erythrocytic cellular abnormalities (ECAs), erythrocytic nuclear abnormalities (ENAs); and intestinal morphology were assessed at the end of the experiment. The results obtained from this study revealed that growth and feed utilization significantly improved in the fish treated with multi-species probiotics compared to the control. Hb and blood glucose level significantly improved in the fish reared with multi-species probiotics in comparison with the control. Frequencies of ECAs and ENAs were significantly lowered in fish treated with probiotics in spite of salinity increase. Moreover, probiotics supplementation significantly improved morphological structures of intestine compared with the control. Taken altogether, the current study revealed that direct administration of multi-species probiotics can be an effective way to reduce stress and improve health status by upgrading hemato-biochemical profile and intestinal morphology of *P. hypophthalmus* at high salinity.

Harnessing Machine Learning to Estimate Aquauculture's Contributions to the Economy of Southwest Bangladesh

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Abstract

Aquaculture in Bangladesh has grown quickly over the past three decades, becoming a major contributor to the country's rural economy. National systems for collecting aquaculture statistics have not kept pace with these changes, so more accurate, up-to-date information is needed to inform policymakers. We used machine learning techniques to extract information from freely available satellite images and estimate the area of waterbodies used for aquaculture in seven districts in southern Bangladesh, one of country's most important aquaculture zones producing fish for domestic markets and crustaceans for export. We combined machine learning derived estimates of aquaculture farm area per district with data from statistically representative farm surveys to estimate farm size, productivity, and total output, economic value of production, on-farm employment generation by gender, and demand for formulated and non-formulated feeds. Machine learning estimates returned a total farm area similar to that reported in Department of Fisheries (DOF) statistics, but we estimate that production of crustaceans (shrimp + freshwater prawn production) is 31% lower than officially reported by DOF in 2020, while fish production and total aquaculture production (fish + crustaceans) are 41% and 27% higher, respectively. Aquaculture makes a massive contribution to food production, farmer incomes and employment in southern Bangladesh. We estimate that there were more than 500,000 farms in 2020, producing 787,000 t of aquatic food (89% fish and 11% crustaceans), with a mean yield of 3.1 t/ha. This production was worth a total $1.45 billion (farmgate value) and generated farm profits of $0.67 billion, after subtracting production costs. These farms support 430,000 fulltime equivalent (FTE) jobs on-farm, of which 15% worked by women, and created demand for 759,000 t of feed, of which 30% comprised of formulated pelleted feeds. Our findings reveal great potential to combine remote sensing and machine learning techniques with representative surveys to estimate a range of statistics that are difficult to obtain otherwise, with potential to expand the approach to whole of Bangladesh and other countries.

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Economic Viability and Seasonal Impacts of Integrated Rice-Prawn-Vegetable Farming on Farming Households in Southwest Bangladesh

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Abstract
Integrated aquaculture is an efficient method to address food scarcity and land resources. This study analysed the impacts of integrated rice–prawn–vegetable farms (RPVF) compared with conventional rice farms (CRF) on farming households in southwest Bangladesh, in terms of cropping pattern, financial profitability and viability, and cash-flow. Data were collected through face-to-face recall interviews from farmers of CRF and RPVF. For RPVF, farmers cultivated diverse produce in the wet season, such as prawn/shrimp, carps in reservoirs and vegetables on dikes, and boro rice with vegetables in the dry season, whereas only rice was cultivated in both seasons for CRF. The annual hectare−1 net revenue from integrated RPVF was USD 2742.7, 3.6 times higher than for CRF (USD 756.6). RPVF had a higher undiscounted benefit–cost ratio (BCR) of 1.58 as compared with 1.34 for CRF. Net Present Value (NPV) and discounted BCR show that the integrated RPVF has higher potential and profitability than CRF. Year-round vegetable production and selling have resulted in a smooth cash-flow in integrated RPVF. Authorised extension agencies, such as the Department of Fisheries and Department of Agricultural Extension collaboratively can promote RPVF in other potential parts of Bangladesh, through which farmers can benefit year after year by investing farm income for the same farm and envisage food security.

Effect of Silica Nanoparticles on the Growth and Production of Two Exotic Fishes: Tilapia, *Oreochromis niloticus* and Thai koi, *Anabas testudineus*

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Abstract
An 8 week experiment was designed to investigate the effects of silica nanoparticles (NPs) on the growth, feed efficiency, and physiology of tilapia (*Oreochromis niloticus*) and koi (*Anabas testudineus*). Highly pure, activated silica NPs at different levels (0, 1, 2, and 3 mg/Kg diet) were incorporated into a 30% protein diet. Tilapia fry weighing 6.52 (±0.20) g and koi fry weighing 1.12 (±0.03) g were randomly assigned to triplicate tanks for each treatment in a recirculatory aquaculture system and fed their respective diets. Throughout the study period, the effects of silica NPs on length gain, survival, dry matter digestibility, blood cell count, hemoglobin level, condition factor, and final product composition, except for lipid content, were insignificant ($p>0.05$) for tilapia. On the other hand, all parameters observed were found to be significant for koi, except for condition factor and muscle compositions (moisture, ash, lipid, and protein). Results showed that growth parameters and feed efficiency increased with increasing levels of silica NPs up to 200 mg/Kg in tilapia and up to 300 mg/Kg in koi, but later decreased in tilapia. This result was due to the highest apparent protein digestibility with strong significance ($p<0.001$) observed in tilapia and koi fed with silica NPs at 200 mg/Kg and 300 mg/Kg diet, respectively. However, fish at an early stage showed better performance in all dietary groups than later. Blood glucose content and histology of the kidney revealed that tilapia

became stressed when silica NPs at 300 mg/Kg diet were used and adapted energetically through excessive excretion via elongated glomerulus. Although no significant ($p>0.05$) effect on villi length was observed, silica NPs widened the villi of the midgut ($p<0.001$) and increased goblet cells in the intestine significantly ($p=0.007$) in T2. The bioaccumulation study of silica indicated that incorporating silica NPs in fish feed would not compromise human health safety upon consumption. In conclusion, incorporating silica NPs at 2 mg/Kg and 3 mg/Kg diet can be regarded as the best performer in tilapia and koi, respectively, with regards to all indicators.

Effect of Dietary Methionine Supplementation on Growth, Feed Utilization and Hemato-biochemical Parameters of Koi, *Anabas testudineus* (Bloch, 1972)

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Abstract

The current study examined the impact of dietary methionine supplements on the growth, muscle composition and hemato-biochemical parameters of climbing perch (*Anabas testudineus*) from 26 August to 21 October 2021, in 12 glass aquaria in the Wet Laboratory of the Department of Aquaculture at Bangladesh Agricultural University, Mymensingh. For the experiment, the same stocking densities of 20 fish per aquarium with mean initial weight of 4.22 ± 0.03 g were released. Three replications of each of the four treatments were used in this experiment. In the experiment, T_0 was control diet and methionine was incorporated in T_1, T_2 and T_3 at doses of 1 mg/kg, 2 mg/kg, and 3 mg/kg, respectively. Throughout the study, fish were fed at 5% of body weight which were administered twice daily at 9:00 am and 5:00 pm. Sampling was done at 14-day intervals to capture various growth characteristics using a portable scale and a fortified push net. The highest final weight was 43.33 ± 0.84 g in T_3 and the lowest was 28.65 ± 0.97g in T_0. The highest weight gain was 39.32 ± 1.09 g in T_3 and the lowest was 24.94 ± 0.92 g in T_0. The highest percent weight gain was found 910.45 ± 38.27% in T_3 and the lowest was found 578.97 ± 13.19% in T_0. The highest specific growth rate was 3.93 ± 0.68% /day for T_3 and the lowest was 3.19 ± 0.29% /day for T_0. T_0 had the highest FCR (1.53 ± 0.03) while T_1 had the lowest FCR (1.32 ± 0.03). The survival rate was highest in T_2 at 94.85 ± 4.87% and lowest in T_0 at 90.59 ± 2.70%. T_3 had the best growth performance, followed by T_2, T_1 and T_0. The study showed highest crude protein percentage 14.97 ± 0.012% in T_3 whereas T_0 showed lowest 13.75 ± 0.041%. Muscle composition analysis showed no significant variations. The hemoglobin and body glucose ranged from 7.61 to 7.73 g/dl and 105.60 to 111.89 mg/dl, respectively which showed negligible variations. The study revealed that 3 mg/kg methionine in feed might be used by feed manufacturers and fish farmers for optimized production of climbing perch in Bangladesh.

Study the Effects of Probiotics on Growth and Reproduction of Selected Farmed Fishes in Bangladesh

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Abstract

Hence, we conducted studies to know the effects of probiotics on growth performance of gulsha and stinging catfish shing. In one study, we checked the growth performance along with hematology,

intestinal and liver morphology of gulsha reared with commercial probiotics (Pond care and Everfresh) and one Laboratory developed probiotic. The results showed that significantly highest growth performance (weight gain and specific growth rate), feed efficiency, and upgrading intestinal morphology of fish were observed in fish reared with Laboratory developed probiotics. Moreover, significantly increased immune response indicators such as fattening of the intestinal mucosal fold, width of lamina propria, width of enterocytes, and abundance of goblet cells were also scrutinized in fish reared with Laboratory developed probiotics. The purpose of another study was to inspect the effects of selective probiotics (Pond care, Everfresh and Laboratory developed) on the growth, hematology, microbes and morphology of the intestine of stinging catfish in biofloc. The study also revealed the benefit cost ratio (BCR) by specific probiotics used in the biofloc. The stinging catfish fry (average weight 0.86 ± 0.26 g) were distributed equally (250 fry/400 L water-filled PVC tank) under three different treatment groups into two replications and were reared for 16 weeks. The results specified that significantly highest growth performance (weight gain and specific growth rate), feed efficiency, and upgrading intestinal micro-biota and morphology of fish were observed in biofloc with Laboratory developed probiotics. Moreover, significantly increased immune response indicators such as fattening of the intestinal mucosal fold, width of lamina propria, width of enterocytes, and abundance of goblet cells were also scrutinized in fish reared with Laboratory developed probiotics. BCR which determines the business profitability also showed highest in using Laboratory developed probiotics in biofloc. Locally developed putative probiotics showed better performance compared to commercial probiotics in terms of growth studies of gulsha in aquarium and shing in biofloc.

Increase in Temperature Increases Ingestion and Toxicity of Polyamide Microplastics in Nile Tilapia

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Abstract

Microplastics (MP) pollution and global warming are worldwide concerns, creating various physiological problems for aquatic organisms. This study was carried out to know the effects of different temperature (30, 33 and 36°C) on ingestion of MP along with the physiological consequences in Nile tilapia (*Oreochromis niloticus*) exposed to virgin polyamide (PA) (10 mg/L water) for 15 days. A significant difference was found in PA ingestion of the fish treated with different temperature. Fish from 36°C temperature groups ingested highest amount of PA (136 ± 24.40 item/fish) during the exposure period. The hemoglobin (Hb) and red blood cell (RBC) decreased significantly in the highest temperature (36°C) without PA exposure. At the same time, Hb increased, but RBC significantly reduced in all the temperature conditions with PA exposure. The number of white blood cell (WBC) and glucose level increased significantly in the highest temperature (36°C) without PA exposure. In contrast, WBC increased and glucose decreased significantly in all the temperature conditions with PA exposure. Frequencies of various nuclear and cellular abnormalities of erythrocytes increased significantly in the fish exposed to all temperature with PA exposure, though severity increased with temperature. Similarly, histological damage of gills (hyperplasia, epithelial necrosis, deformed pillar system, epithelial lifting, telangiectasia) and intestine (epithelium breakage, enterocyte vacuolization and shortening of villi) was found to be mild to severe by the accumulation of PA, increased severity with increase of temperature. This study confirms that global warming as a consequence of climate change might influence MP ingestion hampering physiological state of fish.

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Dried Fish More Prone to Microplastics Contamination Over Fresh Fish-higher Potential of Trophic Transfer to Human Body

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Abstract
Globally, microplastics (MPs) contamination in aquatic organisms is emerging as an alarming phenomenon. In the present study, we investigated MPs in three commercially important fishes (Bombay duck *Harpadon nehereus*, ribbon fish *Trichiurus lepturus* and hairfin anchovy *Setipinna phasa*) in fresh and dried conditions collected from two sites (Chattogram and Kuakata) of the Bay of Bengal. It was evident that fresh *T. lepturus* ingested highest amount of MPs through the gills (6.41 mps/g) from Chattogram followed by in the gastrointestinal tract, GIT (6.20 mps/g) and in the muscle (1.20 mps/g) from Kuakata. Among the fresh fishes, *H. nehereus* from Kuakata accumulated highest amount of MPs (0.21 mps/g), while *S. phasa* from Kuakata contained the least amount of MPs (0.06 mps/g). On the other hand, among the dried fishes, *T. lepturus* from Kuakata contained highest amount of MPs (46.00 mps/g), while *S. phasa* from Kuakata retained lowest amount of MPs (2.17 mps/g). Strangely, all the dried fishes showed significantly higher amount of MPs compared to fresh fishes from both the locations. Fiber was the most dominant type of shape of MPs which accounted 66%, followed by fragment (27.38%), microbeads (3.59%), film (1.48%), foam (1.31%) and pellet (0.25%). Size-wise, the major portion (39.66%) of MPs was present to be in size range less than 0.5 mm followed by 37.67% in the size range of 0.5 to 1.0 mm group and rest 22.67% within 1.0-5.0 mm. Red (41.55%) colored MPs was the most prominent, followed by brown (22.11%), blue (16.32%), pink (11.69%), purple (5.10%), and green (2.25%). Among polymer types, low-density polyethylene (LDPE) was the most common (38%), followed by polystyrene (PS-22%), polyvinyl chloride (PVC-16%), polyamide (PA-13%) and ethylene-vinyl acetate (EVA-9%). The present study confirms high occurrence of MPs in the dried fishes over the fresh fishes from the Bay of Bengal, with high potential of trophic transfer to the human body.

Maximum Sustainable Yield and Fisheries Management of Savalai Hairtail *Lepturacanthus savala* in the Bay of Bengal

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Abstract
The study aimed to work on the assessment of maximum sustainable yield (MSY) and the development of management suggestions for the perpetuity of savalai hairtail *Lepturacanthus savala* in the Bay of Bengal. The savalai hairtail, locally known as suri, is an important species and a common component of the marine catch. The recent statistics of the Department of Fisheries reveals that the species contributes substantial biomass to the national total marine fish production, a fact that establishes its recognition as building a commercially indispensable fishery. Assessment of MSY of *L. savala*, therefore, is proposed to develop management roadmap for sustainable protection and conservation of the valuable species in the Bay of Bengal. Length-weight data of five monthly samples were recorded, and gonads were collected from all individuals to determine the sex ratio, gonadosomatic index, spawning season, length at maturity, spawning frequency and fecundity. Among the collected five samples comprising of 457 individuals, the preanal length of male and female ranged

from 6.6 to 28.1 cm, and from 6.4 to 30.2 cm, respectively, and their body weight ranged from 5.56 to 270.57 g, and from 5.44 to 401.09 g respectively. Collection of samples at regular monthly intervals to complete one calendar year will be continued for next seven months (July 2022-Janaury 2023) to determine the age and growth, recruitment, mortality and to estimate the MSY. The findings being pursued will be used as input data for fisheries management of this valuable species in the Bay of Bengal.

Stock Assessment and Conservation of Hilsa Shad *Tenualosa ilisha* in the Bay of Bengal

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Abstract
The research project estimated the population parameters and determined the maximum sustainable yield of hilsa shad, *Tenualosa ilisha* with a view to develop a sustainable fisheries management regime for the perpetuity of the valuable species in the Bay of Bengal. Fifty specimens at each month of a calendar year were collected from the industrial hilsa fisheries based at Gangamotir char, Kolapara upazilla, Patuakhai district in Bangladesh. The total length ranged from 14.6 to 53.4 cm, and the body weight from 37.2 to 1700 g over the study period. The von Bertalanffy appeared as the best growth model comparing with Gompertz and Robertson models based on χ^2 goodness of fit index, and the equation was $TL_t = 67.73\ [1- \exp\ \{-0.139\ (t + 1.312)\}]$, where TL_t is total length (cm) at age t (years). The species growth performance and the longevity were 2.8 and 21.38 years respectively. The length-weight relationship was $BW = 0.01TL^{3.03}$, and the von Bertalanffy equation in terms of weight was $BW_t = 3518.1\ [1- \exp\ \{-0.138\ (t+1.284)\}]^3$. Hilsa shad recruited when they were at 19.32 cm TL, and at age of 1.103 years to the adult stock in the Bay of Bengal. The Bay population suffered from the natural and fishing mortalities of 0.213 and 0.757 per year respectively, and the exploitation rate was 0.78 in the study period. The maximum yield per recruit was 228.09 g at the fishing mortality of 0.3 per year. The biomass analyses, however, estimated that *Tenualosa ilisha* attained 336.12 kg relatively at the age of 6.9 years if 1000 individuals recruited to the parent stock in the Bay of Bengal.

Population Dynamics of Ticto Barb *Pethia ticto* and Recommendations for Its Stock Management in Bangladesh

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Abstract
Population parameters of ticto barb *Pethia ticto* (Hamilton, 1822) and their implications for its sustainable management in the river Old Brahmaputra were studied. Twelve monthly samples comprising 1200 individuals were collected. Sex ratio between male and female did not differ from parity ($\chi^2 = 2.01$, *d.f.* = 1, $P > 0.05$). Asymptotic SL and BW of male and female were 72.8 and 72.5 mm, and 15.58 and 15.60 g. Growth coefficients of male and female were 0.63 and 0.53 per year. Longevity and growth performance index of male and female were 5.66 and 4.76 years, and 3.52 and 3.44. Gonadosomatic index (GSI), and external features and histology of ovary observations concluded that spawning season lasted from December to July, while December-April was appeared as peak spawning season. SL of the youngest spawning female was 31 mm, and mean SL at first sexual

maturity was 33.93 mm. Absence of post ovulatory follicles in ovaries designated the species as synchronous. Calculated fecundity was from 1328 to 15250 eggs in terms of SL (34-81 mm), while it ranged from 263 to 12961 eggs in terms of BW (1.48-8.81 g). Recruitment occurred at SL 32.48 mm and 31.0 mm, and at age 0.94 and 1.05 years for male and female. The natural and fishing mortalities of male and female were 0.97 and 1.36, and 0.81 and 0.76 per year. Exploitation rates of male and female were 0.60 and 0.42 in the study period. Statistical tests provided evidence that there were no difference (P>0.05) in SLs and growth equations between male and female. Yield per recruit was 1.74 g at fishing mortality of 1.8 per year. The biomass method estimated that *P. ticto* attained 1.56 kg relatively at age of 2.07 years if 1000 individuals recruited to parent stock in the river Old Brahmaputra, Bangladesh.

Stock Assessment and Management of Tengra Catfish *Mystus tengara* in Bangladesh: Part II

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Abstract
The study has been proposed to estimate population parameters and maximum sustainable yield of *Mystus tengara*, to develop management strategies for its numerous stocks across Bangladesh. The tengara catfish is a freshwater bagrid, locally known as bajari tengra, widely distributed in slow and shallow waters of rivers of plains and estuaries, canals, streams, beels, ponds and inundated fields in Bangladesh. Samples were collected monthly for one year comprising about 1200 individuals from Dingaputa haor at Netrokona district, Bangladesh. Male and female gender ratio did not differ from the parity ($\chi^2 = 3.01$, $d.f. = 1$, $P > 0.05$). Among samples of 12 months, the standard length (SL) of male and female ranged from 3.1 to 5.6 cm and 3.2 to 5.9 cm, and their body weight ranged from 0.7 to 4.22 g and 0.97 to 5.62 g respectively. ELEFAN methods described the growth equations for male and female tengra catfish populations separately, and they were as $SL_t = 61.7\ [1- \exp\ \{-0.52\ (t + 0.014)\}]$ and $SL_t = 65.1\ [1- \exp\ \{-0.48\ (t + 0.018)\}]$ respectively. The length-weight relationships appeared as negative allometric for both male and female, and they were as $BW=0.00009SL^{2.63}$ and $BW=0.0001SL^{2.64}$ respectively. von Bertalanffy growth models in terms weight were constructed for both male and female, and they were as $BW_t = 4.61\ [1- \exp\ \{-0.58\ (t + 0.002)\}]^3$ and $BW_t = 6.12\ [1- \exp\ \{-0.54\ (t + 0.0001)\}]^3$ respectively. The present findings will be used as input data for fisheries management of this valuable species in the Dingaputa haor and adjacent aquatic ecosystems in Bangladesh.

Culture of Nutritious Green Algae, *Monoraphidium littorale* in Low-Cost Media and their Use in Rearing Zooplankton and Fish Larvae

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Abstract
Growing microalgae in vegetable waste media can be an excellent substitute to expensive commercial media in reducing feed costs for rearing zooplankton and fish larvae. As a way of starting an inevitable step-up, *Monoraphidium littorale* was grown in 25% (T_1), 50% (T_2), and 75% (T_3) of Digested Rotten Potato Supernatant (DRPS) for 16 days and at the same time in Bold Basal Medium (BBM) as a

control (T_4). The highest cell density of *M. littorale* was recorded in T_1, followed by T_4, T_2 and T_3. In T_1, *M. littorale* biomass production was significantly higher ($P < 0.05$) than other treatments. The protein content achieved in T_1 at the end of the cultivation time was quite higher ($P < 0.05$) than in T_4. An in-door rearing study was also executed with *Oreochromis niloticus* larvae fed on live *Monoraphidium littorale* (T_1), live zooplankton (copepods) enriched with *M. littorale* (T_2), powdered *M. littorale* (T_3), powdered enriched zooplankton (T_4), live *M. littorale* + live enriched zooplankton (T_5), powdered *M. littorale* + powdered enriched zooplankton (T_6) to evaluate their effects on growth and survival. The *O. niloticus* larvae fed with the T_2 diet outperformed all other treatments, with significantly higher growth ($P < 0.05$) followed by T_5, T_6, T_4 and T_3 fed groups. Larvae fed with T_1 diet showed lower growth performance. Furthermore, the percent survival of the *O. niloticus* larvae was significantly higher in T_2, T_4 and T_6 groups followed by T_3 and T_5 groups. Larvae fed with T_1 diet showed significantly lower survival rate. Based on the results attained in this study, it is concluded that live zooplankton enriched with *M. littorale* is suggested as the best promising candidate for the surged growth and survival of *O. niloticus* larvae which in turn will lead to higher hatchery productivity with attaining increased economic return.

Occurrence, Abundance and Seasonal Dynamics of Noxious Blue Green Algae in Fish Ponds

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Abstract
As noxious blue green algae are very alarming and causing serious problems in fish ponds, a study was done in three fish ponds in Mymensingh region, from March 2021 to February 2022, to know the occurrence, abundance and seasonal dynamics of bloom forming harmful blue green algal genera in relation with certain water quality parameters. During the study, a total of 33 microalgal genera were recorded and out of which 15 belong to Chlorophyceae, 7 to Cyanophyceae, 7 to Bacillariophyceae, 3 to Euglenophyceae, and 1 to Rhodophyceae. Efforts were made to know the physicochemical factors and their effect on the occurrence, abundance, and seasonal dynamics of the blue green algal population. Though Chlorophyceae showed numerical superiority over other groups in respect to the number of genera, but Cyanophyceae ranked the first in respect to abundance. The highest abundance of Cyanophyceae was 1192.66×10^3 cells/L in May (summer) in pond 1, 6134×10^3 cells/L in March (spring) in pond 2, and 11120×10^3 cells/L in April (summer) in pond 3. Cyanophyceae was dominated by *Microcystis, Anabaena, Aphanizomenon, Oscillatoria, Aphanothece, Spirulina,* and *Gomphosphaeria*. *Microcystis* only represented as the main and most dominantly occurring genera throughout the study period. Physicochemical parameters like temperature and pH were within optimum level for fish ponds but nitrate-nitrogen, phosphate-phosphorus, transparency and dissolved oxygen were found in considerably lower level in all the three ponds during the peak abundance of cyanophytes. Cell densities of Chlorophyceae, Bacillariophyceae, Euglenophyceae, and Rhodophyceae were found comparatively lower in pond 1 and 2 due to the high abundance of Cyanophyceae. In pond 3, the abundance of both Euglenophyceae and Cyanophyceae was found highest among the three ponds. Extensive research on aquaculture inputs given in ponds and their impacts on noxious/harmful algal proliferation are needed to keep our aquaculture industry sustainable and out of danger.

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Astaxanthin Producing Green Alga *Haematococcus pluvialis* and its Utilization in Rearing Zooplankton and Fish Larvae

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Abstract
Haematococcus pluvialis, a unicellular freshwater microalga, is known to be one of the richest sources of natural astaxanthin. The present research was conducted in two consecutive broad phases: at first, *H. pluvialis*, cow dung, and Baker's yeast were used in rearing zooplankton and secondly, Indian major carp larvae were reared using both *H. pluvialis* and zooplankton as their feed. In the first experiment, mass culture of zooplankton was conducted under five treatments given five different feeds (T_1: live *H. pluvialis*; T_2: Baker's yeast; T_3: cow dung; T_4: both live *H. pluvialis* and Baker's yeast; and T_5: both live *H. pluvialis* and cow dung). In this experiment, the use of cow dung (T_3) resulted significantly higher population density of the *Cyclops* sp. and *Diaptomus* sp. The maximum population density of *Daphnia* sp. was found in T_5, where *H. pluvialis* and cow dung were used together as feed. On the other hand, the maximum population density of *Diaphanosoma* sp. was found in T_1, where *H. pluvialis* was used as feed. Among the five treatments, the mean population density of the four zooplankton species was quite less in T_2, where Baker's yeast was given as their feed. In the second experiment, the rearing of 4-day old Indian major carp larvae was conducted under six treatments using both *H. pluvialis* and zooplankton as their feed: T_1 (live *H. pluvialis*); T_2 (live zooplankton); T_3 (powdered *H. pluvialis*); T_4 (powdered zooplankton), T_5 (live *H. pluvialis* + live zooplankton); and T_6 (powdered *H. pluvialis* + powdered zooplankton). The major carp larvae fed with live zooplankton (T_2) outperformed all other treatments, with significantly higher ($p < 0.05$) larval growth (length and weight) and specific growth rate, as well as 90.00 ± 0.00% (*Catla catla*), 85.00 ± 0.00% (*Labeo rohita*), 81.67 ± 2.89% (*Cirrhinus mrigala*), and 73.33 ± 2.89% (*Labeo calbasu*) survival at the end of the experiment. The findings of the study explained the great potentiality of the utilization of *Haematococcus pluvialis* in the rearing of zooplankton and larvae of Indian major carps.

Mass Culture of a Freshwater Microalga *Nannochloropsis* sp. for Increasing Rotifer Production

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Abstract
The *Nannochloropsis* sp. is one of the nutritious microalgae which is used in mass scale rearing of zooplankton and fish larvae in many countries. *Nannochloropsis* sp. was collected and isolated from natural water and cultured in the laboratory. The cultured *Nannochloropsis* sp. was used in rearing rotifers. The growth performances of *Nannochloropsis* sp. were studied in four different concentrations (treatments) viz. 1, 10, 100 and 300 mg/l of nitrate-nitrogen and phosphate-phosphorus in modified Bold Basal Medium (BBM) in triplicates. The best growth was observed in 300 mg/l nitrate-nitrogen and in 100 mg/l phosphate-phosphorus. The algae *Nannochloropsis* sp. did not grow well in very high and low phosphate concentrations media. The water temperature, pH, dissolved oxygen and other physico-chemical factors were within suitable ranges of microalgae culture. During the culture of rotifer the maximum density was influenced significantly by the food type. The density of *Brachionus*

sp. was found to be significantly higher (255 individuals/ml) when fed only *Nannochloropsis* sp. than those fed with only yeast or yeast + *Nannochloropsis* sp. The maximum population density of the rotifer was also found to be influenced significantly by the algal concentration. In the present study, rotifers fed with high concentrations of *Nannochloropsis* sp. had higher 'r' value and maximum density than those fed with low concentrations of *Nannochloropsis* sp. It is concluded that *Nannochloropsis* sp. can grow well in media having wide range of nitrate concentration but sensitive to low and high phosphate concentrations. Our result also revealed that *Brachionus* sp. shows a better growth performance in high concentration of *Nannochloropsis* sp. than in low concentrations of this species.

Occurrence and Abundance of Harmful Microalgae and Their Relation to Environmental Factors in the Coastal Waters of the Bay of Bengal, Bangladesh

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Abstract
The dynamic environmental conditions of the Bay of Bengal (the largest bay in the world), Bangladesh foster several unique features that lead the bay as a conformable zone for harmful algae. The Bay of Bengal is exceedingly suffering from coastal pollution that influences frequently occurring harmful algal species of different groups. Accordingly, this study presented the occurrence and abundance of several harmful algae of different groups belong to dinoflagellates, diatoms and cyanobacteria during the period of winter, spring, summer and autumn. The study was conducted by collecting samples from twelve selected locations in the Bakkhali River Estuary, Maheshkhali Channel, Laboni Point and Deep Sea of the Bay of Bengal, Bangladesh. Many harmful genera of different groups were identified that are globally marked as severely harmful in varying degrees and frequencies, such as *Karenia, Ceratium*, *Dinophysis*, *Prorocentrum*, *Protoperidinium*, *Noctiluca*, *Spatulodinium*, *Alexandrium*, *Gonyaulax, Cochlodinium, Pyrophacus, Scrippsiella, Asterionella, Amphora*, *Pseudonitzschia*, *Chaetoceros*, *Skeletonema*, *Rhizosolenia*, *Coscinodiscus*, *Nitzschia, Eucampia, Trichodesmium, Microcystis* and *Oscillatoria*. Concededly, the prevalence of the occurrence and density of the recorded harmful algae in the present study area strongly suggested increased monitoring and research efforts in order to effective management of harmful algal blooms.

A Preliminary Study on the Occurrence and Accumulation of Agro-pesticides in a Typical Treshwater Floodplain Ecosystem of Bangladesh

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Abstract
Organochlorine pesticides have been banned in Bangladesh due to their high toxicity, persistence, and ability to bioaccumulate and biomagnify in the food chain. As a result, pest control in Bangladesh has

shifted towards application of organophosphate, neonicotinoids and other groups of pesticides. In this study, taking a deeper pert of a floodplain (Dalia *Beel*, Gouripur, Mymensingh) as the 'pesticide sink', contamination and bioaccumulation of agro-pesticides have been investigated in surface water, sediment, mussel and fish. This *beel* has been chosen for study because local farmers routinely use a variety of pesticides to protect their crops grown around the *beel* and it gets connected to the Old Brahmaputra River during monsoon. During this study, samples were collected both during dry season (December) and wet season (August). Extraction of pesticides from *beel* samples were done using QuEChERS technique and tested using gas chromatography mass spectrometry (GC-MS). Two pesticides, namely acetamiprid (neonicotinoids) and dimethoate (organophosphate), were detected from the *beel* samples. Acetamiprid concentrations in surface waters ranged from not detectable (n.d.) to 2.89 ppb, in sediments from n.d. to 37.30 ppb and in freshwater pearl mussel (*Margaritifera margaritifera*) from n.d to 0.81 ppb. On the other hand, dimethoate concentrations in surface waters ranged from n.d. to 1.32 ppb, and in sediments from n.d. to 17.9 ppb; in *M. margaritifera*, dimethoate was n.d. Residual concentrations of these pesticides in fish were n.d. The presence of neonicotinoid and organophosphate pesticides in the *beel* environment (water and sediment) and bioaccumulation in a resident species (mussel) are indicative of the fact that pesticides applied in the floodplain agricultural lands are being 'sunk' to the neighboring *beel* ecosystems which might pose potential threats of bioaccumulation to the organisms living there.

Study on Shelf Life of Squid (*Loligo Edulis*) and Quality Assessment of Squid Products under Various Storage Conditions

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Abstract

Due to the nutritional benefit of seafood, growing interests in healthy lifestyles result in increasing demands for innovation of seafood products leading to more accessible and less time-consuming confection products. To ensure proper utilization of un-utilized and under-utilized fisheries resources of the Bay of Bengal, the present study was carried out to determine the shelf life of squid (*Loligo edulis*) kept in the chill, and frozen storage, and quality aspects of squid products. This study revealed that the shelf life of raw squid in chill storage (±2°C) was 15 days whereas in frozen storage (-18 to -20°C), more than 6 months. The initial TVB-N content of the squid sample was 6.07 mg/100g which raised to 23.33 mg/100g at the end of 17 days of chill storage, and to 12.13 mg/100g at the end of 165 days of frozen storage. Fried squid rings (calamari) were developed by marinating squids with three different combination of spices (special fish spice, chicken spice, and a mixed content of turmeric and cumin powder). A panel test was conducted to find out the best combination of squid ring and it was disclosed that the marinated squid ring with fish spice was the most preferable. Finally, the marinated squid ring with fish spice were further prepared and stored at room (25 to 30°C), refrigeration (4 to 8 0°C), and frozen storage temperature (-18 to -20°C) in zipper polythene packets and vacuum sealed packets. It was found that the shelf life of the marinated squid rings at room temperature was only 24 hours (the initial TVB-N content, 6.53 mg/100g which rocketed to 16.24 on the 2nd day) whereas at refrigeration temperature, the shelf life of the ring in zipper polythene packet was 7 days (TVB-N value 16.05 on 7th day) and in vacuum sealed packet was 11 days (TVB-N value 14.98 on 11th day). On the other hand, at frozen storage, the marinated squid rings remained in good condition even after 47 days of storage in both zipper polythene packets (TVB-N value 14.57 on 47th day) and vacuum-sealed packets (TVB-N value 13.35 on 47th day). The obtained results indicated that, the shelf life of either raw squid or squid ring can be extended by storing them at low temperature.

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Changes in Bacterial Community Structure during Live Fish Transportation

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Abstract
Bacteria present in the water during live fish transportation cause deteriorative changes (post-harvest loss), even death of the fishes. The community structure of bacteria is the sum of different species, important to understand the activities of bacteria to a particular environment. This study was conducted to determine the changes in bacterial community structure in water used during live transportation of different fish using the high-throughput sequencing approach. The correlation between the bacterial community structure with different physico-chemical parameters such as temperature, dissolved oxygen, ammonia, pH etc. was also assessed. Three supply channels of two selected fishes, Pangasius catfish, Pangas (*Pangasianodon hypophthalmus*), and Climbing perch, Koi (*Anabas testudineus*) were considered. The supply channels were from Mymensingh to Dhaka, Faridpur, and Sylhet for Pangas; and from Mymensingh to Dhaka, Sylhet, and Rajshahi for Koi. Water samples were collected at 2 hours intervals during transportation and the water temperature, dissolved oxygen (DO), pH, and ammonia concentration were measured. For bacterial community structure, 200-500 ml of collected water was filtered using sterivex filter (0.22µm), DNA was extracted, polymerized targeting V4-V5 region of 16S rDNA, and sequenced using next generation sequencer, NGS (MiSeq, Illumina). The sequence data were analyzed using QIIME and other statistical tools. In case water quality parameters, ammonia and dissolved oxygen changed remarkably while temperature and pH remain almost stable in the transport water. Bacterial community structure changed with time, some groups become dominant gradually and some others outnumbered. In case of Pangasius catfish, Gammaproteobacteria, Flavobacteria and Firmicutes were the most dominant groups of bacteria. While in case of Climbing perch, Flavobacteria, Gammaproteobacteria, Betaproteobacteria and Firmicutes were the most dominant groups. Nonmetric multidimensional scaling showed that bacterial community structure of Pangasius catfish and Climbing perch were differently arranged indicating there were differences in the community structure of bacteria between studied fish species.

Identification and Characterization of Health Promoting Metabolites from Semi-fermented Fishery Products of Bangladesh

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Abstract
During fermentation of fish, cleavage of proteins and lipids by endogenic or microbial proteases and lipases yields secondary metabolites which are referred as bioactive compounds. The bioactive compounds ultimately improve the nutritional profile, and render typical flavour and taste. Semi-fermented fishery product, locally known as *shidal* or *chepa* is indigenous fermented product of Bangladesh which is prepared using several freshwater and marine fish species, namely, spot-fin swamp barb *Puntius sophore*, anchovy *Setipinna* spp., Indian pellona herring *Pellona ditchela*, croaker *Johnius* spp., smooth-back herring *Raconda russeliana*, Indo-Pacific king mackerel *Scomberomarus guttatus*, bronze featherback *Notopterus notopterus*, and Gangetic leaffish *Nandus nandus*. *Shidal* is a protein-rich fermented food evolved long ago but information regarding health benefits and nutritional

significance, such as protein and fatty acid profiles are insufficient. Fatty acid profiles of fermented fishery products indicate the degree of unsaturation, variations in fatty acid composition and factors affecting the variable pattern. Fatty acids composition of semi-fermented fishery products was analyzed by GC-MS using Shimadzu QP2010 quadruple Gas Chromatography Mass Spectrometer (GC-MS). Amongst saturated fatty acids, palmitic acid was found to be dominant in both freshwater and marine semi-fermented fish and contributed about 40-61% of the total fatty acids. In case of monoenoic fatty acids, oleic acid contributed about 19-34% followed by palmitoleic acid. The ω-3 fatty acids in semi-fermented products were in the range of 2-13% whereas the ω-6 fatty acids were in the range of 1.6-9%. Contribution of EPA and DHA were about 0.7-11%. The ratio of ω-3/ω-6 fatty acids was found in the range of 0.6-6%. The fatty acid profiles of semi-fermented fishery products showed that these types of products are richer in terms of PUFAs and the ω-3/ω-6 fatty acid ratio remained lowest in case of freshwater fishes whereas higher in marine fishes.

16s Metagenomics in Tracking Microbiome Associated with Spoilage and Foodborne Pathogens in Shrimp Processing Industry to Ensure Food Safety

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Abstract

Recently, the US Food and Drug Administration has adopted molecular-based bacteriological protocol to detect virulence genes in pathogenic bacteria, while UK, Denmark and France have introduced next generation sequencing (NGS) technology for surveillance of foodborne pathogens. Efforts were, therefore, made to utilize 16s rRNA amplicon sequencing that can directly detect un-culturable microorganisms in shrimp processing facilities of Bangladesh, and improve our understanding on microbiome source and related spoilage and foodborne pathogens in these plants. A total of 10 samples in triplicates (5 swab samples from shrimp receiving point, grading table, peeling table, deveining table, packaging table; 2 water samples from water used for washing, water from drain; 1 shrimp sample; 2 worker samples from male and female hand) were collected from 2 shrimp processing plants of Khulna Sadar, Khulna. The physico-chemical parameters of water were recorded, and eDNA was isolated from all samples using FavorPrep Soil DNA Isolation Mini Kit (Favorgen Biotech, Taiwan). Their quality was judged to be of sufficient for NGS analysis, and the TruSeq® DNA PCR-Free Sample Preparation Kit (Illumina) was used to prepare genomic library that was sequenced on an Illumina NovaSeq 6000 sequencer. Data analyses was then done using SILVA pipeline after necessary screening. This is the first report of bacterial community of shrimp processing plant using Illumina NovaSeq sequencing where a total of 285,652 high quality reads assigned to 31,135 OTUs were obtained from 4 samples of one shrimp processing plant. The majority of the sequence reads fall in range of 400–430 bp (99.86%) that was found to belonged to 43 phyla and 935 genera. The highest number of genera were found for swab sample collected from shrimp grading table. Values of richness indices including Chao1 was also highest for sample collected from shrimp grading table. In this sample, enteric bacteria (e.g. *Bacteriovorax*, *Buttiauxella*) as well as opportunistic pathogen (*Flavobacterium*) were dominant while soil and sand bacteria (e.g. *Crossiella*, *Aridibacter*) were dominant in the sample from shrimp receiving point. New sample data and further analysis is on-going to address the root cause of contamination in shrimp processing plants.

Determination of Effectiveness of Clove Oil as a Natural Anaesthetic on the Transportation of Clarias Gariepinus Fingerlings

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Abstract
This study investigated the effect of clove seed extract on *Clarias gariepinus* fingerlings' anesthesia in a semi-arid environment. The experiment used varying concentrations of clove oil extract at 25.0, 50.0, 75.0, 100.0, 125.0 and 150.0 mg per liter of water to determine the amount needed for effective anesthesia. Each concentration was tested in glass aquariums on a group of 15 *Clarias gariepinus* fingerlings (35.23 ± 0.30) g in weight and (5.98± 0.156) cm in length. Results showed that as the concentration of the extract increased, the time it took to anesthetize the fish decreased. The quickest anesthesia time (3.19±0.19) minutes was observed in fish treated with 150mg/L of the extract. When the fish recovered from anesthesia, those treated with lower dosages of the extract (25 to 125mg/L) regained consciousness more quickly (2.5–4 minutes) than those treated with higher dosages. Additionally, fish that were anesthetized with higher concentrations of the extract (150 and 125mg/L) experienced a higher mortality rate after 24 hours of recovery.

Smoked Hilsha (*Tenualosa ilisha*): Assessment of Nutritional Quality and Shelf-Life Study under Various Storage Conditions

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Abstract
Due to high lipid content, hilsha cannot be sun dried. For hilsha processing salting is a common practice. Hilsha products cannot be frozen for longer period because of denaturation of protein and oxidation of lipid. Therefore, attempts were taken to study the shelf life and different quality aspects of smoked hilsha (*Tenualosa ilisha*) stored at room (28 to 32°C) and refrigeration (5 to 8°C) temperatures. Moisture content (%) of smoked fish prepared from hilsha decreased throughout the storage period. At room temperature moisture content in sealed packets decreased from 56.4±0.02 to 47.84±0.43% and in case of vacuum sealed packets decreased to 46.97±0.67. At refrigeration temperature, moisture content in non-sealed packets fluctuated many times. At room temperature, peroxide value in sealed packets increased from 21.06±.002 mEq/Kg to 57.32±.07 mEq/Kg in 12 hours, whereas at refrigeration temperature peroxide value reached to 57.64±.098 in 27 days in sealed packets.Effect of salt concentration, spices and various woods (as smoke source) on smoked hilsha also observed. To study the effect of salt concentration, six different concentrations of salt 0%, 5%, 10%, 15%, 20%, 25% were used. Sensory tests showed that, 0 to 15% salt treated hilsha spoiled within 3 days of storage in sealed packets at room temperature (28 to 32°C), whereas 20 to 25% salt treated hilsha was acceptable for more than 3 days and in vacuum sealed pack for 10 days. At refrigeration temperature (4 to 8°C), 25% salt treated hilsha was acceptable until 25 days in sealed packets, whereas in vacuum sealed packets hilsha remained acceptable about 30 days. In the case of room temperature, percent moisture content increased and ash content decreased whereas hilsha stored at refrigeration temperature, showed reverse result. With the lapse of storage period pH showed a decreasing pattern. For spice treatments, four different combinations of spices were used including control (T_0 = control/no spices; T_1= 100/kg onion +25g/kg garlic + 25g/kg ginger + 25g mustard seed + 25g/kg chilly; T_2 = 100g/kg onion + 50g/kg garlic + 50/kg ginger. T_3= 50g/kg ginger + 50gmustard seed +

50g/kg chilly; T_4= 100g/kg ginger + 50g/kg chilly. At room temperature, no significant effect of spices could be observed on smoked hilsha in sealed packets. In the case of vacuum sealed packets, T_1 and T_2 showed longer shelf life in compare to other treatments. At refrigeration temperature, T_2 became unacceptable at 30th day whereas for other treatments product were beyond acceptable condition within 15-20th day. At both temperatures, moisture content increased but protein, lipid and ash content decreased significantly. T_1 was found to have the longest shelf life among all the spices treatments. In another experiment, a great effect of smoke source was found on the shelf life of the smoked hilsha. Use of Mango tree wood and rice husk showed the best result in compared to other sources of smokes (charcoal, coconut husk, neem tree wood along with rice husk).

Investigation on Traditional Fermented Fish Products Throughout Bangladesh and Improvement of Their Nutritional Quality and Shelf life

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Abstract
Fish fermentation has long been a popular technology for the preservation of small cheaper fish in different parts of Bangladesh, especially in the North, Northwestern and Southeastern regions. There are many unknown fermented fish products available in rural Bangladesh, which have been serving important nutrition to the rural people, but their quality and nutritional status are completely unknown. Being the low quality could be serious public health concern, the traditional products with the existing processing methods, storage and marketing need to be investigated. The present project aims to record all the traditional products produced throughout the country, along with their quality and nutritional status, in order to recommend for improved practice for commercial production to enhance indigenous production, nutritional security and export. Field data were collected through face-face interview using semi-structured questionnaire, and also by check-list survey under holistic approach on traditional formulation, storage and marketing, constraints facing, solution measures taken, etc. in greater Mymensingh, entire North Bengal, Brahmmanbaria, Sylhet-Moulvibazar-Shunamganj, Chattagram, Khagrachari-Alikodom and Cox's Bazar regions. Survey data were cross-checked by key informant interviews. A total of 21 traditional products were recorded, and were collected through appropriate method and then stored in variable conditions in the laboratory for quality and shelf-life analysis, *viz*., proximate composition, per-oxide value, thioberbeturic acid reactive substance value, standard plate count, volatile base nitrogen, etc. Analyses have been on-going. Partial investigation showed huge potentials for fermented fishery products throughout the country, since several new products were identified and their processing technologies have been known for the first time. Problems have been detected and several solutions options are suggested for production, quality improvement, storage and marketing. Vacuum packaging seems to be a better option for adequate storage of these traditional products for good shelf life.

Effects of Chemical Additives on Bacterial Concentrations of Water Used During Live Fish Transportation

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Abstract
In order to avoid stress on fishes, enhance water quality parameters, and avoid bacterial regrowth, some chemical additives are commonly used during live transportation Pangasius catfish

(*Pangasianodon hypophthalmus*), Climbing perch (*Anabas testudineus*) etc. However, the efficiencies of these chemical compounds as well as their appropriate doses are not well established. The present study was undertaken to determine the effects of some commonly used chemical additives, such as salt, market available saline, and methylene blue (MB), on the viable bacterial counts of the water used during live transportation of fish. Two different sets experiments were conducted in indoor laboratory and field conditions; a number of tanks containing fish and water were maintained and treated. Some tanks were kept as control without treatment. To assess the viable bacterial counts, water samples were collected at 2 hours interval from 0 hr to 8 hrs. Changes in some water quality parameters such as temperature, dissolved oxygen (DO), pH, and ammonia concentration, and blood glucose levels of the experiment fishes were also measured. In both types of experiments for both the studied fishes, the water temperature was almost stable and pH values were slightly decreased but the DO level gradually decreased and ammonia concentration increased. Viable bacterial counts and the blood glucose level of the fishes were also higher in the case of the control tanks, indicating the fishes in these tanks had experienced more stressful condition than the others. Considering all the assessed parameters, this study rebuilt that addition of chemical additives keep the water quality parameters better, reduce bacterial regrowth, and stabilize blood glucose levels of the fishes. However, the efficiency depends on the types of chemical additives and their doses. The combined use of salt/ saline and MB at a dose of 2 ppt salt or saline + 1.0 ml MB/l was found more effective in live fish transportation.

Checklist of Sea Shells Recorded Along the Coast of the Bay of Bengal

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Abstract

The coastal zone of Bangladesh is filled with rich and unique biodiversity. Seashells (e.g., Molluscs) is the second largest phylum of animals, next to the arthropods. The exploitation of the mollusk resources could have a direct benefit to the poor as well as the national economy. Identification of economically viable populations, i.e. standing crops of these mollusks around the coast of Bangladesh is an important first step. In the present study, seashell mollusk samples were collected from intertidal or subtidal habitats at locations across the southeastern coastal region of Bangladesh, namely the Kuakata coast. All specimens were cleaned and immediately fixed with 90-100% ethanol, and transferred to the laboratory for further processing. They were observed closely by the necked eye and sorted into major faunal groups. A laboratory study was conducted in the wet laboratory and Marine Fisheries Science laboratory of the Faculty of Fisheries BAU, Mymensingh, Bangladesh. From our study, it was found that about 38 hard-shelled mollusks were identified from the coast of Kuakata. Among them, bivalve is the most commonest, and then the gastropods. *Codakia tigerina* species are available on the coast and it covers about 40% of all hard-shell mollusks. Some other common bivalves are *Donax faba*, *D. cuneatus*, *C. punctate*, *Atactodea striata*, *Fulvia laevigata,* etc. are important. Among the gastropods *Cypraea annalus, C. tigris, Olivia caerulea, Mitra mitra* etc. are important. The seasonal dynamics of the abundance, size distribution and percentage of marketable size, the present level of exploitation, and use if there be any, are essential prerequisites for the establishment of a sustainable mollusk fishery for the export market.

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Application of Synbiotics as an Environment-friendly Approach to Growth and Immunity Development in Two Important Catfishes of Bangladesh

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Abstract
Synbiotic treatment in fish feed in aquaculture is very promising, with better growth performance and a more robust immune system. In the present study, treatment 3, (7%)3.09×10^8 CFU/ml of synbiotic inclusion in the feed produced the best growth performance, body index parameters, and hematological and biochemical parameters of stinging catfish *H. fossilis*. The study additionally revealed that a longer period of synbiotic supplementation could show better results in health and growth improvements. The present study also indicated a significant effect of the doses of synbiotics on the intestinal morphology of *H. fossilis.* Although the present study revealed some new findings, it is also fair to acknowledge that further research is still required to expand these findings in this research area. Although an extensive field study is needed to elucidate the efficacy of synbiotics, we could still recommend using this synbiotic in the culture of *H. fossilis* for better growth and health status.

Species Diversity of Hard-shelled Mollusks in the Kuakata Coast of Bangladesh

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Abstract
Molluscs are the second largest phylum of animals, next to the arthropods. Today, many mollusks of commercial interest are at risk of extinction. However, controls are often lacking and very often many mollusks are still harvested indiscriminately. Identification of economically viable populations, i.e. standing crops of these mollusks around the coast of Bangladesh is an important first step. In the present study, seashell mollusk samples were collected from intertidal or subtidal habitats at locations across the southeastern coastal region of Bangladesh. All specimens were cleaned and immediately fixed with 75-90% ethanol, and transferred to the laboratory for further processing. They were observed closely by the necked eye and sorted into major faunal groups. A laboratory study was conducted in the wet laboratory and Marine Fisheries Science laboratory of the Faculty of Fisheries BAU, Mymensingh, Bangladesh. From our study, it was found that about 45 hard-shelled mollusks were identified from the coast. Among them, bivalve is the most commonest, and then the gastropods. *Codakia tigerina* species are available on the coast and it covers about 45% of all hard-shell mollusks. Some other common bivalves are *Fulvia laevigata, Atactodea striata*, *Donax faba*, *D. cuneatus*, *C. punctate*, etc. are important. Among the gastropods *Cypraea annalus, C. tigris, Olivia caerulea, Mitra mitra* etc. are important. Hence, the purpose of this study aimed to provide a status on the indiscriminate wild mollusk capture in the coastal zone of Bangladesh and their impact on the fisheries resources, and biodiversity, as well as to support environmental risk assessments of wild capture in aquatic ecosystems in relation to the management of coastal fisheries resources.