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Book of Abstracts

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Date: 11–12 December 2021

11 December 2021 (Saturday)

Inaugural Session; Venue: Zoom Platform (https://bdren.zoom.us/j/2147921954)

10:00	:	Recitation from Holly Books
10:10	:	Welcome Address **Prof. Dr. Md. Abdul Baset Mia** Secretary, Bangladesh Society of Plant Science and Technology (BSPST)
10:20	:	Keynote Speech **Prof. Dr. Kamal Uddin Ahamed** Former Vice Chancellor, Sher-e-Bangla Agricultural University
10:40	:	Address by Special Guests **Prof. Dr. Md. Giashuddin Miah** Honorable Vice Chancellor, Bangabandhu Sheikh Mujibur Rahman Agricultural University **Prof. Dr. Md. Shahidur Rashid Bhuiyan** Honorable Vice Chancellor, Sher-e-Bangla Agricultural University **Prof. Dr. Lutful Hassan** Honorable Vice Chancellor, Bangladesh Agricultural University (BAU)
11:40	:	Address by Chief Guest **Prof. Dr. Shamsul Alam** Honorable State Minister, Ministry of Planning, GoB
12:10	:	Vote of thanks **Prof. Dr. Jalal Uddin Ahmed** Dept. of Crop Botany, Bangabandhu Sheikh Mujibur Rahman Agricultural University
12.20	:	Address by the Chair **Prof. Dr. Md. Solaiman Ali Fakir** Dept. of Crop Botany, BAU & Convenor, BSPST
14:00	:	**Technical Sessions- I, Venue: Zoom Platform (https://bdren.zoom.us/j/64513139956)**

12 December 2021 (Sunday)

09:00	:	**Technical Sessions- II** **Venue: Zoom Platform (https://bdren.zoom.us/j/69198070982)**
11:00	:	**Technical Sessions- III** **Venue: Zoom Platform (https://bdren.zoom.us/j/69198070982)**
14:00	:	**Annual General Meeting**

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Plenary -1

Smart Farming Solutions via Plant Tissue Culture and Indoor Farming Technology

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Abstract

Micropropagation or plant tissue culture plays an important role in the multiplication of orchids, figs, gac, banana, rose, medicinal plants, kiwano, dragon fruit, Cape gooseberry, and gingers has enormous roles in plants propagation with desired characters in large quantities. Tissue culture technology is a reliable and potent alternative in mass propagating plants *in vitro* at a consistent and faster rate from novel varieties. The thin cell layers technique is useful in plant tissue culture through transverse and longitudinal making mass clonal propagation easier, more reproducible improving regeneration and micropropagation of difficult to propagate species. Cryopreservation of *in vitro* plant culture is one of the ways in which valuable germplasm can be kept indefinitely at relatively low costs. It involves the storage of *in vitro* grown plant tissues at extremely low temperatures (-196°C) in liquid nitrogen. Almost any plant tissue could be cryopreserved with most techniques that advocate the use of actively growing meristematic tissues and embryos due to the increased capacity for totipotency. Secondary metabolites are formed as part of the plant's arsenal during injuries and invasion by pathogenic organisms. The obvious advantage of employing cell culture technology is the short culture period to obtain secondary metabolites under sterile and controlled conditions, which eliminates the risk of environmental influence on *in vivo* plant growth and leads to ease of extraction of compounds from *in vitro* cultured cells. One such attempt is the production of 9-methoxycanthin-6-one from the hairy root cultures of *Eurycoma longifolia* (Tongkat Ali), betalain from reddish purple dragon plants (*Hylocereus costaricensis*), petunidin and dendrobine from *Dendrobium* Sabin Blue orchid, anthocyanins from the Jewel orchids (*Anoectochilus* spp. and *Ludisia discolor*) and artemisinin from *Artemisia annua*. Light is one of the most important variables affecting the growth and development of plant tissue cultures. The illumination system of lights for the *in vitro* plant should supply light in the spectral region which is involved in photosynthesis and also in the photomorphogenic responses. Development of the Smart LED plant tissue culture technology system, which incorporates intelligence to achieve the function as well as cost efficiency, and utilizing different LED, operated spectra of uniform intensity determined for enhancing the production efficiency of superior quality of selected plantlets. Research and development of commercially-viable urban container farms for the cultivation of vertically-farmed high premium lettuces, microgreens, and strawberry plants were developed. Optimization of the growth, marketable yield, and characteristics of selected plants grown in an automatically-controlled vertical farming system was established based on soilless crop cultivation, environmental control, and automated nutrient dosing developed in combination with the synergistic integration of IoT, AI, and computer vision technologies.

Keywords: Micropropagation, *in vitro* plant culture, smart agriculture, vertical farming, thin cell layers (TCLs) technique

Plenary -2

An overview of the Sri Lanka antidiabetic medicinal plant, *Salacia reticulata* Wight

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Abstract

Salacia reticulata (*Kothala himbutu*) belongs to the family Celastraceae, which is indigenous to dry zone forests of Sri Lanka and reported in the southern region of India as well. S. reticulata contains salacinol and kotalanol, neosalacinol and neokotalanol. It is a woody climber and widely used in Ayurvedic medicine for diabetes and obesity treatment. According to National Red List (2012), the genus Salacia which belongs to the family Celastraceae is represented by five species in Sri Lanka. These species were recognized by the local people throughout the centuries utilizing nutrition, health, medicinal, and economic values. But no systematic cultivation has been reported on this valuable species in Sri Lanka, mainly because planting materials are not available and no proper agro-technology package developed until recently. Therefore, Salacia species in the wild are illegally harvested by unskilled persons in an unsustainable manner for illegal sales. This suggests that there is an urgent need to develop practical and economically sound strategies for the efficient utilization of Salacia species. Arunakumara and Subasinghe (2010) reported that traditional practitioners are eager to find out the most effective parts of the plant for different health care purposes and continue to use them even without the proof provided by standard clinical trials. According to them, at least two Sri Lankan Salacia species (*S. reticulata* and *S. prinoides*) have been patented by other countries due to pharmaceutical potential in producing antidiabetic drugs (Pushpakumara et al., 2002). According to Morikawa et al. (2015) Salacia species play a vital role in diabetic control worldwide for thousands of years, and it has now become a subject of broad studies for diabetes control and management. Even at present, studies continue on the Salacia species to investigate their potential capabilities in controlling diabetes and management. Katalanol is the most active component in the aqueous extracts of Salacia reticulata, which is traditionally used in Sri Lanka, India and Thailand to treat diabetes (Yoshikawa et al., 1997, Yoshikawa et al., 2002). Dried roots and stems in powders are used in medicinal preparations such as decoction or tea prepared by boiling the powders in water. The roots and stems of S. reticulata and the roots of S. oblonga are specific remedies for the initial stages of diabetes in traditional Ayurvedic medicine (Ratnasooriya et al., 2003; Flammang et al., 2006; Arunakumara and Subasinghe 2010; Basu et al., 2013). According to Keeragalaarachchi et al. (2016), S. reticulata has high demand in the national and international markets. Therefore, people uproot them from the wild on a large scale. The decline of Salacia species can be attributed to the effects of habitat destruction and modification for farming, forestry, and herbal trade collectors and natural changes to the forests. The Salacia species industry has a huge potential in developing into a major agri-business in Sri Lanka where an ever-increasing demand exists due to the expanding tourism, medicinal and herbal drug industry. However, the Salacia species industry is being constrained, particularly by its high demand and low supply. Therefore, the conservation of this valuable plant is very important before reaching endangered in Sri Lanka.

Keywords: Antidiabetic, conservation, medicinal value, *Salacia reticulata*

Plenary -3

Investigations of Selected Underutilized Plants as Supplemental Sources of Food and Nutrition Security in Tropics and Subtropics

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Abstract

Bangladesh has gained self-sufficiency in cereals and yet to achieve nutrition security. Considering the high cost of production and declining soil fertility in paddy culture, we need to explore the cheaper source of starch yielding minor crops like cassava, quinoa and buckwheat compared to major cereals like rice, wheat and corn that are rich in carbohydrates and constituting staple food in many Asian and African countries. The diet of the rural population of South Asian countries is usually deficient in quality protein which can also be supplemented with minor plant produce like beans and leaf of cassava, moringa, sweet potato that are enriched with balanced proteins, minerals and other phytochemicals of health benefit. The situation of increasing population and rapid urbanization resulting in decreased cultivable lands in subtropical countries including Bangladesh demands supplementary and cheaper sources of carbohydrates and proteins. In this perspective, some minor crops could be potential sources since they can be easily grown in the homestead and other unutilized lands which are not competitive with lands occupied by cereals and high value crops. Many of the neglected and underutilized species (e.g. cassava, pigeon pea and roselle) are tolerant to abiotic stress hence produce appreciable yield with little inputs and care. In addition to food and nutritional security in the regions, such crops appear to be climate resilient. Our research has examined yield potential and processing techniques of developed products in selected carbohydrate, protein yielding minor crops of tropical and subtropical countries.

Keywords: Minor crops, supplemental carbohydrate & protein, nutrition security

Plenary -4

Understanding the Angiosperm Phylogeny Group (APG) Classification System

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Abstract

Plant classification is a never ending process. It has a long history of development started from Theophrastus (300 BCE) to the present time. The development has been classified from artificial to natural, phylogenetic, phenetic and cladistic systems. The most formative classification was first given by C. Linnaeus (1753) and then by G. Bentham and J.D. Hooker (1862-1883). Then, after the acceptance of C. Darwin's theory of evolution (1859), the modern era of classification has started with the evolutionary idea. The important steps gradually laid down in this line of classification were by A. Engler and K. Prantle (1887-1915), C. E. Bessey (1915), J. Hutchinson (1959), A. Cronquist (1988), A. Takhtajan (1997) R.M.T. Dhalgren (1989) and R. F. Thorne (1999). The main efforts given in these classifications were to embrace all the taxa as much as phylogenetic after considering as many characters analyzed from different corners of experimental sciences like- cytology, ecology, physiology, embryology, palynology and also chemistry along with the morphology. By this time some advancement of applying computing data in light of the statistical analysis of different character aspects emerged into the phenetic system (Numerical Taxonomy) for arranging of plants. By the end of 1980s, the advancement of molecular biology (gene sequencing) added new ideas and means of analysis which has ultimately emerged into Molecular Taxonomy. Phenetic analysis when united with the molecular taxonomy Cladistic System of classification has emerged finally. In this line of development, by the end of the 20th century, a new classification system named "The Angiosperm Phylogeny Group or APG system" has published (1998) by a large number of scientists from different corners of sciences. This classification is then revised several times in the name APG II, APG III and APG IV (published in 2003, 2009, and 2016). In this system, the traditional suprafamilial ordinal taxa position and concept have been greatly changed along with the most enigmatic and most debated phylogenetic taxa. The resulting APG IV (last version) system allows greater predictability than all the previous classifications because the taxa or groups that are arranged reflect closer to evolutionary relationships of the Angiosperms.

Keywords: Plant taxonomy, molecular taxonomy, evolution, Angiosperm Phylogeny Group/ APG system

Plenary -5

Horticultural crops of the North East India- its role in food and nutritional security

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Abstract

The North-East India is a biodiversity hotspot in the world having the richest reservoir of plant diversity in India supporting about 50% of India's biodiversity. North Eastern region occupies 7.7% of the total geographical area of the country and harbors 50% of Indian flora (8,000 species) of which about 4% is endemic (2,526 species). The distinct tribes in the region have a rich indigenous knowledge system on the use of components of biodiversity for their daily sustenance like food, fodder, shelter and healthcare. The region has several unique features such as fertile land, abundant water resources, evergreen dense forests of about 66%, high rainfall, and an agriculture-friendly climate. Its unique phytogeographical positions, topography and a high degree of precipitation are some of the important factors which are mainly responsible for its enormous biological diversity. As a result, an array of unexplored plants is grown across the region ranging from tropical to alpine. The large diversity in fruits belonging to the genera *Artocarpus*, *Annona*, *Averrhoa*, *Garcinia*, *Musa*, *Passiflora*, *Phyllanthus*, etc. are reported from the region besides diverse vegetables, and spices with some unique quality because of their locational advantage. The region has a great ethno-cultural diversity with major and sub-tribes, which explains the wealth of traditional ecological knowledge among farmers. People of the region have their own culture, tradition and medicinal system of treatment and knowledge acquired through close observation of nature. Its ethnic people living in the remote forest areas still depend to a greater extent on the forest ecosystems for their livelihood and avoid malnutrition. They collect different wild fruit plants along with other medicinal plants and use them in traditional ways to cure their health related problems. The minor and wild fruits are mostly used to cure various gastrointestinal disorders, respiratory problems, cardiovascular compliance, muscular illness, bone diseases, gynecological problem, cancers, snake bite, allergy and malaria etc. by local people of the region besides their use as fruit. These lesser known horticultural crops are rich in minerals like Ca, Fe, P, Mn, organic acid, vitamins and other nutrients like carbohydrates, proteins, and fats. Tribal people used to take lesser known fruits either raw or in the form of beverages, pickles or cooked/boiled with some other diets. This indigenous system of treatment based on such fruits is still an important part of the social life and culture of the tribal people. Malnutrition affects badly in countries like India. The hidden potential of these novel fruits needs to be explored to strengthen nutritional security. Even though works on underutilized fruits are done, a large number of species being endemic remained underexplored. Hence cultivation, promotion and conservation of these underexploited are very important. This paper provides information on some horticultural plants and their role in overcoming malnutrition by the tribes of the region.

Keywords: Malnutrition, Unutilized crops, Traditional medicine, Indigenous knowledge

Abstract-6

Plants: Eco-friendly and cost effective tools for green synthesis of metal nanoparticles

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Abstract

Primary metabolites are the phytochemicals resulting from the primary metabolism of a plant. Generally, they are involved in basic life functions. Therefore, they are more or less similar in all living organisms. On the other hand, products/byproducts of primary metabolic pathways enter into secondary pathways and generate secondary metabolites (SMs). Indeed, SMs are products of subsidiary pathways such as the shikimic acid pathway. Interestingly, SMs not only protect the plants from various biotic and abiotic stresses but also protect animals including human beings from various diseases dating back to the age of Hippocrates (Father of medicine) who claimed '*Let food be thy medicine and medicine be thy food*'. In modern medicine, SMs provided lead compounds for the production of pharmacological drugs/products/medicines for treating various diseases from migraine up to cancer. Recently, enhanced production of a large number of commercially important SMs has been reported in various plant species grown under different culture conditions by using different types of nanomaterials. In fact, nanomaterials emerge as efficient elicitors of plant SMs production both in terms of their specificity and productivity. Both primary and secondary plant metabolites actively participate during the bioreduction of metal ions, but the proficiency of SMs as capping/stabilizing agents is unparallel. Nanomaterials were characterized by visual observation, UV-Vis spectrophotometer, FTIR, XRD and SEM. A comprehensive and critical account of plant SMs, their classification, their distribution in different plant families, their application for synthesizing metal nanoparticles were explored and/or examined. Finally, we critically discussed the uses of phytofabricated nanomaterials for plant adaptation to an adverse environment and scaling up commercially-valued products (pharmacy, cosmetic, agriculture, food/feed) development strategies in the current nano era.

Keywords: Abiotic stress management, Plant Metabolites, Nano-particles, Plant Medicine

Abstract-7

Photocatalytic degradation of safranine O dye by using copper nanoparticles (CuNPs)

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Abstract

Water pollution owing to disposal of hazardous dyes from textile industries in water bodies like lakes, rivers and groundwater is a major concern of our aquatic ecosystem. The dyes released in wastewater are difficult to remove by traditional water treatment procedures. Thus, there is a need to develop more suitable methods of effluent treatment. Photocatalytic activity of metal nanoparticles (MNPs) could be used in treating and degrading dyes efficiently without limitations. Indeed, physical and chemical methods of MNPs synthesis have got some drawbacks like less efficiency, expensive, toxic, longer time period, size of the nanoparticles. In contrast, nanoparticles which are synthesized by plant extracts are non-toxic, cost effective and eco-friendly. Previously, we successfully synthesized silver nanoparticles (AgNPs) and copper nanoparticles (CuNPs) in our laboratory by using plant extracts. We evaluated the efficiency and mechanisms of phytofabricated CuNPs in photodegradation of hazardous dyes like Safranine O. The results revealed that CuNPs are an excellent catalyst for the reduction of hazardous dyes, which is confirmed by UV–Vis spectroscopy.

Keywords: phytofabricated CuNPs, photodegradation, hazardous dye, Water pollution

Abstract-8

Altered micromorphology in mung bean (*Vigna radiata* (L.) Wilczek) under salt stress

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Abstract

Salinity is one of the serious abiotic stresses which hinders the crop yield drastically. The deleterious effects occurred in tissue and cellular levels by altering tissue size and system. An experiment was conducted to observe the effect of salinity on the micromorphological attributes of mung bean genotypes. The experiment was conducted under hydroponic conditions using a modified Hoagland nutrient solution. The design of the experiment was a randomized complete block design with two factors i.e. factor I- genotype and factor II five levels of salinity viz. 0, 6, 8, 10 and 12 dSm-1. The results reflected that germination and emergence of plumule and radicle were influenced by the increase of salt stress, and radicle anatomical features were influenced by the imposition of salt stress. Similarly, the micromorphological features of salt induced mung bean root, stem and leaves were influenced by the application of salt after 30 days of salt application. The cortex, stele radius and vascular bundle strands were reduced due to salt application. The vascular bundle strand size especially the length was decreased with the increased levels of salinity. Similarly, the cortical radius was also decreased with the increased levels of salinity however the stele area i.e. the radius was curvilinear in trend. The micromorphological features of leaves were also affected by various degrees of salinity where spongy parenchymatous tissues are more vulnerable than the palisade parenchyma tissue. The palisade parenchyma tissue became more compact due to the imposition of salinity.

Keywords: Abiotic stress, Mung bean anatomy, Salt stress, Germination

Abstract-9

Tobacco industry wastewater influenced germination and early seedling traits of mung bean [*Vigna radiata* (L.) Wilczek]

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Abstract

Scarcity of freshwater is becoming an increasing problem due to the increasing demand for water for domestic, municipal, agriculture and industrial sectors, especially in the developing countries of the world. With the increasing scarcity of freshwater resources that are available to agriculture, the use of industrial wastewater for irrigation is increasing, especially in arid and semi-arid regions. The tobacco industry is one of the biggest industries in the world that generates and disposes large quantities of wastewater containing many toxic chemical compounds, which may be toxic to the flora, fauna, public health as well as environment. An experiment was conducted during February 2021 at Crop Physiology and Ecology Laboratory, Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh to study the influences of tobacco industry wastewater on germination and early seedling traits of mung beans. Five mung bean accessions (BD-10022, BD-10023, BD-10024, BD-10026 and BD-10027) and two growing media (normal tap water and tobacco industry wastewater) were assigned in a completely randomized design with three replications in germination test. Mung bean accession, growing media and their interaction significantly influenced germination characteristics and seedling traits of mung bean. Tobacco industry wastewater lowered the germination percentage, rate of germination and co-efficient of germination but produced longer shoot and root and increased the seedling dry weight as compared to tap water. Among the five mung bean accessions, BD-10024 and BD-10027 performed comparatively better performance regarding germination and seedling traits, respectively under wastewater conditions. The findings support the hypothesis that the tobacco industry wastewater hinders the germination traits though leads to beneficial changes in early seedling traits to some extent. Therefore, tobacco industry wastewater needs a thorough assessment for its suitability as irrigation water.

Keywords: Mung bean, environmental pollutants, tobacco industry wastewater, germination, seedling growth

Abstract-10

Present status and future prospects of tea production and research: varietal improvement and tea diversification in Bangladesh

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Abstract

Tea is one of the most important non-alcoholic beverages in the world and has been gaining further popularity as an important 'health drink' because of its inferable medicinal value. In Bangladesh, commercial tea was cultivated since 1854 by establishing the first tea garden Malnicherra Tea Estate in Sylhet. From 1947 to 2020, tea growing area, production and per hectare yield were increased 116.35%, 370.53% and 137.96%, respectively. The major reasons behind this increasing tea productivity are the extension of tea growing areas as well as the cultivation of Bangladesh Tea series tea clones (BT clones) which were released by the Bangladesh Tea Research Institute (BTRI). Till now BTRI released 23 clones and 5 biclones, having an average per hectare yield of 3461.67 kg. In the world, tea production, consumption and exportation have increased significantly. Unlike world conditions, there is a negative relation between tea production and export in Bangladesh. From 1972-1973 to 2020-2021, the quantity of tea exports was decreased by 11.61%. This situation emphasizes the need for exploring alternative means by the tea industries of increasing profits from tea cultivation, tea export and tea diversification. Along with black tea, BTRI has given more emphasis on research on tea diversification: health benefitted green tea, flavored white and orthodox tea, different types of artisan tea, value added tea, tea products, etc. As our per-capita income is increasing rapidly along with living standards, the consumer will demand quality and value added tea. At present, our country's tea own consumption is more than our production and hence, the tea exporting country has been converted as a tea importing country. As a result, research on tea varietal improvement and tea diversification is needed for rapid economic growth and development of the tea industry as well as to encourage tea plantation business to go ahead with more products to meet our demand along with quality tea to flourish tea business in Bangladesh.

Keywords: Tea production, yield, export, tea diversification.

Abstract-11

Application of CRISPR/Cas9-mediated genome editing technique for the trait development in rice

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Abstract

The biggest danger to agricultural productivity is climate change, which is the cause of both biotic and abiotic stresses. The development of climate resilient crop varieties using modern techniques is vital to address these unfavorable situations. Traditional breeding techniques have considerably enhanced crop development and production, but contemporary approaches such as CRISPR/Cas9 (Clustered Regularly Interspaced Short Palindromic Repeats) are required for further agricultural development to ensure food security for the world's rising population. The CRISPR/Cas9 is an effective tool for creating targeted mutations in a wide range of cells and species. The CRISPR/Cas9 system is a simple and effective technique of transforming a native background into one with novel characteristics, accelerating the production of excellent breeding lines for new crop varieties. CRISPR/Cas9 is also being utilized to speed up the breeding and has been used extensively in crops for functional genomics investigations, fighting biotic and abiotic stresses, and improving other essential agronomic features. The CRISPR/Cas9 system has been successfully used to develop glutinous, high-amylose, fragrant, sweet endosperm, blast resistant, insect resistant, herbicide resistant, salinity tolerant, cold tolerant, TGMS rice, and nitrogen use efficient rice germplasm by targeted mutagenesis of the *Waxy*, *SBEIIb*, *Badh2*, *ISA1*, *OsERF922*, *CYP71A1*, *ALS*, *OsRR22*, *TIFY1b*, *TMS5* and *NRT1.1B* genes, respectively. The capacity of the CRISPR/Cas9 technology to genetically modify an organism without leaving any foreign DNA is its main advantage, resulting in no difference between crops developed by genome editing and those developed through conventional breeding. The current study used CRISPR/Cas9-mediated targeted mutagenesis of the *OsERF922*, *CYP71A1*, *OsRR22*, and *TMS5* genes to develop traits for biotic and abiotic stress tolerance (blast, BPH, and Salinity) and TGMS line for a two-line hybrid system.

Keywords: Genome editing, CRISPR/Cas9, climate change, biotic and abiotic stress

Abstract-12

Selection of drought tolerant genotype of soybean (*Glycine max* L.) through morpho-physiological and biochemical analyses

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Abstract

The soybean crop is exposed to adverse environmental conditions; among them, drought stress is responsible for great losses of crop yield. The crop productivity improvement may have a limit due to stress factors, as noted by its stabilization in the past years in 80% of their theoretical yield potential. These stress factors may be biotic or abiotic, affecting plants' growth and development. Among the abiotic factors, the drought is considered the most devastating, affecting all growth and development stages causing huge losses in soybean yield. This study was carried out to investigate the effect of drought stress on proline content, chlorophyll content, and yield characteristics in seventeen genotypes of soybean (G1= G00022, G2= G00150, G3= G00137, G4= G00145 G5= G00123, G6= ST2, G7= BARI soybean 5, G8= BARI soybean 6, G9= BD2331, G10= G00156, G11= G00018, G12= BD2334, G13= BD2338, G14= BD20, G15= BD2339, G16= G00341, and G17= G00101,). This study was conducted in the research field of Patuakhali Science and Technology University, Dumki, Patuakhali. The experiment was conducted during the period from October 2019 to March 2020. A pot (30 L plastic pot) experiment with four treatments was carried out in a randomized complete block design with three replications. Treatments included: factor A: To= control, T1=600 ml water, T2=300 ml water and T3=150 ml water applied every alternate day, and factor B: 17 genotypes of soybean. All physiological parameters were affected by drought stress. Drought stress imposed during vegetative growth or anthesis significantly decreased chlorophyll content. Among the 17 soybean genotypes, G15 (BD2339) genotype showed the highest plant height, (55.15 cm), chlorophyll content (41.35), number of pod plant^{-1} (34.52), number of seed pod^{-1} (2.24) and 100 seed weight (10.55 gm), but G7(BARI soybean 5) genotype showed the highest 257.78 µmol per gram proline accumulation among them. The lowest plant height (25.75 cm), chlorophyll content (31.36 at 30 days old plant and 25.23 at 40 days old plant), proline content (153.20 µmol per gram), number of pod plant^{-1} (20.34), number of seed pod^{-1} (1.56), 100 seed weight (5.14 gm) and yield pot^{-1} (5.54 gm) were found from G13, G13, G3, G17, G3, G17, G9 and G9 soybean genotypes, respectively. Under drought conditions, the drought tolerant genotypes 'G15 (BD2339)' gave the highest yield, while G5 contained the highest amount of proline but it yields very low. Drought stress at the anthesis phase reduced seed yield more severely than that on the vegetative stage. In the future, since drought events tend to become more severe and frequent in Bangladesh and worldwide, the obtainment of drought resistant cultivars are necessary.

Keywords: Abiotic stress, drought, soybean morpho-physiology

Abstract-13

Spectral reflectance indices and agronomic traits unveil drought tolerance potential of bread wheat genotypes

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Abstract

Drought stress is a severe environmental constraint to wheat growth and yield in the world, including Bangladesh, and is becoming more critical with global climate change scenarios. So, the selection of drought adaptive traits and drought-tolerant genotypes are the integral components of wheat breeding programs. This study aimed to explore the phenotypic associations between spectral reflectance indices (SRIs) and agronomic traits in wheat genotypes adapted to Bangladesh under irrigated and drought conditions. Fifty-six wheat genotypes were assessed for SRIs, stay green (SG), canopy temperature depression (CTD), biological yield (BY), grain yield (GY), and yield contributing traits under irrigated control and drought conditions in 2017–'18 and 2018–'19 wheat growing seasons. Different SRIs linked to staying green, pigment content, hydration status, and aboveground biomass exhibited a steady response to drought and a strong association with GY. Phenotypic associations of GY with SG, CTD, and yield components were higher under drought compared to the control condition. The hierarchical cluster analysis revealed three major clusters, of which cluster 1 (13 genotypes) showed a relatively higher degree of tolerance to drought followed by cluster 2 (32 genotypes) and 3 (11 genotypes). Linear discriminant analysis (LDA) confirmed that genotypes were assigned to different clusters with full correctness and the clusters differed significantly from each other. Principal component analysis (PCA) exhibited that the first and second components accounted for 48 and 8.3% of the total variation among traits. The findings of the study underlined the possible use of proximal canopy reflectance sensing in the screening of drought tolerant wheat genotypes for yield stability in Bangladesh environments.

Keywords: Spectral reflectance indices, wheat, drought tolerance, multivariate analyses.

Abstract-14

Role of halopriming in improving morpho-physiology and yield performance of salt affected rice plant

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Abstract

Different seed priming agent has been demonstrated to improve plant performance under stress condition. Halopriming of seed with different salt is a simple and cheap agro technique that has been found to improve germination, seedling establishment, growth and development of different crops under various stress conditions. Halopriming can be an effective way to improve the performance of rice plants suffering from the adverse effects of salinity grown in the saline region. Present study investigated the role of halopriming (with 0.25 dSm-1 NaCl, HP1 and 0.50 dSm-1 NaCl, HP2) to regulate the growth, development and yield performance of rice plants under salt stress (8 dS m-1 NaCl, S1 and 12 dS m-1 NaCl, S2). Seeds of Oryza sativa L. cv. BRRI dhan67 were soaked in various concentrations of NaCl (0.25 dSm-1 and 0.50 dSm-1) for 12 h followed by drying to the original moisture level as that of the pre-priming stage. Plants were grown following recommended method. Salinity treatments were given 15 days after transplanting. Data on different growth parameters, physiological parameters and yield contributing characters of rice plants were tested. Salt stress decreased plant height (cm), number of tillers plant^{-1}, leaf area, SPAD meter reading (chlorophyll measurement of leaf), days to flowering, number of effective tillers plant^{-1}, panicle length, number of fertile grains plant^{-1}, number of unfertile grains plant^{-1}, 1000 seed weight, total weight of grains, dry weight of stem, leaf, root, leaf membrane stability index (LMSI), relative water content (RWC) and K content in shoot and root whereas increased Na content in root and shoot. Between two salinity levels, the damaging effect was higher in higher salinity level (S2, 12 dSm^{-1}). On the other hand, the damaging effects of salt stress were alleviated to some extent by halopriming. The rice plants performed better in response to halopriming under salt stress conditions. Between the different levels, halopriming with 0.50 dSm^{-1} NaCl (HP2) showed better results in terms of growth, physiology, yield attributes and yield. The findings of the present study disclosed that halopriming of rice seed improved the physiological performance which contributed to improved growth, development and yield performance of salt affected rice plants. Halopriming with NaCl is suggested to improve the plant adaptation to salinity that may be acted to defend the injurious effects caused by high doses of salinity in the present study but the defense mechanism behind this should be studied further.

Keywords: Seed treatment, halopriming, salinity, abiotic stress

Abstract-15

Role of mannitol to improve morphophysiology and yield of wheat plant under salinity

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Abstract

Mannitol, an osmolyte, is normally synthesized in different plants and performs different physiological functions such as osmoregulation, scavenging of reactive oxygen species, etc. A little is known about the function of mannitol under abiotic stress conditions. To investigate the role of mannitol under salt stress, an experiment was conducted in the shed house of the Department of Agricultural Botany, Sher-e-Bangla Agricultural University, Dhaka-1207 during the period of November-March, 2018-2019. Wheat (*Triticum aestivum* L. cv. BARI Gom-25) plants were subjected to different treatments viz. T1 = Control, T2 = 15 mM Mannitol (M1), T3= 30 mM Mannitol (M2), T4 = 4 dS m^{-1} NaCl (S1), T5 = 4 dS m^{-1} NaCl + 15 mM Mannitol (S1+M1), T6 = 4 dS m^{-1} NaCl + 30 mM Mannitol (S1+M2), T7 = 8 dS m^{-1} NaCl (S2), T8 = 8 dS m^{-1} NaCl + 15 mM Mannitol (S2+M1) and T9 = 8 dS m^{-1} NaCl + 30 mM Mannitol (S2+M2). The experiment was laid out in a Complete Randomized Design (CRD) design with three replications. Data on different growth, physiological and yield contributing parameters were recorded. Both levels of salinity exerted damaging effects but wheat plants exposed to a higher level of salinity (8 dS m^{-1} NaCl) resulted in the lowest value of the studied parameters such as plant height (cm), tillers number $plant^{-1}$, leaf chlorophyll content (SPAD value), filled grains $spike^{-1}$, unfilled grains $spike^{-1}$, 1000- seed weight (g), dry weight of plant at harvest (g) and grain yield $plant^{-1}$ (g). Mannitol applied wheat plants showed significant improvement of the studied parameters under salt stress. Between two doses of mannitol, 30 mM mannitol applied plants performed better, compared to 15 mM mannitol applied plants in mitigating the damaging effect of salinity on different growth, physiological, yield contributing parameters and yield. The results of the present study showed that mannitol added salt affected plants performed better in terms of growth, physiology and yield, compared to salt treated plants without mannitol. Different other biochemical and physiological attributes should be examined to reveal the actual mechanism of mannitol-induced mitigation of salt stress damage in the wheat plant.

Keywords: Osmoregulation, reactive oxygen species scavenger, salinity, abiotic stress.

Abstract-16

Ameliorative role of sulfur in mitigating salt-induced damages in rice

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Abstract

Salinity is one of the major environmental stresses that limit the growth and yield of a wide variety of cultivated crops including rice. Exogenous use of protectants can be effective in conferring salt tolerance to rice plants. Among the macronutrients, sulfur (S) not only plays an essential role in plant growth and development but also in reversing the adverse effects of abiotic stress. Considering this, an experiment was conducted at the experimental shed and Plant Physiology Laboratory of the Department of Agricultural Botany, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh to assess the effects of different salinity levels on the morphological, physiological and yield performance and the role of S in improving the above mentioned traits of rice plant under salt stress. *Oryza sativa* L. cv. BRRI dhan67 was used as a test crop plant under various levels of salinity (0, 8, 12 dS m^{-1}) and S (0, 3, 6 Kg S ha^{-1}) with a completely randomized design and three replications. Treatments were given at 15 days after transplanting and maintained throughout the growing period. Salt stress increased root and shoot Na content, decreased K content, relative water content (%RWC), chlorophyll content and membrane stability index (MSI%). Different growth parameters like leaf area, plant height, dry weights, no. of tillers also decreased under salt stress. Yield attributes (panicle length, spikelet fertility, no. of effective tiller, no. of filled spikelets $panicle^{-1}$, 1000 grain wt.) and yield (grain and straw yield) decreased due to exposure to salt stress. In contrary, exogenous S application with salt stress decreased the Na accumulation in root and shoot, increased root and shoot K, improved all the studied physiological and growth parameters, compared to salt stress alone. As a result, S treated rice plants showed improved yield attributes and higher yield under salt stress. The results revealed that exogenous S reduces the Na toxicity and increases K accumulation, maintaining ionic homeostasis, improving physiology, growth and yield attributes and yield conferred salt tolerance of rice plants.

Keywords: Sulfur, nutrient, salinity, ionic homeostasis, abiotic stress

Abstract-17

Screening of sorghum (*Sorghum bicolor* L.) genotypes for salinity tolerance based on morpho-physiological traits using multivariate analysis

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Abstract

Soil salinity is an increasing problem in the world and the main obstacle to agricultural productivity, especially in areas where irrigation is necessary. Adoption of salt tolerant genotype is more important therefore; screening of salt tolerant cultivars is essential. A hydroponic experiment was conducted to study the morphological and physiological responses of selected sorghum genotypes to salinity stress at the early vegetative stage to screen salt tolerant genotypes. Seventeen sorghum genotypes *viz.* BD 687, BD 688, BD 689, BD 690, BD 691, BD 692, BD 693, BD 694, BD 695, BD 696, BD 697, BD 698, BD 741, BD 4685, BD 4686 were grown in hydroponics with a full nutrient solution at 12 dSm^{-1} and control condition for fourteen days. Different morphological and physiological parameters *viz.* root length, shoot length, shoot fresh weight, root fresh weight, shoot dry weight, root dry weight, total dry matter, root shoot ratio, relative chlorophyll content and maximum photochemical efficiency of PSII (Fv/Fm) were recorded. The genotypes were evaluated salinity tolerance based on different multivariate analyses of traits studied. Most of the parameters mentioned above showed significant variation due to salinity stress and among the genotypes. Correlation analysis revealed that most of the studied traits were significantly correlated among them. The robust hierarchical co-cluster analysis indicated that all the genotypes were clustered into four, with cluster 2 (BD 693) being, in general, highly salinity tolerant whereas, cluster 4 (BD 688, BD 741, BD 696, BD 686, BD 699, BD 689, BD 691, BD 692, and BD 4686) being moderately salinity tolerant, cluster 1 (BD 690, BD 687, BD 648, BD 694, BD 695, and BD 697) being salinity susceptible, and cluster 3 (BD 4685) being the highly susceptible genotype. The results concluded that the salinity tolerant genotypes obtained in this study will be valuable for genetic improvement and will show more productive returns under changing climate.

Keywords: Abiotic stress, Salinity, Morpho-physiology, multivariate analysis

Abstract-18

Effect of seedling age on growth and yield of japonica and indica rice cultivars in boro season

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Abstract

An experiment was conducted at the Field Laboratory of the Department of Crop Botany, Bangladesh Agricultural University (BAU), Mymensingh during the period from December 2018 to May 2019 to study the effect of seedling age on the growth, yield and yield attributes of *japonica* and *indica* rice cultivars in boro season. Three rice cultivars of which two were premium quality *japonica* rice (Koshihikari and Taichung 65) and the other one *indica* rice (BRRI dhan28) were used for the experiment. The experiment comprised of nine treatments i.e. the three rice cultivars transplanted with three seedling ages *viz.* 25, 35 and 45 days. The experiment was laid out in randomized complete block design with three replications. The results revealed that the cultivars had exerted significant influence on growth parameters, yield attributes and yield of *boro* rice. At the vegetative stage (45 days after transplanting, DAT), the growth parameters were found better in Koshikari with the 45-day old seedling. With the advancement of the growth period, the trend became different. At the reproductive stage (65 DAT) and harvesting stage, growth parameter was found better in BRRI dhan28 with the 35-day old seedling. Yield attributes were higher in BRRI dhan28 with 35-day old seedlings compared to the other rice varieties even with their different seedling age. The highest grain yield (6.23 tha^{-1}) and biological yield (20.25 tha^{-1}) were obtained from BRRI dhan28 with the 35-day old seedling. However, maximum straw yield (14.6 tha^{-1}) from Taichung 65 with 45-day old seedling and highest harvest index (35.47%) was found in Koshihikari with the 45-day old seedling. The result led to the conclusion that *indica* rice cultivar, BRRI dhan28, with 35-day old seedling yielded high compared to the other seedling age and the *japonica* cultivars (Koshikari and Taichung 65) in *boro* season.

Keywords: Seedling age, *boro* season, rice growth, BRRI dhan28

Abstract-19

Analysis of land use land cover of Lawachara National Park using satellite imagery

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Abstract

Lawachara National Park (LNP) has been declared a Protected Area (PA) in 1996 and is one of the important PA of Bangladesh due to its rich biodiversity. Though LNP is a PA, the area is well connected by rails, roads, gas pipelines and encroached by insider ethnics as well as surrounding villagers. Moreover, illegal felling, agricultural activities at LNP are considered a major threat to biodiversity. Knowledge about the current land use land cover (LULC) is important for the management of habitat. But there is no comprehensive report about the current vegetation cover of LNP. Therefore, this study was undertaken to measure the LULC of LNP using satellite imageries. Landsat 8 multiband surface reflectance (SR) imagery of 30 m × 30 m resolution (acquisition date-19 January 2020) with cloud cover 1.06% of LNP was acquired from USGS (earthexplorer.usgs.gov). After preprocessing, the imagery was classified following Maximum Likelihood classification in ArcMap 10.8 with a satisfactory accuracy of over 80%. Based on the vegetation cover, the area was categorized into five (05) land classes viz. Agriculture and Barren, Dense Forest, Medium Dense Forest, Settlements and Waterbody. The result shows that among the 1312.76 ha of LNP, Dense Forest occupied the most (678.19 ha), followed by Medium Dense Forest (533.89 ha), Agriculture and Barren (77.93 ha), Settlement (12.55 ha) and Waterbody (10.2 ha). The Dense Forest is distributed all over the area while the Medium Dense Forest is concentrated in the North-eastern part. Agriculture & Barren land, waterbody and Settlements are dominant in the northeastern border of LNP. The study could not separate mixed agriculture (Betel leaf in forest plant), narrow path and water trails due to the low resolution of the imageries. Results of the study can be useful for planning the future management activities of LNP.

Keywords: LULC, protected area, remote sensing, biodiversity

Abstract-20

Analysis of vitamin C reducing enzymes in a phytoflagellate *Euglena gracilis*

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Abstract

Euglena gracilis is a unicellular phytoflagellate, which belongs to the protist phylum Euglenozoa as well as trypanosomatids. As ROS metabolism in eukaryotic algae has not yet been established, we have been studying molecular mechanisms of ROS metabolism in Euglena. l-Ascorbate (AsA) becomes popular for its antioxidant properties and preventing from reactive oxygen species (ROS) damage, acts as a cofactor of many enzymes and electron donors in the electron transport chain and also modulates hormone signaling pathways. AsA pool in plants is tightly controlled by its synthesis, recycling, degradation, and transportation. Ascorbate peroxidase (APX) utilizes AsA as its specific electron donor to reduce H_2O_2 to water with the concomitant generation of monodehydroascorbate (MDA), a univalent oxidant of AsA. MDA is spontaneously disproportionated to dehydroascorbate (DHA) and directly reduced to AsA by the action of NADPH-dependent MDAR. DHAR utilizes glutathione (GSH) to reduce DHA and thereby regeneration of AsA. This cycle is designated as AsA-GSH (ascorbate-glutathione) cycle. To date, studies on DHAR and MDAR in higher plants have focused largely on *Arabidopsis* and agricultural plants, and there is virtually no information on the molecular characteristics of DHAR and MDAR in Euglena. The present study reports the cloning and characteristics of a DHAR (*EgDHAR*) from *Euglena gracillis*. The *EgDHAR* gene encodes a protein of 249 amino acid residues with a calculated molecular mass of 28.92 kDa. The sequence analysis of *EgDHAR* revealed that *EgDHAR is* considered a member of the typical glutathione S-transferase family. The molecular mass of recombinant *EgDHAR* was approximately 29 kDa resolved on a SDS-PAGE. The recombinant *EgDHAR* was overexpressed in *Escherichia coli* following purification with TALON affinity column chromatography. The recombinant *EgDHAR* exhibited enzymatic activity (4.10 µmol/min/mg of protein) and high affinity (a *K*m of 0.38041 and 0.76459 mM) towards the substrates DHA and GSH, respectively. Moreover, the recombinant *EgDHAR* was a thermostable enzyme and retained the maximum of its initial activity at 40°C. The activities of DHAR might account for the regeneration of ascorbate from monodehydroascorbate and dehydroascorbate produced by ascorbate peroxidase for scavenging hydrogen peroxide.

Keywords: Vitamin C, antioxidants, algae, reactive oxygen species

Abstract-21

Comparison of root and shoot growth performances of saplings developed from different tea clones

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Abstract

Tea (*Camellia sinensis*) is the second highest consumed beverage next to the water in Bangladesh. Tea cultivation needs more than 2000 mm rainfall annually but recently the tea plants are facing drought conditions almost every year due to the effects of climate change. Bangladesh was a tea exporting country but recently converted to a tea importing country due to the increase in local consumption. So far there are no released tea clones in Bangladesh having drought tolerance. Clone varieties of tea need to be developed to produce higher yields with better liquor quality having stress (drought, insects and mites) tolerant ability. A research program has been undertaken to compare the root and shoot growth performances of saplings developed from eight tea clones collected from various tea estates. In the present study, tea clones viz. D 24-1, D-21, Nurjahan, TRF-1, TV-23, TV-18, Teenali and AN-1 were used to develop saplings. The saplings are growing in four nurseries e.g., Chandpore tea nursery, Amo tea nursery, Joalbhanga tea nursery of Habigonj and the tea germplasm nursery of the Sylhet Agricultural University, Sylhet. Data on root and shoot growth parameters were recorded periodically. All the saplings are now at the growing stage in nursery conditions. Results obtained from the preliminary studies revealed that the saplings developed from D-21 clone are the best for root initiation and from Teenali are the best for shoot initiation and growth. The saplings developed from different clones will be used to compare the growth performances, liquor quality and tolerance abilities against stresses (drought, insects and mites).

Keywords: Tea, abiotic stress, clones, drought

Abstract-22

Development of suitable microclimate using low-tech greenhouse for off-season production of high value crops in Bangladesh

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Abstract

Low-tech greenhouses (low-techs) have been used globally to cultivate horticultural crops for many years, but their utilization in Bangladesh is a recent phenomenon. Moreover, information on altered microclimate inside the low-tech is hardly reported. A study was conducted in the Field Laboratory of the Department of Crop Botany, Bangladesh Agricultural University (24°72´N, 90°43´E and 18 m asl), Mymensingh during the late autumn to winter seasons from mid-October to mid-February of 2015/16, 2016/17 and 2017/18 years to find out the variation in microclimatic parameters between inside and outside of low-techs and to evaluate the suitability of altered microclimate inside the low-techs for off-season production of high value crops in Bangladesh. Three low-techs were erected each year using a bamboo frame covered with single inflated polyethylene film (thickness = 0.2 mm). Major microclimatic parameters inside and aside outside the low-techs were measured with standard devices or techniques. Around 30 percent of incoming photosynthetically active radiation (PAR) was cut-off by low-tech cover during solar noon when the sun's zenith gets minimum (around 0°C). However, this cut-off portion of PAR was gradually increased with the sunrise and sunset when zenith is around 90°. During the daytime, low-tech retains higher air temperature than that found outside and the differences in air temperature between inside and outside of low-techs was gradually increased after sunrise with a peak difference of 7 to 9°C following the solar noon (i.e. 13:00-14:00 hour). No distinct variation in relative humidity was recorded between inside and outside of the low-tech. Low-tech cover retains higher soil temperature than that was recorded outside. The variation of both air and soil temperatures between inside and outside of low-techs was higher during the daytime but lower at nighttime or even at daytime when the sky remained overcast. The variation in microclimatic parameters under low-techs not only protect the growing crops from climate vagaries during autumn, winter and spring seasons but also provide a suitable warmer environment for growing many high value crops during that season and thus crop production in off-season and/or season extension benefits can easily be achieved by low-techs.

Keywords: climate vagaries, low-tech greenhouse, microclimate, PAR, plastic culture, temperature

Abstract-23

Black pepper management, production and prospects in the north-eastern region of Bangladesh

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Abstract

Bangladesh imports almost 100% of black pepper (*Piper nigrum*) from abroad to meet up the requirement. Although locally some black pepper is produced in the north-eastern part of Bangladesh, there is no substantial information about the black pepper growing areas, management and production status. To collect information about the current status and existing management practices of black pepper, a survey was conducted in the three districts of the North-eastern region. A total of 50 people, who have black pepper in their homes, were interviewed. The survey indicates that black pepper is not very common in this region and many homesteads have only a few plants. Traditionally they grow black pepper in their homestead (80% of respondents have garden size <5 decimal) for a long time (74% respondents have >10 yrs experience). Betel nut, jackfruit and mango trees are mainly used as support trees for black pepper. They grow black pepper mainly for family consumption (60% farmer) and rely on traditional knowledge (96% farmer) for plant management. Plants bear flowers in June-August (59% respondents) and black pepper is harvested in November-January (76% respondents). The plants start to flower around 3 years after planting (70% respondents) and bear flowers every year (98% respondents) and 58% of respondents reported yielding more than 1 kg plant^{-1} yr^{-1}. About 34% of the respondents have reduced the black pepper production area in the last 5 years by replacing more profitable crops. Although 34% of respondents think that per plant yield is increasing over time while 22% of respondents opined a decrease in the yield. The majority of the respondents opined that black pepper grows well under normal light, temperature and well-distributed rainfall conditions. About 84% of the respondents observed that plants with medium dense leaves give better yield. Around 82% of respondents never irrigate or fertilize and 54% of the respondents never mulch the plants. Only 22% of the respondents perform pruning and 73% of them reported a positive effect of pruning on the yield. Most of the respondents identified anthracnose and sting bugs as major diseases and insects but they never used any chemicals to control them. Around 83% said that they are unaware of the appropriate management of black pepper. The survey revealed a remarkable gap in farmers' knowledge and perception regarding black pepper cultivation. The area is suitable for black pepper production but the lack of appropriate knowledge on management practices decreases the area and yield of black pepper in this region.

Keywords: Underutilized crop, spices, black pepper yield, farmers' perception

Abstract-24

Chloroplast genome of genus *Calotropis* and genomic comparisons with other Apocynaceae members

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Abstract

The genus *Calotropis* comprises of two species viz. *C. procera* and *C. gigantea*, have attracted great attention because of their medicinal, fiber, and biodiesel production potential. The chloroplast has a great impact on the regulation of mechanisms and metabolic activities such as photosynthesis in plants. Besides, the chloroplast (cp) genome has highly maternal inherited conserved genes that might be useful in plant systematics and evolution, genetic engineering, and estimation of the ancestral state of the species. There are some phylogenetics and population genetics related investigations available for *Calotropis*, but the chloroplast (cp) genome sequence of this key plant is still unknown. Here, we first obtained the whole chloroplast genomes of both species of *Calotropis* using next-generation sequencing. Then we conducted comparative chloroplast analyses using the two *Calotropis* species and another four Apocynaceae species (*Asclepias syriaca*, *Cynanchum auriculatum*, *Nerium oleander*, and *Carissa macrocarpa*). *C. procera* possessed the largest chloroplast genome (166,010 bp) followed by *C. gigantea* (165,928 bp) as compared to other studied genomes (varied 154,903−160,840 bp). Both species of *Calotropis* had 114 genes including eighty protein coding, thirty transfer RNAs, and four ribosomal RNAs. The six investigated genomes exhibited dominant mononucleotide microsatellites and 50−59 predicted RNA editing sites. We found a negative selection in most of the protein coding genes in *Calotropis* except *rps3* (non-synonymous ones (*Ka*) / synonymous substitutions (*Ks*) = 1.37). The shortest and longest *accD* (acetyl-CoA carboxylase carboxyltransferase beta subunit) gene was observed in *Plumeria cubensis* (Rauvolfioideae, 1,458 bp) and *C. gigantea* (Asclepiadoideae, 4,332 bp), respectively. The expansion of *accD* gene length in the three subfamilies of Apocynaceae is remarked as Asclepiadoideae> Apocynoidea> Rauvolfioideae. A total of 37 types (R1−R37) repetitive elements (tandem repeats) were identified in Apocynaceae lineage. The cp genome sequences of *Calotropis* are helpful to understand the evolution, effective conservation of the genetic resources, and breeding of this valuable plant. This study played a significant role in manipulating the activation of the chloroplast *accD* gene for increasing the seed fatty acid production in Apocynaceae plants, especially in *Calotropis*.

Keywords: *accD*, apocynaceae, biodiesel, *calotropis*, chloroplast genome, repeat sequences

Abstract-25

Evaluation of organic amendments in alleviating the adverse effect of water deficit stress on soybean

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Abstract

The experiment was conducted at the Crop Physiology and Ecology research field of Hajee Mohammad Danesh Science and Technology University, Dinajpur from November 2020 to June 2021 to study the effect of different soil amendments in alleviating the adverse effects of water deficit stress on soybean (BARI Soybean-6). The experiment was laid out in a randomized complete block design with three replications. The treatments were, T_1- Recommended dose of fertilizer (RDF) in well water condition, T_2- Recommended dose of fertilizer (RDF) in water stress condition, T_3- Biochar (10 t ha^{-1}) + RDF in water stress condition, T_4- Biochar (20 t ha^{-1}) + RDF in water stress condition, T_5- Poultry compost (5 t ha^{-1}) + RDF in water stress condition, T_6- Poultry compost (10 t ha^{-1}) + RDF in water stress condition, T_7- Cattle manure (25 t ha^{-1}) + RDF in water stress condition, T_8- Cattle manure (50 t ha^{-1}) + RDF in water stress condition, T_9- Vermicompost compost (2.5 t ha^{-1}) + RDF in water stress condition, T_{10}- Vermicompost compost (5.0 t ha^{-1}) + RDF in water stress condition, T_{11}- Humic acid (2.5 kg ha^{-1}) + RDF in water stress condition and T_{12}- Humic acid (5.0 kg ha^{-1}) + RDF in water stress condition. Well water plots were irrigated three times (at 30, 60 and 90 days after sowing) and water stressed plots were not irrigated throughout the growing period and were protected from rainfall by rainout shelter. Additional application of biochar, poultry composed, cattle manure, vermicompost and humic acid improved plant height and leaves plant^{-1}, increased the greenness of leaf which was indicated by SPAD reading, improved leaf water status as indicated by water retention capacity and relative leaf water content, increased leaf proline content and total plant dry weight in different magnitude under water stress condition. Seed yield m^{-2} of soybean reduced (38.92%) significantly due to water stress condition (T_2) compared to well water condition (T_1) and it was increased by 20.94, 75.07, 67.84, 67.14, 11.06, 24.38, 58.31 and 31.79% with additional application of biochar @ 10 t ha^{-1}, biochar @ 20 t ha^{-1},poultry compost @ 10 t ha^{-1}, cattle manure @ 50 t ha^{-1}, vermicompost @ 2.5 t ha^{-1}, vermicompost @ 5.0 t ha^{-1}, humic acid @ 2.5 kg ha^{-1}, and humic acid @ 5.0 kg ha^{-1}, respectively under water stress condition compared to application of recommended inorganic fertilizer alone.. The positive influence of organic amendments on seed yield under water stress conditions was contributed mainly by pods plant^{-1} and seed size. Additional application of biochar @ 20 t ha^{-1}, poultry compost @ 10 t ha^{-1}, cattle manure @ 50 t ha^{-1} and humic acid @ 2.5 kg ha^{-1}performed better in alleviating the adverse effect of water deficit stress on soybean.

Keywords: Soybean, drought stress, organic amendments, biochar

Abstract-26

Morpho-physiological traits and microsatellite markers reveal diversity in drought tolerance of bread wheat genotypes

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Abstract

The current study used a combined strategy to assess the genetic diversity of Bangladeshi wheat genotypes for drought tolerance. To achieve this, genetic diversity as measured by simple sequence repeat (SSR) markers was compared to diversity as measured by 16 morpho-physiological traits under irrigated and drought-stressed field conditions. Different phenological, physiological and yield traits showed consistent and substantial change due to drought. Hierarchical (HR) clustering of wheat genotypes unveiled three clusters differing in tolerance to drought. Genotypes of cluster 2 exhibited minimal changes in morpho-physiological traits, imparting better tolerance and yield stability under drought followed by the genotypes of cluster 3 and 1. Principal component analysis (PCA) exhibited that the first and second components accounted for 76.2 and 6% of the total variation among traits, and all the traits markedly contributed to genotypic diversity. Twenty-five SSR markers were used for the genotyping of wheat genotypes, among which 23 were highly polymorphic. A total of 244 alleles were detected with an average polymorphic information content (PIC) and genetic diversity of 0.77 and 0.79, respectively. Among the markers, wmc177, wmc179, and wms484 amplified the most alleles (13), as well as the highest PIC (0.90) and genetic diversity (0.90). The unweighted neighbor joining (NJ) tree grouped wheat genotypes into three major clusters. The topologies of HR and SSR-based NJ clusters were 71% co-linear, with the tolerant HR cluster 2 showing 86% co-linearity with NJ cluster 1, implying the genetic basis of drought tolerance of the genotypes within the clusters was mostly identical. The present study suggests that wheat genotypes assembled into the tolerant cluster could be used in the breeding programs for the improvement of tolerance and yield stability under drought.

Keywords: Wheat breeding, drought tolerance, SSR marker, cluster analysis.

Abstract-27

Bio-fortification of purple rice through K fertilizer management

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Abstract

Black/purple rice cultivars are rich in anthocyanins, antioxidants, vitamins and fibres, which possess various health benefits including preventing cancer, diabetes and heart disease. An experiment was conducted to enhance (or modify) the nutrient composition of a Bangladeshi Purple rice cultivar by K fertilizer management. Four fertilizer doses *viz*. T1: Control (the recommended dose: Urea-Triple Super Phosphate-Muriate of Potash-Gypsum @ 150-52.2-82.5-60 kg ha^{-1}, respectively), T2: 20% less Urea than the control, T3: 20% additional Urea + 25% additional Muriate of Potash than the control, T4: 25% additional Muriate of Potash than the control, were used as experimental treatments. Three rice cultivars *viz*. purple rice, Binadhan-7 and Pahari dhan, were used as experimental materials. Brown rice (or hulled rice) of the purple rice cultivar is rich in protein and minerals compared to test cultivars. The grain yield and mineral content of purple rice did not improve significantly by K fertilizer, alone or with additional N, except Fe and Zn. The highest amount of Fe and Zn (195.83 ppm and 47.75 ppm, respectively) was obtained with 25% additional K indicating the scope of bio-fortification through cultural practices. Purple rice could be used as a potential parental source or donor for further micronutrient enriched rice breeding programs in Bangladesh. If we can transfer the respective gene to modern cultivars and/or increase the grain yield to a certain stage (/threshold limit), the purple rice cultivar could be used as a weapon for combatting micronutrients deficiency in Bangladesh and the world as well.

Keywords: Grain yield, mineral content, purple rice, Bangladesh

Abstract-28

Individual and combined effect of heat and drought stress on physio-chemical properties in tomato

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Abstract

Plants often experience simultaneous heat and drought in the field due to global climate change resulting in limited crop production including tomatoes. A pot experiment following a completely randomized design with three replications was conducted in the Department of Crop Botany, Bangladesh Agricultural University, Mymensingh to investigate the physiological and biochemical responses in tomato plants to individual and combined short term heat and drought stress. The experimental factors were i) Tomato cultivars (BARI Tomato-8, BARI Tomato-16 and BARI Tomato-18) and ii) Stress treatments (control, heat, drought and heat + drought). The plants of three tomato cultivars were exposed to heat (38/25°C Day/night for 3-4 d), drought (350 mbar) and a combination of heat and drought at seedling and flowering stages. Shoot biomass, relative greenness/SPAD, maximum photochemical efficiency of PSII (F_v/F_m), photosynthetic and transpiration rate, leaf chlorophyll, carotenoids contents and fruit weight were significantly declined by the stress treatments in all tomato cultivars compared to control. The catalase and ascorbate peroxidase enzymes activities were significantly increased in plants grown under stress treatments compared to the plants grown in control. The tolerance of cultivars in response to individual and combined heat and drought stress varied significantly. The percent reduction (over control) values in photosynthetic rate in BARI Tomato-8, BARI Tomato-16 and BARI Tomato-18 were 47, 36 and 41%, respectively due to combined stress. The percent increased (over control) values of catalase activities under combined stress in BARI Tomato-8, BARI Tomato-16 and BARI Tomato-18 were 53, 63 and 54%, respectively. The cultivar BARI Tomato-16 showed better stress tolerance based on the studied parameters and could be recommended for cultivation in the simultaneous heat and drought prone areas of Bangladesh with further investigation.

Keywords: Heat & drought, tomato, chlorophyll fluorescence, photosynthesis, pigment, antioxidant

Abstract-29

Morphophysiological trait, yield and yield attributes of colored-grain rice genotypes

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Abstract

Colored rice is becoming popular and is consumed as a functional food due to its nutritional and health benefits. It is richer in proteins, vitamins, minerals antioxidants and dietary fiber than common white rice. Following standard protocols, an experiment was carried out at the Field Laboratory of the Department of Crop Botany, Bangladesh Agricultural University, Mymensingh, during the Aman season (August-Nov'21) to study the variations in morphological and physiological traits, yield and yield attributes of eleven colored-grain rice genotypes namely Vojon, Binadhan-20, BRRI dhan- 84, Bandarban-1, Bandarban-11, Bandarban-12, Khagrachori-3, Khagrachori-6, Rangpur-1 and Kurigram-1 along with a check variety Binadhan-7. The experiment was laid out in the Randomized Complete Block Design with three replications. All genotypes were transplanted on 11 August 2021 using 30-day old seedlings and were harvested in Nov 2021. Data on root length, flag leaf area, plant height, chlorophyll content of flag leaf, number of effective tillers per hill, days to 50% flowering and 80% paddy maturity, panicle length, and number of spikelets per panicle, 1000-seed weight and paddy yield per hill and hectare, and harvest index were recorded. Results revealed that Binadhan-20 showed superiority in terms of plant height, panicle length, root length, grain and biological yields (tha^{-1}) and harvest index. BRRIdhan-84 showed the highest number of effective tillers. 1000-seed weight and leaf area were found superior in colored grain genotype Bandarban-1. Yield and yield attributes were significantly different among the colored-grain rice genotypes. Bandarban-11 genotype showed the highest chlorophyll content during its life cycle was shortest (102 days) compared to the most popular short duration variety Binadhan-7 (120 days). It was observed that the endosperm color of some genotypes was black and in general colored-grain rice genotypes showed lower yield.

Keywords: Colored rice genotypes, morpho-physiological traits, yield

Abstract-30

Canopy structure and calyx yield and quality in Roselle (*Hibiscus sabdariffa* L. var. *sabdariffa*) morphotypes

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Abstract

Roselle (*Hibiscus sabdariffa* var. *sabdariffa*) is an annual subshrub and its leaves, seeds and especially calyx are valued for nutritional and medicinal uses. The objective of the study was to evaluate the morphological characters, biomass yield, calyx yield and quality; and to determine some important biochemical traits (total chlorophyll, carotenoid and phenolic content) of three Roselle morphotypes. The morphotypes of Roselle were green plant with whitish green calyx (WC); light red plant with light red calyx (LRC); and deep red plant with deep red calyx (DRC). The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Several morphological and biochemical traits including plant height, stem base perimeter, number of branches plant^{-1}, number of capsule^{-1}, weight of capsule plant^{-1}, weight of fresh and dry calyx capsule^{-1}, shelling ratio (%), total chlorophyll, carotenoid and total phenolic contents were evaluated. Genetic variations for morphological and biochemical traits were observed. Capsule yield plant^{-1} (fresh weight basis) was greater in DRC morphotype (2227.77 g plant^{-1}) than in LRC and DRC (907.29 g plant^{-1}). Further main edible part or calyx yield (shelling ratio i.e. % calyx to capsule) was also higher in the former than in the latter two morphotypes. Calyces are graded into premier (individual capsule size: 6.0-8.0 cm × 3.8-5.5 cm, length and perimeter, respectively) with no spots and fungal infection; standard (5.5-8.0 cm × 3.0-5.5 cm) with a few spots and little fungal infection; and good (3.5-6.5 cm × 2.5-4.5 cm) with several spots and fungal infection. Dry matter was greater in premier than standard and good one. Dry matter content was greater in stem with branches and leaf, irrespective of morphotypes. Total chlorophyll contents were higher in mature leaves of LRC (1.34 mg g^{-1} FW); phenolic contents decreased with an increase in the capsule size only in WC. It may be concluded that variations in morphological and biochemical traits existed with the deep red plant with deep red calyx (DRC) morphotype that appeared superior in respect of calyx yield and quality.

Keywords: *Hibiscus*, Chukur, morphology, calyx quality, phytochemical of leaf

Abstract-31

Morphological variation in cultivated and wild morphotypes of Roselle (*Hibiscus sabdariffa* var. *sabdariffa*)

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Abstract

Cultivated Roselle (*Hibiscus sabdariffa* var. sabdariffa) is an annual subshrub and its leaf is used in souring curry, calyx for preparing jam and drink, and processed seeds as feed. While the cultivated morphotypes are economically useful, the wild ones are ornamental. Scanty literature exists about the morphological descriptor of the cultivated and wild Roselle genotypes. Hence, the current investigation aimed at evaluating the morphological variations in three cultivated and two wild Roselle morphotypes. The morphotypes were named as per the color of the leaf, stem and capsule. The color of leaf, stem and capsule is green in one morphotype and is designated as cultivated green, abbreviated by CG; that of light red as CLR and deep red as CDR. Two wild morphotypes were named wild green (WG) where both the leaf and stem were green in color while in the other wild morphotype, the color of both leaf and stem was red and is designated as WR. In both the wild Roselle morphotypes, the flowers were bright red. The seeds were sown in the field on 01 April 2020 following standard protocols in Randomized Complete Block Design (RCBD) with three replications. Observation on the color of leaf and stem, sizes (length and breadth) of leaves and floral parts, and photographs of the vegetative and reproductive parts were taken at 50% flowering. Results revealed that five morphotypes can be distinguished based on the color of the leaf, stem, flower and capsule as evidenced in the nomenclature above and in photos. Variations were also observed in respect of sizes of epicalyx, calyx, corolla, androecium and gynoecium in the five Roselle morphotypes. In general, capsules are larger in the cultivated morphotypes than in the wild ones. In cultivated morphotypes, capsule color is light green in CG, deep red in CDR and light red in CLR morphotypes. In wild morphotypes, the capsule is light green in WG, light red in WR, and the capsule of both wild morphotypes contains small hairs on the surface. In summary, the cultivated and wild morphotypes of Roselle (*H. sabdariffa* var. sabdariffa) can be distinguished by the color of leaf, stem, petal, capsule and their sizes.

Keywords: Chukur, *Hibiscus sabdariffa* var. sabdariffa, variations, vegetative and reproductive parts, cultivated and wild genotype

Abstract-32

Morphological traits and nutritional composition of *Moringa oleifera* and *Moringa stenopetala*

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Abstract

Moringa oleifera is known as "horseradish tree" or "drumstick tree", native to India, is one of the best useful trees for nutrition and an enormous number of benefits in the world. *Moringa* is highly valued since almost every part of the plant i.e. the leaves, seeds, roots, bark, fruit and flower is directly or indirectly used as food with high medicinal and nutritional value. The research was aimed at investigating the differences in morphological and nutritional composition between different parts of *M. oleifera* Lam. ('sajna') and *M. stenopetala* (Baker f) Cufod ('lajina'). A fresh sample of *Moringa* leaves of both species was collected and kept for observation. Both qualitative and quantitative traits of *Moringa* leaves were recorded. The average number of seeds per fruit, weight of a mature fruit and percent edible portion was analyzed to determine morphological characteristics of them. Length and breadth of leaves were higher in *M. oleifera* (54.27 cm and 45.33cm) but the percent edible portion was higher (68.63%) in *M. stenopetala*. Weight of a mature fruit and percent edible portion was greater in *M. stenopetala* (29.04 g and 89.93%). Stomatal apparatus was found larger in *M. oleifera* (1575.21µm^2) and leaf was found thicker in *M. stenopetala* (131.03µm). More dry matter content was present in leaves and edible portions of the fruit of *M. stenopetala* (24.44 and 10.47%, respectively) than *M. oleifera*. Percentage of total N, K, Na and Ca were observed higher (4.09, 2.30, 5.70 and 1.47%, respectively) in leaves of *M. stenopetala* while *M. oleifera* had a higher (0.34%) amount of P. Proximate composition of leaves showed better content of crude protein (28.18% of DM) in *M. stenopetala* and higher content of crude fibre (6.55% of DM) in *M. oleifera*. In fruits also crude protein was found greater (25.88% of DM) in *M. oleifera* and that of crude fibre (28.38% of DM) in *M. stenopetala*. Total chlorophyll content was observed slightly more (2.15mg^{-1}g FW) in *M. stenopetala* and carotenoid content was almost similar (av. 0.35mg^{-1}g FW). The study revealed that significant variations existed in respect of morphological anatomical and nutrient composition between *M. oleifera* and *M. stenopetala.*

Keywords: Sajna & Lajina, proximate compositions, mineral nutrients, leaf, cultivated species

Abstract-33

Canopy structure, nutritional profile and yield in Quinoa (*Chenopodium quinoa*) genotypes

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Abstract

Quinoa (*Chenopodium quinoa* Willd.) is an annual herb, a pseudo cereal, important for its uses of the shoot as vegetable, seeds and sprouts as nutritious food. It is being sold in superfoods due to the presence of rich nutrients and phytochemicals of health benefits. Scanty information is available regarding the nutritional and phytochemicals of quinoa. Hence, this research was aimed at investigating some important morphological traits (plant height and number of leaf at different growth stages), biomass and seed yield, proximate (DM, crude protein, fat, fibre, ash and total carbohydrate on DM basis), mineral nutrient contents (P, K, Ca, Mg, S, Zn, Cu, Fe, Mn on DM basis) of leaf, seed and sprout; and phytochemicals (chlorophyll, Lycopene, beta- carotene, carotenoids, phenol and flavonoid) of leaf in four quinoa genotypes (V1, V2, V9 and Thailand). Seeds of four genotypes of quinoa were sown on 15 November 2019 using the spacing of 25 cm × 15 cm at the Crop Botany Field Laboratory, Bangladesh Agricultural University, Mymensingh, and harvested on 26 February 2020. Standard cultivation protocols were followed. Significant variations existed in canopy structure, proximate composition, nutrient elements and phytochemicals contents. Plant height and leaf number were lower in V9 (28.06 cm, 19.77 cm 23.58 cm and 15.13 cm, respectively) than others at maturity. Total fresh biomass and seed yield were higher in Thailand (2208.33 and 636.66 kg/ha, respectively) than in the V1 (1208.33 and 336 kg/ha, respectively). Proximate composition of leaves showed higher content of crude protein in V1 (18.74%), crude fiber in Thailand (10.66%), fat in V2 (6.30%) than in the others. The proximate composition of the seed showed a different result. Higher content of crude protein and crude fiber was present in V2 (16.25% and 67.60, respectively) and higher crude fat was present in V9 (5.75%) than in the others. In sprouts, crude protein and crude fibre were greater in Thailand (13.5 and 6.55%, respectively). Leaf nutrient content *viz*., K, S, Mg, Fe was higher in Thailand (0.99, 0.5, 1.25% and 428.82 ppm, respectively), P in V2 (0.31% of DM), Ca and Zn in V9 (0.99% and 38.89 ppm of DM respectively) than in the others. In Quinoa seed, P, K, Ca, Mg (0.31%, 0.52%, 513 ppm and 0.31%) were observed richer in V9; and S, Zn and Fe (0.41%, 30.48 ppm and 411.13 ppm, respectively) higher in V2 than in the others. In sprout, the result was different from the former two. Nutrient content viz., P, Mg, Fe was higher in V9 (3290, 2402.33 and 145.73ppm); and K, S, Ca, and Zn were higher in V2 (0.63%, 1.08%, 1666.33ppm and 58.01ppm). In contrast, phytochemical traits, total chlorophyll content was observed higher in Thailand (2.30 mg/100g of FW), lycopene content was almost similar (0.12 mg/100 g of FW) in four genotypes, V9 was richer in total phenolic content (2.47 mg GAE/g of FW) and total flavonoid content was higher in V1 (24.92 mg QE/g of FW). It appears that variations exist in respect of morphological features, seed and biomass yield; proximate, nutrients and phytochemicals content in four quinoa genotypes.

Keywords: Quinoa, leaf, seed, proximate compositions and mineral nutrients

Abstract-34

Drying and Nutritional Composition of Leaf, Calyx and Seed of *Hibiscus sabdariffa* L. var. *sabdariffa*

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Abstract

'Chukur' (in Bangla) or Roselle (*Hibiscus sabdariffa* var. sabdariffa) is an annual subshrub and its leaves, seeds and calyces are valued for nutritional and medicinal uses. Tender leaves and stalks are consumed as green vegetables, salad and seasoning curries; calyces are extensively used for preparing herbal drinks, cold and warm beverages, as well as making jams and jellies and seeds are used as feed. Three morphotypes (M_1, M_2 and M_3) of Roselle were used in that experiment. The M_1 is characterized by green plant with the green calyx; M_2 by deep red plant with the deep red calyx; and M_3 by light red plant with light red calyx. At physiological maturity, healthy leaves, calyces and seeds were subjected to sun drying (30 °C Day temperature; drying duration 2, 3, 4 and 5 days) and oven drying (50, 40 and 30°C drying temperature; 60, 72 and 96 hrs drying duration) to assess drying temperature and drying duration effects on quality. Leaves, calyces and seeds were analyzed for nutrient elements (total N, P, K, S, Ca, Mg, Zn, Mn, Fe and Na) in the three morphotypes of Roselle in Completely Randomized Design. Results revealed that sun drying required 3 to 4 days while oven drying required 60 hrs at 50°C, 72 hrs at 40°C and 96 hrs at 30°C appeared good for storing calyces and seeds. The shelling ratio (% calyx to capsule) was greater in M_2 (45.3%) than in the M_1 (34.5%) and M_3 (29.7%) morphotypes. Dry matter content was greater in seed and leaf, irrespective of morphotypes. Leaf of M_3 contained a higher amount of Ca, Zn and Fe (4.16%, 37.38 ppm and 318.95 ppm, respectively). Besides, calyces of M_2 had a higher amount of Mg (2117.35 ppm) than other morphotypes. Seeds of M_1 contained a higher amount of Mg (10173.33 ppm) than other morphotypes. On the other hand, seeds of M_3 contained a higher amount of Fe (137.04 ppm) than other morphotypes. It might be concluded that sun drying for about 2 days for drying leaves and 4 days for drying calyces and seeds appeared good. Nutrient contents of leaves, calyces and seeds appeared well in the three Roselle morphotypes.

Keywords: Chukur, proximate compositions, mineral nutrients, leaf, calyx, seed

Abstract-35

Drought and the first phase of salt stress: differential response to physiological and biochemical parameters in three maize genotypes

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Abstract

Salt and drought stress are regarded to be relatively similar as key restrictions on maize productivity. An experiment was conducted at the Department of Crop Botany, Bangladesh Agricultural University, Mymensingh, using the hydroponic method to demonstrate the differential responses of maize to drought and the first phase of salt stress. Drought and salt sensitive BARI hybrid maize-7 was compared to two newly released drought resistant maize genotypes, namely BARI hybrid maize-12 and BARI hybrid maize-13, to observe differential responses to salt and drought stresses on a variety of morphological, physiological and biochemical traits. In a completely randomized design with four replicates, we simulated control (1 mM NaCl), salt stress (100 mM NaCl), and drought stress (equiosmotic PEG-6000) on each of the three maize genotypes examined. Shoot fresh weight decreased in all maize genotypes when stressed with salt or drought. In BARI hybrid maize-7, BARI hybrid maize-12, and BARI hybrid maize-13, respectively, salt stress lowered shoot fresh weight by 28.2, 35.8, and 42.2%, whereas drought stress dropped it by 22.6, 18.1, and 32.4%. In all maize genotypes, chlorophyll content as SPAD units, carotenoids content, and Fv/Fm ratio were found to be unaffected by salt or drought stress when compared to the control. Under salt stress, photosynthetic rate, stomatal conductance, and transpiration rate decreased by 23.1, 56.7, and 55.3%, respectively, and by 46.7, 66.67, and 63.3%, respectively, under drought. Drought resistant genotypes BARI hybrid maize-12 and BARI hybrid maize-13, on the other hand, were shown to be unaffected by salt and drought stress. Salt stress raised phenolics content in the shoots of drought resistant genotypes BARI hybrid maize-12 and BARI hybrid maize-13 by 95.1 and 86.6%, respectively, whereas drought stress increased it by 111.7 and 137.8 %. Salt stress enhanced the DPPH scavenging activity of plant extracts by decreasing the IC50 value by 27.7, 3.8, and 1.7%, respectively, whereas drought stress decreased it by 26.2, 19.1, and 30.5 % in the growing leaves of BARI hybrid maize-7, BARI hybrid maize-12, and BARI hybrid maize-13. This research elucidated some physiological and biochemical mechanisms behind drought resistance in BARI hybrid maize-12 and BARI hybrid maize-13.

Keywords: Abiotic stress, drought stress, salt stress, maize

Abstract-36

Feasibility of vegetable beans cultivation in between transplanted *aman* and *boro* for improvement of system yield, nutrition and soil fertility

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Abstract

One of the common cropping systems in Bangladesh includes two rice crops namely, T. *Aman* and *Boro*. In between *Aman* and *Boro*, the fallow period is rather very short to accommodate any profitable *Robi* crops. The selection of shorter duration T. *Aman* (e.g. Binadhan7, 120 days or other such varieties) and subsequent cultivation of late *Boro* rice (Binadhan 14, 140 days or other such varieties) would create a 2-3 month gap between them, allowing a shorter duration (60-90 days) beans (Lignosus-bean, French bean, felon, pea, soybean, and mung bean) to fit into the proposed Aman-bean-Boro cropping pattern. The study was done in two distinct experiments over two consecutive seasons at the Crop Botany Department's field laboratory to determine the feasibility of integrating short duration vegetable beans in between two rice seasons and to analyze the efficacy of various fertilizers to boost the nutritional quality of the produce. The experiments used a split-plot design with two factors: Factor A: bean species (no bean, felon, lignosus bean, pea, French bean, soybean, and mungbean); and Factor B: fertilizer management, including conventional fertilizer (CF); conventional fertilizer + micronutrient fertilizer (CFM); and conventional fertilizer + biofertilizer (CFB). Each treatment was carried out maintaining three replicates. Green pods were picked as they reached physiological maturity to be used as vegetables. After two years of experimentation, it was determined that three vegetable beans, namely French bean, pea, and soybean, were successfully introduced into the soil between the *Aman* and *Boro* rice seasons. Biofertilizers combined with conventional fertilizer management produced the best results. Rice yield and quality were also boosted following the introduction of beans and biofertilizers. With the addition of beans to the cropping system, soil fertility indices such as organic matter content, P, K, Fe, Zn, and Cu were also raised. The field experimental results were validated in a farmer's field in the Bhabokhali union of Sadar Upazila, Mymensingh, where the same experiment was repeated with three bean varieties (namely, French bean, pea, and soybean) between T. *Aman* (Binadhan7) and late *Boro* (Binadhan14). French bean with biofertilizers gave the highest economic return from a crop cycle. The overall output recommends for the cultivation of shorter duration beans, particularly French bean and pea, between the T-*Aman* and *Boro* rice seasons, preferably in combination with biofertilizer, to raise system production, improvement in product nutritional quality, and maintain soil fertility.

Keywords: Cropping system, soil fertility, legumes crops, fertilizers management

Abstract-37

Evaluation of wheat genotypes for thermo-tolerance at autotrophic seedling stage

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Abstract

Elevated air temperature is considered one of the major bottlenecks for sustainable wheat production. Identification of genotypes containing better thermos-tolerance potentiality would improve wheat productivity. Regarding this, a lab experiment was conducted with eighty wheat genotypes and heat stress (35/25°C) was imposed for seven days after attaining the autotrophic phase (17 days after sowing). Several morpho-physiological traits were studied followed by multivariate analysis. Results revealed the significant variations in the studied attributes for the mean values due to heat stress. The majority of studied traits were significantly correlated among them. The heatmap, based on relative value, indicated that the genotypes were clustered into three major groups. The genotypes under cluster 3 were thermo-tolerant with improved pigments features, whereas the genotypes of cluster 1 showed better shoot biomass, membrane stability, leaf relative water content and fluorescence performance. The linear discriminant analysis (LDA) confirmed that around 95% of the genotypes were rightly allocated to clusters. Principal component analysis (PCA) and genotype by trait biplot analysis showed that the first five components accounted for 76% of the total variation, with principal component PC1 accounting for 31.4% and PC2 for 19.3% of the total variation. The combined observation of both PCA and LDA revealed that shoot biomass, cell membrane stability, leaf relative water content, chlorophyll fluorescence, chlorophylls and carotenoids played the most important discriminatory roles in discussing the variations regarding the heat stress tolerance in diverse wheat genotypes. Finally, the identified wheat genotypes responded differently according to attributes and thermo-tolerance levels, would be considered as resourceful genetic tools for further improvement of wheat productivity under the consequence of climate change.

Keywords: Wheat, heat stress, cluster analysis, principal component analysis, linear discriminant analysis

Abstract-38

Physiological responses of tea leaf under different shade conditions

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Abstract

Tea is the most frequently consumptive beverage in Bangladesh that become importing goods recently though the country has 167 commercial estates and more than 7000 small tea gardens. Despite the fulfillment of demand, the quality and nutrition of the drinks are a big concern. To meet up the demand and quality, the health of plants is often neglected, which reduces the production in long run. Almost all of these estates grow tea plants under shade conditions is believed to influence the caffeine, greenness, dry matter of leaves as well as quality of the produced tea. However, this shady condition is unregulated in most of the estates that leading to heterogeneous conditions and overly shaded conditions may affect plants negatively through influencing physiological activities of the leaves. To assess the physiological response under different light conditions an experiment was carried out in the Khadimnagar tea estate of Sylhet on exiting BT2 variety. The response from the third leaf of the plant under three shade conditions *viz.* over shade, optimum Shade, no Shade condition that laid out in a Randomized Complete Block Design with a plot size of 20 m × 10 m in three replications. The physiological responses of tea leaves were recorded with a photosynthesis system (3051C). The photosynthetic rate of leaves in the overshade condition reduced by almost half of that recorded in no shade conditions with reduced PAR (photosynthetically active radiation). The CO_2 concentration in the air under the shade condition was higher with low use efficiency inside the leaves. Although the air temperature was lower under over shade conditions, the leaf temperature was not lower than the leaf from the plant under no shade conditions due to almost half fold reduced transpiration, stomatal conductance and water use efficiency (WUE). “optimum shade” was found to be balanced between no shade and over shade condition for better health of tea plant. Further morphological and growth attributes like leaf area, dry matter production, specific leaf area, greenness as well as chemical properties of leaves can be combined and critically evaluated to recommend the best shade condition to produce better quality tea with managing the health of tea plants.

Keywords: Tea physiology, photosynthesis, tea plant health, tea production

Abstract-39

Species diversity in the family Marantaceae at the Botanical Garden of Bangladesh Agricultural University and their ethnobotanical uses

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Abstract

The Marantaceae, popularly known as the arrowroot or prayer-plant family, is a perennial flowering herb family that includes 29 genera and 627 species, notable for its huge starchy rhizomes. The present study was aimed to document the taxonomic diversity and ethnobotanical uses of plants from this family available in Bangladesh Agricultural University Botanical Garden. All available taxonomic resources viz. literatures, herbarium specimens and botanical illustrations were taken under consideration to identify the species. Digital imagery of the species was also used to supplement plant identification and document their habitats. Updated nomenclature, description, photographs and ethnobotanical uses are provided for each species. A total of 22 species belonging to 7 genera was identified. C*alathea* was the largest genus that contributed 12 species, followed by *Maranta* with 4 species and *Thalia* with 2 species; the remaining 4 genera each contributed one species. These species are mostly found in shady areas of forest edges, sides of ponds, canals and swampy areas. There is a growing demand for the species of *Calathea* and *Maranta* as ornamentals. Although the family contains several edible species, only one, *Maranta arundinacea* L., or West Indian arrowroot, is economically significant. In cookery, it is used as a thickener in soups, sauces, puddings and desserts. It produces a transparent, odorless, pleasant-tasting jelly when boiled in water. The fresh leaves of *Calathea* and *Phrynium* are used for wrapping foods, to cover cargo, and as bottle stoppers. The split petioles of *Schumannianthus dichotomus* (Roxb.) Gagnep. is used for making baskets, matting, and strings for a musical instrument. Furthermore, arrowroot contains several phytochemicals that have antidiarrheal, antiulcer, antioxidant, antibacterial, vibriocidal, and immunostimulatory properties. As demand for herbal products increases both within and across the country, the current study may serve as a preliminary addition to this field by utilizing normal research methodologies and focusing on medicinal plants and their indigenous usage in healthcare. This extensive information will aid botanists, ethnobotanists, and pharmacologists in collecting and identifying plants for research purposes and in isolating plant products beneficial to human health.

Keywords: Marantaceae species, diversity, ethnobotanical uses

Abstract-40

Density Effect on Canopy Structure, Yield and Proximate Composition in Roselle (*Hibiscus sabdariffa* var. *sabdariffa*) morphotypes

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Abstract

An experiment on the effect of planting density on canopy characters, yield and proximate composition in *Hibiscus sabdariffa* var. *sabdariffa* was conducted at the field laboratory of Crop Botany, Bangladesh Agricultural University, Mymensingh from March to December 2017. Plants were grown at three density levels (1, 2 and 3-plants stand^{-1}) with six treatments (2 morphotypes × 3 plant densities) to assess the effect of density on morphological traits, calyx, biomass and seed yield in three morphotypes (M_1, M_2 and M_3). Green plant with green calyx is denoted as M_1, light red plant with light red calyx as M_2 and deep red plant with deep red calyx is as M_3. Stem diameter, forking height, stem and branch fresh and dry biomass yield, leaf fresh and dry biomass yield plant^{-1} were greater at 1-plant stand^{-1} (2.98 cm, 26.41 cm, 1079.16 g and 458.33 g, 458.33 g and 78.75 g, respectively) than 2 and 3-plants stand^{-1} (2.37 cm, 18.34 cm, 684.37 g and 173.80 g, 297.20 g and 52.92 g, respectively). The number of mature capsules, fresh weight of mature capsule, fresh and dry weight of calyx and epicalyx, dry weight of pericarp and seed were also greater at 1-plant stand^{-1} (146.33 g, 783.33 g, 320.83 g and 38.12 g, 77.25 g, respectively) than 2 and 3-plants stand^{-1} (85.84 g, 456.87 g, 201.11 g and 23.7 g, 43.48 g, respectively). Irrespective of morphotypes, dry matter content was greater in seed (93.54%) than leaf (17.29%) and calyx (10.56%). In the proximate composition of leaf, crude protein was recorded higher in M_3 (23.51%) than M_1 (20.72%) and crude fibre was higher in M_3 (9.36%) than M_2 (7.57%) morphotypes. In calyx, crude protein was higher in M_2 (10.78%) than M_1 and M_3 (7.31%) and crude fibre was greater in M_1 and M_3 (12.85%) than M_2 (9.56%). In seed, crude protein was higher in M_2 (31.45%) than M_1 (29.57%) and crude fibre was higher in M_3 (21.30%) than M_1 (18.57%). Crude fat content varied insignificantly among the three morphotypes (23.74%). The results revealed that 1-plant stand^{-1} produced higher biomass, increased calyx yield and greater mature capsule. The nutritional composition of leaves, calyces and seeds appeared good in all three morphotypes.

Keywords: Chukur, density, morphology, proximate composition, calyx yield