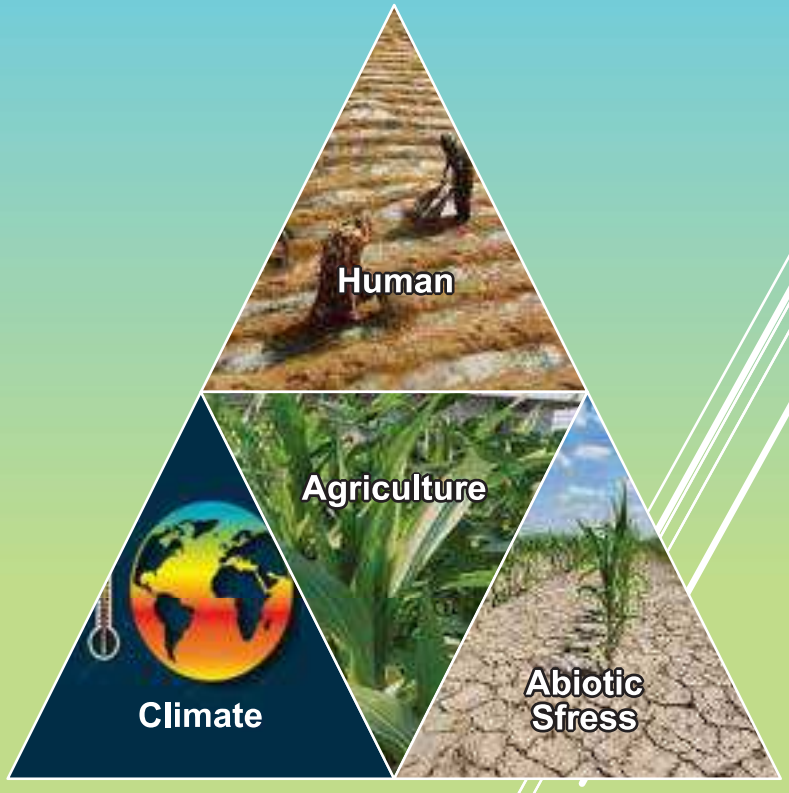
2nd Conference
on
Plants for Food, Health and Resilient Environment

Book of Abstracts

23-24 January 2023, Cox's Bazar



Bangladesh Society of Plant Science and Technology
www.bspst.org

Message from Chief Guest

It is a pleasure to know that the Bangladesh Society of Plant Science and Technology (BSPST) is going to organize a Second Annual Conference on 23-24 January 2023 at the Horticultural Centre, Jhilangjha, Cox's Bazar. The recently formed society, BSPST, has begun its journey with an international seminar in 2021 and has been progressing well in the field, I see. Disciplines viz., Plant Physiology & Ecology, Morphology & Taxonomy, Biodiversity & Conservation etc. form the foundation of other subjects like Plant Production, Protection and Crop Improvement. Hence, investigating and understanding processes, and mechanisms of stress physiology helps formulate management and breeding of new crops, likewise understanding ecology for the climate smart Agriculture, and acquiring in-depth knowledge on biodiversity for conservation of Plant Genetic Resources.

The current theme of the Conference, **"Plants for Food, Health and Resilient Environment"** is an important area that needs to share, discuss and arrive at recommendations to boost crop production under a changed climate, especially under Bangladesh conditions. I am happy to learn that around sixty abstracts have been submitted and expect the participants would present, discuss and recommends valuable findings to ultimate users/farmers. The professional society has an important role to guide course-curricula in teaching, providing solutions to solve problem-based issues, and catering training to the farmers, Agro-entrepreneurs and resolving challenges through implementing collaborative research projects in the specific subject areas, and the society BSPST has been marching well in this direction.

I thank the society for inviting me as Chief Guest and wish success of the second Annual Conference of the Bangladesh Society of Plant Science and Technology.

Prof. Dr. Lutful Hassan
Vice-Chancellor
Bangladesh Agricultural University
Mymensingh

Message from Special Guest

It is a great honour and pleasure for me to be invited to say some words during this opening ceremony of the second conference organized by the Bangladesh Society of Plant Science and Technology on "Plants for Food, Health and Resilient Environment". I would like to thank to the members of BSPST for arranging such time demanding issue. The conference showcases the research findings of leading plant scientists of ours and I am very pleased to see the focus that this conference places on supporting and encouraging young researchers also.

The Government's commitment to fundamental research and raising the profile of science set out how the Government is setting its priorities for research, science and technology and the process that will unfold throughout the rest of the year. Fundamental research is vital for any advanced society. It is from such research that innovations emerge that contribute to our economic and social development.

We know that we produce high-quality agricultural research in Bangladesh most probably the only world class research in ours. In fact, using the traditional academic measures of research quality, we are doing very well. But we need to think well beyond impact as measured by publications and citations.

So, if there is one message, I want to get across today, it's that partnerships are fundamental to deliver the transformational potential of science and technology in sustainable development to build the Sonar Bangla as the Father of the nation dreamed about.

I wish you all the best.

(Dr. Shaikh Mohammad Bokhtiar)
Executive Chairman
Bangladesh Agricultural Research Council
Farm Gate, Dhaka 1215

Message from President

This is my great pleasure in welcoming participants and guests to the second Annual Conference on 23-24 January'23 to be organized by the Bangladesh Society of Plant Science and Technology (BSPST). The current theme of the conference, **"Plants for Food, Health and Resilient Environment"** is practically a time-demanded area where researchers would attend, share and present their findings in achieving food and nutrition security in changing Climate. The society, BSPST, has been founded in 2020 and begun its head journey with the first International Conference entitled **"Plants for Sustainable Environment and Food Security"** held in 2021 housing five plenaries and thirty-five other abstracts. This year I am glad that fifty-seven abstracts have been submitted covering plant physiology, ecology, taxonomy, morphology and other fields of Agricultural Botany/Crop Botany.

Crop production has continually been challenged by multifarious abiotic stresses viz., drought, salinity, waterlogging etc. and it is the responsibility of Plant Physiologists to devise techniques to alleviate stress providing sustainable yield. The other scenario of current climate change points to investigating environmental attributes in a way to formulate a resilient climate suitable for sustainable crop production. Matter of fact all other attributes like identification of stress tolerant morphological and anatomical structures, and biotechnological approaches are urgently needed to produce good crop yield and to help aid in food and nutrition security in Bangladesh in the particular and the hungry world on the other. I urge participants would share, discuss and recommends approaches and techniques for good yield in one hand, and identify research areas that are urgently needed to be investigated.

I wish the second Annual Conference of BSPST a success.

Dr. Md. Solaiman Ali Fakir
President, BSPST
&
Professor, Department of Crop Botany
Bangladesh Agricultural University, Mymensingh

Message from General Secretary

The Bangladesh Society of Plant Science and Technology was founded in June 2020 with the goal of increasing the professionalism of plant scientists working in research, extension, and academic settings. Graduates from crop botany, agricultural botany, crop physiology & ecology, and plant physiology are involved in this journey. To better understand fundamental agricultural processes and functions, namely photosynthesis, respiration, nutrition, assimilation, partitioning, and increasing tolerance for biotic and abiotic challenges, plant physiologists have a greater role to play. Plant physiology, plant ecology, plant taxonomy & biodiversity, biotechnology, microbiology, mineral nutrition, seed biology, etc. are among the current trends in plant science research being organized in Bangladesh.

Around 60 scientists and academicians from various universities, research institutes, extension workers, and NGOs from home and abroad are participating, sharing their research outcomes, and exchanging their views. The thematic area of the conference encompasses the following subthemes: plant physiology and ecology, plant abiotic stress tolerance, climate smart agriculture, post-harvest physiology and food processing, plant taxonomy and biodiversity, economic botany and medicinal plants, plant anatomy and biotechnology, plant embryology and seed biology, and underutilized plants.

I hope and believe that the two-day conference will stimulate research in Bangladesh.

Md. Abdul Baset Mia, Ph. D
General Secretary, BSPST
&
Professor, Department of Crop Botany
Bangabandhu Sheikh Mujibur Rahman Agricultural University
Gazipur 1706

Program

Date : 23-24 January, 2023
Venue : Horticulture Center, Cox's Bazar

23 January 2023	
9.30 am	Recitation from the Holy Books
9.40 am	Welcome Address by **Dr. Md. Abdul Baset Mia** Secretary, BSPST and Professor Department of Crop Botany Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur
9.50 am	Keynote Speech by **Dr. Jiban Krishna Biswas** Executive Director Krishi Gobeshona Foundation (KGF) BARC Complex, Dhaka
10.20 am	Address by the Special Guests **Dr. Shaikh Mohammad Bokhtiar** Executive Chairman Bangladesh Agricultural Research Council (BARC) Farmgate, Dhaka 1215
10.50 am	Address by the Chief Guest **Professor Dr. Lutful Hassan** Honorable Vice-Chancellor Bangladesh Agricultural University, Mymensingh
11.10 am	Vote of Thanks by Professor Dr. Kamal Uddin Ahamed Former Vice-Chancellor Sher-e-Bangla Agricultural University, Dhaka
11.20 am	Address by the Chair **Dr. Md. Solaiman Ali Fakir** President, BSPST & Professor Department of Crop Botany Bangladesh Agricultural University, Mymensingh.
11.30 am -1.30 pm	Technical Session-I
2.30 pm-5.00 pm	Technical Session-II
5.0 pm-6.0 pm	Poster Session
24 January 2023: Sight-seeing tour	

Executive Committee of the BSPST for the year 2022-2024

Name	Designation
Prof. Dr. Md. Solaiman Ali Fakir	President
Prof. Dr. A. F. M. Saiful Islam	Vice-President 1
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Dr. Md. Ayub Hossain Khan	Member
Mr. Md. Mosharoff Hossain	Member

Different Committees of the 2nd Conference of BSPST 2023

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Mr. Md. Mosharoff Hossain	Member
Dr. Md. Sazzadur Rahman	Member Secretary

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Molecular dissection of physiological elicitation in fruit with reference to redox homeostasis

M.K. Adak* and A. Kundu

Crop Physiology and Molecular Biology laboratory
Department of Botany,
University of Kalyani, Kalyani, 74 3165, India
* Correspondence: mkadak09@gmail.com

Abstract

Cellular redox is the key to the ripening event at physiological and molecular levels in the induction of ripening specific genes. Application with various endogenous and exogenous elicitors induced the water relation, secondary metabolites, anti-oxidation and nuclear stability of the ripening tissues. Ethylene signaling as well as biosynthetic pathway governing genes are also responsible to influence the elicitors mediated ripening phenomena. The present experiment was conducted in the laboratory of plant physiology & plant molecular biology, Department of Botany, University of Kalyani, Kalyani, INDIA. Initially, capsicum fruits were selected from the farm in green colored stage and applied with various concentrations of chitosan with a polyamines mixture. The coating material was maintained for 7 days of post-harvest storage conditions under cold storage with ambient light. In another experiment the application of CO_2 was maintained for 1 hr under 1000-1200 µM CO_2 in a $NaHCO_3$ reacted with dilute HCl. In the third experiment, the various wavelength of light (white, blue, red) and their mixture was applied to freshly collected green capsicum fruits. The application of Chitosan, CO_2 and varying wave lengths (physical and chemical respectively) triggered to turn over the metabolites in fruits through ripening. Primarily a change of ROS as detected by both in vitro and in vivo indicated peroxidation reactions in tissue through LOX, carbonyl and MDA activity. Metabolic pathways concerning fruit cell wall dissolution with dextran hydrolysis, and inter-conversion of acid –sugar turnover suggested the anabolic pathways. Hydration capacity, secondary metabolites, and volatile substance accumulation suggested the ripening of specific characters for post-harvest storage. Secondarily, CO_2 sensitization with $NaHCO_3$-generated devices added support to current photosynthesis with NADP malic enzyme and other dehydrogenase activities. These are attributed to a distinct variation in polyamine content for cellular integrity as well as anti-oxidation capacities. The combination of chitosan and polyamine has a distinct response for ethylene biosynthesis and catabolism of ROS. The individual, as well as combinational treatment, can activate ethylene metabolism gene(s) like - ACC synthase and ACC oxidase directly control the anti-oxidation metabolism. The combination of physical and chemical treatments like light, and CO_2 sensitization regulation of ETR1, ETR2 isoform an ethylene signaling. Therefore, the study concludes the effectivity of both physical and chemical elicitors both for ROS and ethylene signaling and ruling for post-harvest of fruits

Keywords: Chemical elicitors, polyamine, redox, ROS, RNS

Exploring antimicrobial potentiality with extract and nanoparticles synthesized from duckweeds

S K Sil[1*] and S. Gupta[2]

[1]Department of Botany, University of Gour Banga, Malda, India
[2]Department of Botany, Malda College, Malda, India
* Correspondence: sudiptakrsil@gmail.com

Abstract

Duckweeds are omnipresent almost everywhere in tropical aquatic ecosystems, they prefer nitrogenous and phosphorus enriched aquatic niches for luxuriant growth. Duckweeds are the source of proteins and other micronutrients for aquatic poultry farming and also provide exudates some of the secondary metabolites having counter microbial values. The duckweeds were randomly collected from the lengths and breaths of the Malda district of West Bengal and identified as their taxa, thereafter, in vitro growth was established to maintain uniform growth parameters and to obtain standard metabolite production as far as possible. The fresh biomass was taken from mid-log growth phase and underwent metabolite profiling to ascertain the major groups present in the duckweed biomass under study. The methanolic extract was employed for antimicrobial assay using disc diffusion methods, the green synthesized silver and zinc oxide nanoparticles were tested for characterization and antimicrobial potency following the same disc diffusion methods by using different dose-dependent inputs. Lemna sp. and Spirodela sp. were reported and the micromorphology based difference between them was worked out using SEM study. The characterizations of Ag-nanoparticles and ZnO-nanoparticles were carried out using SEM, TEM, FTIR analysis. The dimension was found to be below 20 nm and the overall shape was spherical to oval. The flavonoid fraction of the methanolic extract was found to be potent in terms of antimicrobial potentialities. However, the antimicrobial potency of the nanoparticles showed a direct correlation with size. Smaller the sizes better the efficacy. Lemna sp. and Spirodela sp. Were the two duckweed species predominantly present in the aquatic ecosystems in the Malda district of West Bengal? The flavonoid fraction was found to be more potent in antimicrobial attributes. The gram positive and Gram negative – both types of bacteria were found to be controlled using both the plant extract and the green synthesized nanoparticles from the biomass.

Keywords: Duckweeds, Lemna, Spirodela, nanoparticles

Importance of colored rice for human health

Ujjawal Kumar Singh Kushwaha[1*] and Bisheswar Prasad Yadav[2]

[1]National Plant Breeding and Genetics Research Centre, Khumaltar, Lalitpur, Nepal
[2]Directorate of Agricultural Research, Parwanipur, Bara, Nepal
* Correspondence: kushujjwal@gmail.com

Abstract

Rice is the major staple food crop of Nepal. It provides nearly 35 % of calories and 23 % of total protein to the whole Nepalese population. Every Nepalese citizen consumes rice about 137 kg per year. Though rice plays a major role in food security in the country, still more than 43 % of the Nepalese population is malnourished. It is because most of the rice consumed by them is white and finely polished which loses many micronutrients beneficial for human health. Alternatively, colored rice like black rice, brown rice, and red rice has been found highly nutritious, and therefore, consumption of these rice varieties could save millions of dollars used for reducing malnutrition. Black rice contains several useful antioxidants anthocyanins and a large amount of fiber. Indigenous black rice has been found promising for alleviating many ailments of the body. This rice increase longevity reduces age and controls hypertension, diabetes, and obesity. Several pieces of research evidence show that the daily intake of black rice reduces cancer growth. This paper summarizes the importance of colored rice to human health and highlights recent research activities regarding black rice varietal development in Nepal.

Keywords: Black rice, colored rice, Oryza, kings of rice

Genetic characterization of leaf endophytes synthesizing silver and ZnO nanoparticles isolated from medicinal plants (*Ocimum sanctum, Azadirachta indica*) and development of nanoformulations against soil borne plant pathogens

Shaik Thahir Basha[1]*, N.P. Eswara Reddy[2] and Srinivasa Rao Tumati[1]

[1]Department of Veterinary Public Health and Epidemiology, Sri Venkateswara Veterinary University, NTR College of Veterinary Science, Gannavaram. Andhra Pradesh. India.
[2]Department of Biotechnology, Institute of Frontier Technology, Acharya NG Ranga Agricultural University, Tirupati. Andhra Pradesh. India.
* Correspondence: thahirbashas@yahoo.com

Abstract

Over the last two decades, agriculture has witnessed significant changes in terms of plant pathogens becoming major limiting factors in crop production and emphasizing the researchers to think out of the box to combat aggressive soil borne plant pathogens. The introduction of nanotechnology paved a new ray of hope for agricultural sustainability. This study is aimed to explore new horizons by identifying the potential endophytes from medicinal plants to replace the non-judicious use of chemical pesticides that are wiping out countless putative antagonistic microorganisms. The potential endophytes from the medicinal plants, Ocimum sanctum and Azadirachta indica were identified upon screening in vitro by dual culture technique, poisoned food technique, and compatibility studies with systemic and nonsystemic fungicides. Further, greenhouse studies and multilocational field trials were conducted. The biosynthesis of silver and ZnO nanoparticles by the potent endophytes was characterized by UV spectroscopy, FTIR and SEM. Moreover, the development of antimicrobial, and antifungal nanoformulations and their shelf life was evaluated till 120 days. RAPD and RFLP were employed to assess the molecular diversity among the potent leaf endophytes. Out of 500 isolates screened (250 from each medicinal plant), 100% inhibition was exhibited by the 08 potent leaf endophytes viz., PPB01, CB221, ICB03, CHB190, HAP294, POM333, BUD473 and CAB481 against Sclerotium rolfsii, Cercospora arachidicola, Sclerotium oryzae, Rhizoctonia bataticola, Aspergillus flavus and Aspergillus niger. The synthesized silver and ZnO nanoparticles by the eight endophytes recorded a significant reduction in the percent disease incidence (100%) over 06 pathogens under the study and substantially increased the plant growth parameters. Further, the evaluation of cost-effective nanoformulations of silver and ZnO for three consecutive seasons in field trials was found to be highly promising. The unique fragment of 650 bp amplified in PPB01 leaf endophyte has opened up the possibility of developing SCAR marker. The findings of the present study, especially the rolling out of nanoformulations have gained tremendous interest among progressive farmers due to their multiple benefits and shall become a key component of the agricultural practice to control; stem rot of groundnut, early leaf spot of peanut, charcoal rot of sunflower, dry root rot of chickpea and sheath blight of rice.

Keywords: Medicinal plants, endophytes, nanoparticles, plant pathogens

In vitro propagation and phytochemical screening of the medicinal plant *Glycyrrhiza glabra*

Ghazala Shaheen*, Naveen Gaurav and Arun Kumar

Department of Biotechnology, School of Applied Sciences, Shri Guru Ram Rai University, Dehradun, India.
* Correspondence: ghazalabiotech071@gmail.com

Abstract

Licorice (Glycyrrhiza glabra L.) commonly called mulethi is a small perennial shrub medicinal plant widely used to produce active compounds by ayurvedic and pharmaceutical industries. World Health Organization reported 80% of people in the developing world use medicinal plants for primary health and about 40% of compounds are used in the pharmaceutical industry which directly threatens the over exploitation and extinction of medicinal plants in the future. However, tissue culture can address the possibilities of conserving the genetic material and enhancing the production of G. glabra to cater to the needs of various sectors. The mother plant was collected from nearby villages in Dehradun, Uttarakhand and later authenticated at the Botanical Survey of India, Northern Regional Centre, Dehradun. India. In vitro propagation of G. glabra using nodal explants on MS medium was carried out as per Murashige and Skoog (1962). Phytochemical profiling was carried out according to standard protocols. Callus was observed on explants within a few weeks of transfer on MS medium. Shoot and root formation were successful by using MS medium supplemented with different concentrations of growth hormones. Supplementation with sucrose and indole-3-acetic acid provided the optimum rate (85%) of bud break, shoot proliferation, and growth of the nodal explants, root initiation, maximum numbers of roots, lateral roots formation and total root length. The survival rate was 95% following acclimatization where the rooted plantlets were initially acclimatized in the growth room under laboratory conditions followed by transfer to the nursery. New plants were successfully regenerated from the wild plant. The evaluation of total sugars, total starch, total tannins, total phenolics, and total flavonoids was recorded as higher in the newly propagated plant compared to the control. The current study on explants of the newly propagated plant shall be suitable for the production of desired metabolites through in vitro propagation unlocking the insight into understanding the biology of biosynthesis and also providing a suitable alternative for year-round production of metabolites without disturbing the conservation and management of G. glabra in natural ecosystems.

Keywords: Glycyrrhiza glabra, micropropagation, supplements, phytochemicals

Artificial ripening accelerated the total sugar, phenolic content and antioxidant capacity of sukkari dates at khalal stage

Tanjina Alam, Md. Ahasan Habib, Mst. Kohinoor Begum, Md. Shamsul Arefin, Md. Anisur Rahman and Md. Jahirul Islam*

Physiology and Sugar Chemistry Division, Bangladesh Sugarcrop Research Institute, Ishurdi-6620 Pabna
*Corresponding author, email: jahirulislam213@gmail.com

Abstract

This study was conducted to investigate the acceleration of ripening of Sukkari dates and their changes in colour, pulp, carbohydrate, vitamin, and antioxidant capacity under nine individual treatments. Fresh dates at the khalal stage were immersed in normal water for 5 hours or in hot water for 5 mins along with/without NaCl (2%), potassium metabisulphite (PM, 0.5%) and acetic acid (AA, 1.5%) individually or in combined form followed by allowed to ripen for 72 h in an aerated incubator at 40 oC. Changes in colour shade, fruit weight, pulp, texture, total soluble carbohydrates (TSC), total soluble sugar (TSS), beta carotene, total polyphenol (TPC), total flavonoid (TFC), total condensed tannin, DPPH radical scavenging activity, FRAP value and overall appearance assessed the efficiency of the treatment. The treatments T6 (normal water with 1.5% AA + 0.5% PM) and T8 (hot water with 1.5% AA + 0.05% PM) were found more acceptable which represented soft, less pungent, brownish and highly attractive with more than 77% and 88% pulp and ripened fruit, respectively. Results also revealed that T6 manifested higher TSC, TSS, tannin, DPPH radical scavenging activity and FRAP value with lower beta-carotene, TPC and TFC. Besides, T8 also performed better for all parameters except beta-carotene.

Keywords: Pulp, beta carotene, total polyphenol, total flavonoid, DPPH radical scavenging activity, FRAP value

Physiological behavior and yield contributing attributes of *Oryza sativa* in aerobic and anaerobic conditions

Md. Shoriful Islam*, Md. Moinul Hoque, Kamal Uddin Ahamed

Department of Agricultural Botany, Faculty of Agriculture, Sher-e-Bangla Agricultural University
Dhaka-1207, Bangladesh.
* Correspondence: shorif@sau.edu.bd

Abstract

About 90% of the world's rice production is harvested from irrigated or rainfed lowland rice fields. Rice requires a soil moisture content of 70% throughout the season. Continuous flooding is no more needed to have a good yield of rice. The aerobic system of rice cultivation has been developed very recently where rice can be grown successfully with a saving of 40-70% irrigation water, it requires less water than lowland rice. In an aerobic system, water is made available (through rainfed or irrigation practice) to a level where the plant deserves it to maintain its sound physiological system. Considering the above mentioned hypothesis, an experiment was conducted at the experimental farm and Plant Physiology Laboratory of the Department of Agricultural Botany, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh to assess the growth behavior and yield of hybrid rice varieties, to characterize the role of stem reserve translocation and current photosynthate in the yield formation of hybrid and inbred rice varieties under aerobic and anaerobic conditions. In this research, we used three Systems of cultivation [T1: Low land transplant (anaerobic) condition; T2: Raised upland (aerobic) condition, and T3: Raised transplant (aerobic) condition] and five rice Varieties [V1: BRRI hybrid dhan3; V2: Bolaka; V3: Moina; V4: Gold and V5: BRRI dhan 45], where different morpho-physiological data was taken for evaluating their performance with complete randomized design and three replications. Among the different systems of cultivation significant variation was observed in growth, yield and yield contributing parameters. All the studied hybrid varieties showed superiority in respect of physiological characteristics, yield and yield attributes in anaerobic conditions over aerobic conditions. BRRI hybrid dhan3 provided the highest grain yield (8.05 t ha^{-1}) at low land transplant conditions. BRRI hybrid dhan3 performed well due to yield attributes [amount of chlorophyll (2.47 mg g^{-1}) in its flag leaves, leaf area index (4.25), shoot reserve translocation (34.97%), grain dry matter accumulated from current photosynthesis (85.87%), higher filled grains per panicle and 1000 grain weight] than others varieties and the lowest (4.28 t ha^{-1}) was obtained from BRRIdhan45 at raised transplant condition. The results of the present study revealed that Low land transplant conditions with BRRI hybrid 3 showed the best performance regarding growth, yield and yield-contributing characteristics of Boro rice varieties than others.

Keywords: Rice, system of cultivation, hybrid, yield

Taxonomic diversities and ethnomedicinal uses of plants belong to the family Amaryllidaceae in Bangladesh Agricultural University Botanical Garden

Md. Redwanul Islam Rafi, Md Jahid Hasan Jone, Md Ashrafuzzaman*

Department of Crop Botany, Bangladesh Agricultural University, Mymensingh-2202
*Correspondence: ashrafcbot@bau.edu.bd

Abstract

The amaryllis family (Amaryllidaceae) of lily is one of the most recognizable bulbous (rarely rhizomatous) plant families well known around the world for its distinctive bioactive alkaloid components, attractive floral traits, and use in traditional medicine. There are 34 distinct lily species in Bangladesh, each with remarkable beauty and traits. The purpose of this present study is to compile primary documentation of the Amaryllidaceae existing in the Bangladesh Agricultural University Botanical Garden. A total of twenty (20) species belonging to nine (9) genera have been identified where Hippeastrum is the largest genus, with six (6) species, followed by Crinum with four (4) species. Pancratium, Zephyranthes, and Eucharis, each of these three genera contain two (2) species while the remaining five (5) genera are each represented by only one species. Common names, Scientific names, synonyms, applications, economic uses, medicinal uses, and brief descriptions of each species have been added to the text. Graphical presentations illustrating their categorization and categories based on a few criteria have been provided for easier comprehension and identification.

Keywords: Medicinal plants, ethnomedicinal uses, Amaryllidaceae, economic botany

Effects of land use change on major biogeochemical attributes of surface soils across a hill topography in Sylhet

Md. Tanbir Hasan, Sharifunnessa Moonmoon and Md. Masudur Rahman*

Department of Crop Botany and Tea Production Technology, Faculty of Agriculture, Sylhet Agricultural University, Sylhet 3100 Bangladesh.
*Correspondence: masudur.cbot@sau.ac.bd

Abstract

Soil biogeochemical processes depend on plant species grown there. Therefore, land use changes directly or indirectly affect soil quality and nutrient availability. The objective of this study was to assess the effects of the conversion of forest to cropland on soil physical and chemical properties as well as on bacterial populations across a hilly topography in Sylhet. Soil samples were taken from a hill where half of the forest was clear-cut in 2018 and subsequently tea garden (hereafter cropland) was established. Surface soil (0-15 cm) was sampled in three different positions on the hill (top, middle and bottom). Soil properties like soil texture, soil pH, soil EC, soil organic matter (SOM), soil total dissolved solids (TDS), bacterial population, total N, Ca, Mg and available P were measured. Data showed that soil texture did not change significantly after four years of land use change. However, other soil chemical and biological properties differed significantly between land use type and sampling position. Sampling position significantly affects soil properties like SOM, bacterial population, total N, available P and fractions of the soil. For example, the highest amount of SOM and total N was found on the hilltop of the forest and the lowest was found on the bottom hill of the forest. In general, SOM, soil bacterial population, total N, Ca and Mg content were higher in the forest but available P content was higher in cropland. Results showed that there are distinct differences between forest and cropland within four years of land use change. These changes may be more prominent with time and could develop two distinct soil biogeochemical systems in the same hill and thus could have different carbon and nitrogen storage potential.

Keywords: biogeochemical attributes of soil, soil texture, soil chemistry, soil organic matter, soil total dissolved solids, soil microorganism

Bacterial diversity in the rhizosphere zone of black pepper (*Piper nigrum* L.)

Tasfia Tahzin[1a], Saima Sadia Jui[2], Afroza Akter[1], Sushmita Roy[1], Dipty Rani Dey[1] and Md. Masudur Rahman[1] *

[1]Department of Crop Botany and Tea Production Technology, Faculty of Agriculture, Sylhet Agricultural University, Sylhet 3100, Bangladesh.
[2]Department of Plant Pathology and Seed Science, Faculty of Agriculture, Sylhet Agricultural University, Sylhet 3100, Bangladesh
*Correspondence: masudur.cbot@sau.ac.bd

Abstract

Black pepper, the 'King of spices', is distributed all over the world with over 2000 species. It is the most important and widely used spice in the world and is cultivated in tropical and subtropical regions. The yield of black pepper depends on multiple factors such as favorable climatic conditions and soil nutrient availability. Soil microbial community especially rhizosphere bacteria is responsible for plant nutrition and soil fertility. Therefore, information about the bacterial community in the rhizosphere zone is important to understand mineral nutrition availability. The objective of the study was to document the rhizosphere bacterial diversity of black pepper based on the colony morphology of the bacteria. Twenty-four soil samples were collected from the rhizosphere of black pepper from a farmer's field located in Jaintapur, Sylhet. Soil samples were collected with proper precautions to avoid contamination. Upon serial dilution and culturing bacteria on Nutrient Agar medium, the colony morphology of the isolates was recorded by visual observation. Colony morphology features such as shape, color, elevation, size, and the edge of the colony were recorded. The bacterial colonies showed different morphological characteristics. The average colony size ranged from 1.5 mm to 1.7 mm. An apparent predominance of round, flat and smooth colonies with entire edges was observed. Along with that, colonies with oval-shaped, raised and rough-edged were also recorded. According to the colors, the isolates could be divided into several groups where white, off-white and yellow were the most dominant while brown and bluish-pink colonies were quite rare. The results showed that the rhizosphere bacteria of black pepper vary in their morphology. However, further study is needed to identify the different groups of bacteria.

Keywords: Soil fertility, spices crops, black pepper, bacterial diversity

Morphological variation of different black pepper (*Piper nigrum* L.) genotypes found in Sylhet region

Md Moudud Ahmod, Masuma Asha, Feroze Abdullah, Sharifunnessa Moonmoon and Md. Masudur Rahman*

Department of Crop Botany and Tea Production Technology, Sylhet Agricultural University, Sylhet-3100, Bangladesh
*Correspondence: masudur.cbot@sau.ac.bd

Abstract

Black pepper (Piper nigrum L.), a member of the Piperaceae family, is the most widely used expensive spice in the world. There are some genotypes available in the Sylhet and Chottogram regions. The climatic condition of Bangladesh is suitable for the cultivation of black pepper, yet the country imports about 1500 tons annually worth about BDT 600 million. However, there is scanty information about black pepper genotypes grown in Bangladesh. This study aimed to characterize the morphological features of black pepper genotypes grown in the Sylhet region. Healthy, disease-free vines were collected from different locations in Sylhet and grown in the field at Sylhet Agricultural University. One year after planting and management, different qualitative characteristics like- leaf texture, lamina shape, leaf apex, leaf base, shoot tip color, leaf margin and quantitative characters like- leaf length (cm), leaf width (cm), leaf area (cm2), petiole length (cm), internode length (cm), leaf dry matter content (%) were recorded following the guidelines described in "Descriptors of black pepper" (IPGRI, Rome). From the collected vines, 11 genotypes were identified and labelled as G-1, G-2, G-3, G-4, G-5, G-6, G-7, G-8, G-9, G-10 and G-11. For qualitative characters, two types of leaf texture (smooth and rough), four types of leaf lamina (ovate, ovate-lanceolate, ovate-elliptic and cordate), three types of leaf tip (acute, acuminate and caudate), two types of leaf base (cordate and rounded), five shoot tip color (green, light green, yellowish green, purple and dark purple) and two types of leaf margin (wavy and even) were found among the genotypes. For quantitative parameters, leaf length varied between 6.8 and11.24 cm, leaf width between 3.66 and 6.24 cm, leaf area between 26.8 and 66.6 cm2, petiole length between 2.3 and 5 cm, internode length between 1.93 and 6.2 cm and leaf dry matter content between 19.6 and 30.4%. G-8 showed the highest value of leaf length (11.24±0.1 cm), leaf width (6.24±0.2 cm), leaf area (66.6±1.7 cm2), petiole length (5.0±0.3 cm), and internode length (6.20±0.57 cm). Data showed considerable variations for different qualitative and quantitative characters among the 11 genotypes. This baseline morphological information could be useful for the selection and development of high-yielding varieties that would increase black pepper production in Bangladesh.

Keywords: Peppercorn, spice genotypes, morphology, diversity, descriptor

Genome wide identification and characterization of HMG family genes in Chinese cabbage (*Brassica rapa sp. pekinensis*) and expression profiling against abiotic stress

Md. Saiful Islam Khan Rubel[1], Md. Zohurul Hauqe[2], and Md. Abdul Kayum[2]*

[1]MS student, Dept. of Agricultural Botany, Patuakhali Science and Technology University
[2]Professor, Dept. of Agricultural Botany, Patuakhali Science and Technology University
*Correspondence: kayumagb@gmail.com

Abstract

Plant growth and development can be adversely affected by abiotic stresses, limiting productivity. Chinese cabbage is a widely recognized vegetable for its economic importance and contribution to human nutrition, but its yield is severely affected by various abiotic stresses. High mobility group (HMG) proteins found in the nuclei of higher eukaryotes play roles in the regulation of DNA-dependent processes such as transcription, replication, recombination, and nucleosome assembly. It also acts as a regulator of the potential of many physiological processes in the plant. However, there is no information about this family in any Brassica crop. We identified 17 genes encoding HMG proteins from Br135K microarray dataset and the BRAD database characterized the sequences and profiled their expression for the first time in different organs and responses to cold, salt and drought in Chinese cabbage. An extensive in silico analysis of phylogenetic grouping, protein motif organization, chromosomal localization, gene duplication, subcellular localization and intron-exon distribution confirmed that there are four groups of BrHMG proteins. The HMG genes were distributed across 10 chromosomes and chromosomes 6 and 9 contained the highest numbers of genes. Most of the gene pairs were segmentally duplicated. In addition, most of the BrHMG genes showed organ-specific expression. The RNA expression of gene's encoding HMG in different plant's organs such as callus, root, stem, leaf, flower, and silique have been analyzed using different software. Expression profiling of BrHMG genes was performed using cDNA of plant samples imposed to abiotic stresses; cold, salt and drought stresses. Using a low temperature-treated whole-genome microarray data set, most of the HMG genes were found to have variable transcript abundance between the contrasting inbred lines Chiifu and Kenshin of B. rapa. Subsequently, the expression of all 17 BrHMG in response to cold stress was characterized in the same two lines via qPCR, demonstrating that five (BrHMG1, BrHMG6, BrHMG9, BrHMG13 and BrHMG14) genes were up-regulated, whereas BrHMG9, BrHMG13 and BrHMG14 genes were distinctly down-regulated by drought or salt stress. On the other hand, under salt and drought stresses, BrHMG1, BrHMG4, BrHMG6, BrHMG7, BrHMG10 and BrHMG112 genes were up-regulated. These results increase our knowledge of the abiotic stresses related functions of the HMG gene family that could be potential resources for molecular breeding of Chinese cabbage resistant to abiotic stresses.

Keywords: HMG, abiotic stress, gene expression, Chinese cabbage

Substitution of chemical fertilizer with organic fertilizer affects soil total nitrogen and its fractions in northern China

Md Elias Hossain, Xurong Mei*, Wenying Zhang, Wenyi Dong, Zhenxing Yan, Xiu Liu, Saxena Rachit, Subramaniam Gopalakrishnan and Enke Liu

Department of Agricultural Botany, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh.
* Correspondence: meixurong@caas.cn

Abstract

Substitution of organic manure for chemical nitrogen (N) fertilizer is often suggested as a sustainable soil fertility management approach, but their impact on soil labile organic and stabilized N pools in the profile is unclear. Therefore, we analyzed the distribution of soil N pool levels down to 100 cm profile under wheat-maize rotation system in northern China after 5-year continuous 270 kg ha^{-1} N equivalent fertilizer inputs from organic-inorganic sources. The triplicated field experiment was established in 2014 with four treatments: (1) Organic manure (OM), 100% N from composted cattle manure; (2) Organic manure with nitrogen fertilizer (OM+NF), 50% N from composted cattle manure plus 50% N from urea; (3) Nitrogen fertilizer (NF), 100% N from urea; and (4) Control (CK), zero N fertilization. The concentrations of soil total N (STN), particulate organic N (PON), microbial biomass N (MBN), dissolved organic N (DON), and mineral N (NO_3- and NH_4^+) fractions in the selected profiles were determined at 10 cm depth intervals. The correlations between STN and its fractions were also computed. The average total N contents in the profiles were improved with N fertilization irrespective of applied N sources, but OM and OM+NF treatments had significantly higher STN, PON, MBN, DON and NO_3- contents in 0-20 cm topsoil depths. The NF treatment showed no substantial influence on topsoil STN, PON and MBN distributions but resulted in the highest ($P < 0.01$) DON and NO_3- depositions in 40-100 cm subsoil depths. The NH_4^+ contents in topsoil layers as well as NH_4^+ depositions in subsoil depths were significantly highest ($P < 0.01$) under OM treatment. The correlations between STN and its fractions were positively significant only at 0-10 cm and 10-20 cm topsoil depths. Our results suggest that partial substitution of chemical fertilizer with organic manure could be a sustainable option for soil N management of intensive farming systems as it optimized topsoil labile organic and mineral N pools while substantially reducing the potential risk of groundwater contamination by decreasing leachate (DON, NO_3- and NH_4^+) deposition in deep soil.

Keywords: Organic manure; nitrogen fertilizer; soil total N; labile organic N; mineral N; soil fertility

Supplementation of seaweed extract and alginic acid mitigate drought-induced oxidative stress in Rapeseed

Md. Rakib Hossain Raihan and Mirza Hasanuzzaman*

Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh
*Correspondence: mhzsauag@yahoo.com

Abstract

Drought is one of the major environmental constraints that adversely affect plant growth, development, and productivity. Seaweed extract (SWE) and alginic acid (AA) are considered effective biostimulants for their growth promoting ability and other regulatory roles to ameliorate abiotic stresses in plants. Therefore, the current experiment was conducted to evaluate the potential role of SWE and AA in conferring drought-induced damages in rapeseed. Fifteen-day-old rapeseed (*Brassica campestris* cv. BARI Sarisha-17) seedlings were exposed to drought maintaining soil moisture of 20%, and foliar application of SWE (0.02%) and AA (0.02%) were done at 3 d interval from 15 days after sowing until flowering. The experiment was conducted following a completely randomized design (CRD) with three replications. Under drought, plants exhibited osmotic stress indicated by lower relative water content and higher proline content in plants. Moreover, higher accumulation of lipid peroxidation, hydrogen peroxide, and electrolyte leakage induce oxidative stress due to disruption of antioxidant defense and glyoxalase system upon exposure to drought which ultimately retard growth and yield attributes. However, the application of SWE and AA enhanced the ascorbate and glutathione contents and accelerated the activities of ascorbate peroxidase, dehydroascorbate reductase, glutathione reductase, glutathione peroxidase, catalase, glyoxalase I, and glyoxalase II which mitigated drought-induced oxidative damages. Furthermore, improvement of water content with a declination of proline and potassium ion content was also observed when supplemented with SWE and AA to the drought affected plants. Reduction of oxidative stress and improvement of water balance in the drought affected plants ultimately enhanced the growth, biomass, and yield attributes. The findings indicated that the SWE and AA are efficient in mitigating the deleterious effect of drought-induced damages in rapeseed through enhancing antioxidant defense and glyoxalase system. Therefore, SWE and AA would be promising biostimulants to ensure the yield of rapeseed under drought.

Keywords: Drought, biostimulants, stress elicitors, antioxidant defense, bioactive compounds

Climate change adaptation and farm livelihood capitals in coastal Bangladesh: Insights from panel data analysis

Md. Mamun-ur-Rashid

Department of Agricultural Extension and Rural Development, Patuakhali Science and Technology University, Bangladesh
*Correspondence: murashid@pstu.ac.bd

Abstract

Climatic variability and frequent occurrence of extreme weather events on the coastline of the Bay of Bengal posed numerous challenges to people's livelihood. This study examines climate change adaptation strategies, farm livelihood capitals and the effect of livelihood capitals on climate change adaptation strategies using panel data collected from 450 randomly selected respondents in the mid-coastal areas of Bangladesh. Subsequently, this article revealed a set of climate change adaptation strategies (intensification, diversification, alteration, mitigation, transformation and migration) and developed a composite index of these strategies using a principal component analysis-based weighting scheme. The finding of this study reveals that from the year 2019 to 2020 progressive changes took place in intensification and diversification strategies, while a negative trend was observed in the adoption of migration strategies. The random effects of censored panel regression show that the progress of intensification strategies was positively influenced by irrigation access, irrigation water sources, annual income, taking loans, family labor availability, contact frequency with extension agents, internet access, perception of the human activity responsible for climate change while negatively influenced by marital status, number of plots, leased land, ease of getting loan, and belief in sea level rise. Progress in diversification positively relied on ownership of tractors, cellphones and cows, annual income; homestead land, current fallow land, organic fertilizer use, etc., and negatively relied on age, income source, marital status, time of accessing the market, farm area, ownership of thresher, average size of loan, internet access, perception of human activities responsible for climate change, etc. This research suggests the development of irrigation facilities, provision of agricultural credits in easy terms and conditions, enhanced extension contact, access to the internet and cellphone, and awareness building on climate change issues for the enhancement of intensification and diversification strategies.

Keywords: Climate change, farm livelihood capitals, coastal farmer, agricultural marketing

Morphological characterization of 34 coloured rice genotypes: Seed and seedling descriptors

Most. Morsada Khatun, Md. Kabir Uddin, A.K.M. Golam Sarwar and Md. Solaiman Ali Fakir

Laboratory of Plant Systematics, Department of Crop Botany, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh
*Correspondence: morsada.khatun96@gmail.com

Abstract

Black (coloured) rice, a group of traditional rice cultivars, is rich in anthocyanins, antioxidants, vitamins and fibres, which possess various health benefits including preventing cancer, diabetes and heart disease. Bangladesh harbours a huge resource of rice genotypes possessing a treasure of genetic materials that are lesser known to the market front but hold great significance not only for farmers but also for local consumers. A (pot) experiment was conducted at Pot House of the Department of Crop Botany, Bangladesh Agricultural University during Kharif season of 2021 (April to July) to evaluate the performance of 34 coloured rice genotypes of Bangladesh. The experiment was laid out in a Completely Randomized Design (CRD) with three replications. Polymorphism was observed among the studied genotypes for grain and seedling descriptors. The Hull colour of the grain showed wide variation – yellow (13), brown (13), red-brown (5), black (2) and brown with a black strip (1). Only six genotypes were found with awned grains. The presence of hair was observed in all the genotypes however, variation was observed in the density of hairs. The length (L), width (W) and thickness (T) of the grains (with husk) ranged between 7.22-11.02 mm, 2.09-3.56 mm and 1.55-2.24 mm, respectively. The ratios of L/W, L/T and W/T were recorded between 2.20-4.73, 3.49-5.75 and 1.22-1.64, respectively. Grain shape based on the L/W ratio was grouped into three groups viz. semi elongated (24%), elongated (50%) and very elongated (26%). Seedling descriptors viz. root length, shoot length, number of leaf plant-1, tiller plant-1 and dry weight at 25 days after sowing (DAS) ranged between 6.83-22.57 cm, 22.05-34.08 cm, 3.22-5.44, 0.0-1.03 and 0.1-0.4 g, respectively. Root volume and SPAD value at 63 DAS varied between 9.57-32.59 cc and 33.48-88.33, respectively. The rice genotypes viz. Faridpur-1, 2, 3 & 4, Faridpur-6, Birui (Mymensingh), Gaibandha, Pahari Sada, and Binadhan-20, performed better in terms of seedling descriptors. There is high variability among the rice genotypes, which presents great importance for breeding programs or genetic studies on this species.

Keywords: Coloured rice, polymorphism, breeding materials

Evaluation of *Corchorus olitorious* accession lines to figure out salt tolerance potentiality in a typical field condition

Mohammad Saiful Alam Sarker

Basic and Applied Research on Jute (BARJ) Project
Bangladesh Jute Research Institute.
Manik Mia Avenue, Dhaka-1207.
*Correspondence: saiful.barj@gmail.com

Abstract

Coastal areas of Bangladesh are facing tremendous setbacks to produce crops due to soil salinity. Bangladesh Jute Research Institute (BJRI) has a total of 1410 *Corchorus olitorious* accession lines collected from home and abroad. To evaluate salt tolerance potentiality of these accessions six salt concentrations (0 mM, 80 mM, 100 mM, 120 mM, 140 mM and 160 mM) with 0.8% semi solid agar media in the petri-dish were used. Eighteen out of 1410 accessions germinated 120 mM and above in the Petri- dish were primarily selected as salt tolerant lines. These 18 accession lines along with O-9897 as a check variety were sown in the subsequent growing season following the broadcasting method in a plot of Boyerchar, Hatiya, and Noakhali having soil salinity 20 ds/m. In the real field condition, four accession lines (1411, 1432, 1434, 2391) and O-9897 were not germinated where eight accession lines {(1356, 1383, 1454, 1454 (1), 1459, 2072(1), 2116 and 2423(1)} died from 7-20 days after germination. Rest six accession lines (1345, 1365, 1370, 1432, 2072, 2423) survived 45 days with a maximum 6-inch plant height. It might be concluded that survived six accessions may possess genetic potentiality to tolerate salinity. Hence, to develop salt tolerant *C. olitorious* jute variety, these lines can be taken into consideration for further study with modern molecular breeding approaches.

Keywords: *C. olitorious* accession lines, fibre crop, salinity

Morphophysiology and yield responses of black gram under waterlogging stress

Miss. Afsana Mimi, Md. Moinul Haque, Kamal Uddin Ahamed, Jannaul Ferdous, Mst. Natasha Yesmin Tithi, Md. Monir Hossain, Kamrun Nahar*

Department of Agricultural Botany, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh.
*Correspondence: knahar84@yahoo.com

Abstract

Waterlogging is a major limitation of crop production. In tropical and subtropical regions, excessive rainfall is the major constraint for crop production. Black gram (*Vigna mungo* L.) is a waterlogging sensitive legume crop. 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 with the objectives of assessing the effects of different waterlogging levels on the morphological, physiological and yield performance of black gram. *Vigna mungo* L. cv. BARI Mash-4 was used as a test crop plant under various levels of waterlogging (3, 6, and 9 days) with a completely randomized design and four replications. Waterlogging treatment was given thirty days after sowing. In the present study, changes in morphological, physiological and yield contributing characters were demonstrated due to three days, six days and nine days waterlogging stress. Waterlogging stress adversely affected different physiological processes which is clear from different physiological attributes. Waterlogging altered the proline level and relative water content of the black gram plant which indicates the osmotic imbalance. Increased malondialdehyde (MDA) content and decreased membrane stability index (MSI%) were noticed in black gram plants under various days of waterlogging stress. These indicate waterlogging-induced oxidative stress. The chlorophyll content of black gram plants gradually decreased under water logging stress. The phenotypic appearance of the waterlogged plants also showed a visible damaging effect. Root length, plant height, number of branches plant-1, number of leaves plant-1, number of pods plant-1, number of seeds pod-1, number of seeds plant-1, thousands seed weight, grain yield were adversely affected by the water stress condition. Therefore, the present study investigated that altered physiology and biochemistry of waterlogged black were responsible for decreasing growth parameters and yield attributes which finally decreased the yield of black gram plants.

Keywords: Waterlogging, legume, abiotic stress, axoia, oxidative stress, chlorophyll

Responses of flax (*Linum usitatissimum* L.) genotypes to salt stress

Kaisher Ahmed

Department of Crop Botany
Bangladesh Agricultural University, Mymensingh-2202
*Correspondence: baukaisher@gmail.com

Abstract

Flax (*Linum usitatissimum* L.; Family Linaceae), is one of the neglected crops for its poor yield due to the unavailability of improved cultivars in Bangladesh. Salinity, one of the major problems in the world's soils, is the main obstacle to agricultural productivity. Two experiments were, therefore, conducted to study the effect of salinity on seed germination, growth and yield of flax genotypes. Ten flax genotypes namely BD-10703, BD-10701, Chilmari, Hatibandha, Faridpur, BD-10700, BD-10710, BD-10696, BD-7145 and BARI Tishi-1 were used as experimental materials. The germination and seedling growth experiment was conducted at the growth chamber of the Department of Crop Botany, Bangladesh Agricultural University, and experimental treatments (salinity concentrations) were 0 (control), 40, 80 and 120 mM. The experiment was laid by following a completely randomized design with three replications. The second experiment was carried out to evaluate the growth and yield performances of these flax genotypes at the Field Laboratory, Department of Crop Botany during the Rabi season of 2021-2022. Plants were grown in pots (13 Liter Bucket) filled with eight kg of soil and two kg of well-decomposed cowdung. Different morphological, yield and yield contributing descriptors such as root and shoot length, root and shoot fresh weight, root and shoot dry weight, stem diameter, branch (no.) plant-1, inflorescence length, primary branch inflorescence-1, filled and unfilled capsule plant-1, capsule length and diameter, seed no. capsule-1, thousand seed weight and seed yield plant-1 were recorded at different salinity levels (0 and 100 mM NaCl). In the first experiment, flax genotypes had a significant influence on seed germination and seedling growth descriptors and those characters were also significantly affected by salinity stress. Considering the germination percentage and seedling growth descriptors; BD-10710, Faridpur, BD-10700 and BD-10703 appeared salt-tolerant among the genotypes. According to the second experiment, salinity had a significant influence on all the studied yield and yield attributing descriptors; those characters were also significantly affected among the flax genotypes. Considering the plant height, stem diameter, branch (no.) plant-1, filled capsule plant-1, seed (no.) capsule-1, thousand seed weight and seed yield plant-1; BD-10710, BD-7145 and Chilmari appeared to be salt-tolerant among the studied genotypes.

Keywords: flax (*Linum usitatissimum* L.), oil seed crop, salinity

Diversity and therapeutic properties of Phyllanthus plants at Bangladesh Agricultural University Botanical Garden—a review

Tanveer Hussain, Ashfika Tabassum, Md Jahid Hasan Jone, Md Ashrafuzzaman*

Laboratory of Medicinal Plant Resources
Department of Crop Botany, Bangladesh Agricultural University, Mymensingh- 2202
*Correspondence: ashrafcbot@bau.edu.bd

Abstract

Phyllanthaceae, a family of flowering plants with two ovules in each ovary locule, is widely cultivated for its medicinal properties and dyeing quality as well. Plants of this family are also used for a variety of ethnobotanical and religious purposes. A survey was conducted to update the database of available plants of the family Phyllanthaceae conserved at the Bangladesh Agricultural University Botanical Garden. A total of twenty-two (22) species belonging to nine (9) genera were recorded, where Phyllanthus was the most dominant genus with six species, followed by Antidesma and Glochidion with four, Bridelia with three, and Aporosa, Baccaurea, Bischofia, Breynia, Flueggea containing one species each. In terms of habit formation, shrubs were the highest percentage (45%), followed by trees (40%) and herbs (15%). According to IUCN conservation categories - 14 plant species are categorized as "Least Concern," while the remaining species are categorized as "Not Evaluated." A short description of each species with its family and uses has been shown in the text. Some photographs and a graphical presentation with their classification and categories based on a few parameters have been added for a better conclusion.

Keywords: Phyllanthaceae, biodiversity, flowering plants

Role of molybdenum in improving physiology, growth and yield in salt affected mung bean plant

Mst. Natasha Yeasmin Tithi, Kamal Uddin Ahamed, Jannatul Ferdous, Miss. Afsana Mimi, Md. Monir Hossain, Kamrun Nahar*

Department of Agricultural Botany, Faculty of Agriculture
Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh.
*Correspondence: knahar84@yahoo.com

Abstract

Salinity is one of the major abiotic stresses that inhibits the growth, development, and productivity of crops. The growth and yield of salt sensitive legume crops are severely affected under salinity. Plant scientists are working to reveal ways of reducing the damaging effects of salt stress in plants. Exogenous use of protectants can be effective in improving salt tolerance in legumes including mung bean. Molybdenum (Mo), an indispensable microelement, is involved in multiple metabolic and cellular processes in higher plants. Molybdenum performs an important role in improving the nitrogen fixation process and increases the antioxidant system under salt stress, thus increasing the production of pulses and legumes. But the role of Mo under salt stress was investigated hardly. 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 examine the effects of different salinity levels on the morphological, physiological and yield performance and the role of Mo in improving the above mentioned traits of mung bean plant under salt stress. *Vigna radiata* L. cv. BARI Mung-6 was used as a test crop plant under various levels of salinity (4 dS m^{-1} and 6 dSm^{-1}) and Mo (5µM and 10 µM) with complete randomized design and three replications. Treatments were given at 35 days after seed sowing and maintained throughout the growing period. Salt stress decreased different growth parameters like plant height, number of leaves, number of branches, dry weights, relative water content (%RWC), chlorophyll content, K^+ and Ca^{2+} content, and membrane stability index (MSI%). Salt stress increased malondialdehyde (MDA), H_2O_2, proline content, ascorbate (AsA), glutathione (GSH), root and shoot Na content. Yield attributes (No. of pod $plant^{-1}$, No. of seed pod^{-1}, pod length, 1000 seed wt.) and yield (pod and stover yield) decreased due to exposure to salt stress. On contrary, Mo application with salt stress improved antioxidant defense in the plant, decreased oxidative damage, decreased Na^+ accumulation and increased K^+ and Ca^{2+} accumulation in root and shoot, improved all the studied physiological and growth parameters compared to salt stress alone. As a result, Mo-treated mung bean plants showed improved yield attributes and higher yield under salt stress. The results of the present study revealed Mo-induced effects on growth and physio-biochemical attributes in salt-affected mung bean plants. Mo supplementation has the potential to enhance antioxidant defense, maintain ionic homeostasis, and improve physiology, growth, yield attributes and yield. The results indicate the potentiality of Mo in improving the salt tolerance of mung bean plants.

Keywords: Molybdenum, nutrient, salinity, abiotic stress, antioxidant defense, osmotic stress, ionic homeostasis

Growth, yield attributes and yield of tomato (*Lycopersicon esculentum* Mill) as influenced by indole acetic acid

A M Khaled

Youth Training Center, Gaibandha
*Correspondence: khaledytc9780@gmail.com

Abstract

The experiment was conducted at the research field and laboratory of the Department of Crop physiology and Ecology, Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh during the period from December 2013 to April 2014. The experiment was laid out in two factors randomized complete block design with three replications including three concentrations of indole Acetic Acid (0, 100 and 200 ppm) and three tomato varieties (BARI tomato 7, Manik and Ratan). Plant height, number of leaves and number of branches, days required for first flower initiation, days required for 50% flowering, days required for fruit set, fruit cluster plant^{-1}, fruit plant-1, weight tomato^{-1}, yield plant^{-1}, yield plot^{-1} and yield hectare were significantly influenced by the combined application of IAA and varieties of tomato BARI tomato -7 had the highest fruit yield with 100 ppm IAA and the lowest yield was observed in Ratan with 0 ppm IAA. IAA treated plots showed better. Performance for growth parameters and yield compared to control condition and 100 ppm IAA was more suitable than the 200 ppm IAA for higher yield of tomato cultivation. Among the treatment combination, BARI tomato-7 with 100 ppm IAA was superior, Ratan with 0 ppm IAA was inferior and BARI tomato-7 with 200 ppm IAA Manik with 200 ppm IAA and Ratan with 200 ppm IAA treated plots showed the intermediate results for yield and yield components.

Keywords: Fruit yield, IAA, yield attributes, tomato

Zinc-induced improvement of physiology and yield of salt affected mung bean plants

Jannatul Ferdous, Kamal Uddin Ahamed, Mst. Natasha Yeasmin Tithi, Miss. Afsana Mimi, Md. Monir Hossain, Kamrun Nahar*

Department of Agricultural Botany, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh.
*Correspondence: knahar84@yahoo.com

Abstract

Salinity is a major environmental stress among different abiotic stresses which considerably suppresses crop production worldwide through its injurious effects on plant growth and development of various leguminous crops including mung bean. The application of various micronutrients could help the plant cope with salt stress. Among the micronutrients, zinc (Zn) plays important roles in improving the physiology, development and yield response of mung bean by mediating salt stress due to their involvement in diverse mechanisms, i.e., reduced ion toxicity, maintenance of water balance, improved mineral uptake and assimilation, modification of different gas exchange attributes, and decrease in oxidative stress. Considering the above-mentioned roles of Zn, 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. The objectives of the study were to assess the effects of different salinity levels on physiology, development and yield response and the role of Zn in improving the above mentioned traits of mung bean plants under salt stress. Mung bean (*Vigna radiata* L. cv. BARI Mung-6) was used as the test crop plant under various levels of salinity (4 dS m^{-1} and 6 dS m^{-1}) and Zn (15 µM and 30 µM) with complete randomized design and three replications. Treatments were given at 35 days after seed sowing and maintained throughout the growing period. Salt stress decreased various growth parameters like plant height, number of leaves, No. of branch plant-1, chlorophyll content, root shoot K^+ and Ca^{2+} content, relative water content (%RWC), membrane stability index (MSI%), dry weight. Salt stress increased root shoot Na^+ content, malondialdehyde (MDA) level, H_2O_2 level, decreased ascorbate (AsA) and increased glutathione (GSH) contents. Yield attributes (No. of pod $plant^{-1}$, No. of seed $plant^{-1}$, pod length, 1000 seed weight) and yield (pod and stover yield) decreased due to exposure to salt stress. In contrary, Zn application with salt stress decreased the Na^+ accumulation in root and shoot, increased root and shoot K^+ and Ca^{2+}, and improved all the studied physiological and growth parameters, compared to salt stress alone. As a result, Zn treated mung bean plants showed improved yield attributes and higher yield under salt stress. The outcomes of this research revealed that the application of Zn in NaCl-stressed mung bean plants decreased ionic toxicity and improved ionic homeostasis. Zinc supplementation also enhanced the activities of antioxidant enzymes and the levels of non-enzymatic antioxidants which helped to decrease oxidative damage under salt stress. The improvement of physiology, growth, development and yield of mung bean plants were evident in Zn supplemented mung bean plants under salt stress.

Keywords: Zinc, micronutrient, salinity, legume, abiotic stress, ionic toxicity, osmotic homeostasis, antioxidant defense

Physio-anatomical appraisals of field pea (*Pisum sativum* L.) under salt stress

Md. Ayub Hossain Khan[1], M A Baset Mia[2]*, J U Ahmed[2], MA Karim[3] M Mehfuz Hassan[4] and H I Khan[2]

[1]Agronomy Division, Bangladesh Agricultural Research Institute, Gazipur
[2]Department of Crop Botany, [3]Department of Agronomy, [4]Department of Genetics and Plant Breeding Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur 1706, Bangladesh
*Correspondence: miabaset@bsmrau.edu.bd

Abstract

Field pea (*Pisum sativum* L.) is a high-value pulse as well as a vegetable crop, widely grown in Bangladesh; and its yield is severely affected by biotic and abiotic stresses, especially the salinity. An experiment was conducted to observe the anatomical and physiological characteristics of field peas under salt stress conditions. To satisfy these objectives, field pea genotypes were grown in the vinyl house, Department of Crop Botany, Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur under hydroponic conditions. Eight selected field pea genotypes (BD 4175, BD 4182, BD 4225, BD 6944, BD 4176, BD 4193, BD 4493 and BD 4496) and four salinity levels (16, 12, 8 and control dSm −1) were used for this experiment. The results reflected that under higher salinity stress, the growth rate of stem dry matter, leaf dry matter, root dry matter and total dry matter of field pea genotypes were decreased, but the reduction percentage was minimum in BD 4175 than in BD 4182. In anatomical attributes, especially the stem xylem area and phloem area were also reduced in salinity stress but a lower reduction was observed in BD 4182. Stomata density, stomata aperture, pore size, upper stomatal aperture diameter, lower stomatal aperture diameter, upper stomatal pore area and lower stomatal pore area was given higher value in BD 4175 at different levels of salinity stress. The lowest effect of salinity stress was found in BD 4175 and the highest effect was observed in BD 4182. In case of physiological attributes, salinity stress reduced chlorophyll a, chlorophyll b and total chlorophyll content for the field pea genotypes. The accumulation of proline was increased in field pea genotypes under salt stress. The genotype BD 4175 had the greatest increase in proline than the other genotypes. The H_2O_2 and MDA content in the genotypes also increased with the rise in salinity but the increment was lower in the relatively tolerant genotype (BD 4175).

Keywords: Anatomical traits, physiological traits, salinity stress, field pea

Morphological variation of strawberry genotypes in Sylhet region

Afroza Akter, Md. Moudud Ahmod, Tasfia Tahzin, Md. Masum Reza and Sharifunnessa Moonmoon*

Department of Crop Botany and Tea Production Technology, Faculty of Agriculture, Sylhet Agricultural University, Sylhet 3100, Bangladesh
*Correspondence: moondj311@yahoo.com

Abstract

Strawberries are very popular throughout the world as well as among the people of Bangladesh for their attractive color, excellent taste and flavor. Due to the high economic return per unit area, strawberry cultivation in Bangladesh is becoming more popular and total yearly production is increasing gradually. Although strawberries are growing in different regions of Bangladesh yet in the Sylhet region, a small quantity of strawberries is grown in the home garden, but not on a large scale for production purposes, as in other districts. There are no suitable genotypes for this region available as the soil and climate of the Sylhet region are different from other areas of Bangladesh. Thus, the objective of the research was to study the morphological features of strawberry genotypes available in the Sylhet region. For this purpose, a visit was done to various nurseries in the Sylhet region and collected 10 unknown genotypes. After matching morphological characteristics, five different genotypes were identified and planted in the field at the Department of Crop Botany and Tea Production Technology, Sylhet Agricultural University. Various morphological data such as plant height, plant spreading, number of leaves per plant, number of runners per plant, number of suckers, petiole length, crown diameter, leaflet length, leaf breadth, leaf area etc. were recorded. After the seedling establishment, data were collected at 15-days intervals. Results revealed that three genotypes performed better in the field than the rest of the two. They were vigorous, produce a large number of runners for future generations and survived in the long run. The plants are still growing in the field and physiological, reproductive and yield data are yet to be collected. A conclusive inference can be drawn about the genotypes when all the data will be available. If promising results are obtained, farmers in the Sylhet region will be interested in cultivating strawberries commercially.

Keywords: Strawberry, cultivation, climate, morphology, physiology, yield

Leaf level gas exchange capacity and water-use efficiency of hybrid wheat

Sripati Sikder[1]*, Daniel Tan[2] and Richard Trethowan[2]

[1]Department of Crop Physiology and Ecology, Faculty of Agriculture, HSTU, Dinajpur
[2]Faculty of Agriculture and Environment, The University of Sydney, NSW 2570, Australia*
*Correspondence: srisikder@gmail.com

Abstract

High temperature is a severe threat to wheat production in many countries particularly when it occurs during the reproductive phase. Twelve wheat genotypes including 9 hybrids [F_1(2), F_1(3), F_1(4), F_1(5), F_1(6), F_1(7), F_1(8), F_1(9), F_1(10)] and 3 commercial cultivars (Suntop, Sunmate and Spitfire) were grown in pots under controlled-environment greenhouse [22/15 ºC (day/night)]. Heat stress [35/22 ºC (day/night)] was applied in a growth chamber for three days at anthesis. Suntop is the male parent of the F_1(6) hybrid. The objective of the present study was to assess genetic variation for heat tolerance among studied wheat hybrids and commercial cultivars by evaluating differences in their net photosynthesis rate, stomata conductance, transpiration rate, intercellular CO_2 concentration, carboxylation capacity, transpiration efficiency and leaf level water-use-efficiency. Results showed that genetic variations in net photosynthesis, water-use efficiency and other gas exchange characteristics were very prominent among studied wheat genotypes under heat treatments. Most of the wheat genotypes showed increased net photosynthesis rate, stomatal conductance, transpiration rate and intercellular CO_2 concentration at heat stress compared to the control. But in transpiration efficiency and leaf-level water-use efficiency, maximum wheat genotypes showed decreased values of these parameters at heat stress conditions. Hybrid varieties performed better in most physiological parameters compared to commercial cultivars. Hybrid variety F_1(6) was found to be superior in maximum studied characteristics than its male parent Suntop.

Keywords: Wheat, heat stress, photosynthesis, water-use efficiency

Evaluation of selected tea clones performance against drought including biochemical changes in liquor quality

Rashidul Hasan[1]*, A F M Saiful Islam[1], Md. Abdul Maleque[2]

[1]Department of Crop Botany and Tea Production Technology, Sylhet Agricultural University, Sylhet-3100, Bangladesh
[2]Department of Entomology, Sylhet Agricultural University, Sylhet-3100, Bangladesh
*Correspondence: rumel.sau@gmail.com

Abstract

Drought is a very common phenomenon nowadays in tea cultivation in Bangladesh. Drought is one of the main limiting factors affecting tea yield and quality. Tea plants, widely cultivated in the tropics and subtropics, are often exposed to drought stress. Under drought stress, the yield of tea is reduced by up to 40% by wilting their leaves. Drought stress resistance evaluation of selected tea (Camellia sinensis) clones was conducted in the nursery of Chandpore tea estate, Nalua tea estate and Tea Germplasm Center of Sylhet Agricultural University in 2021 and continued. Single-leaf stem cuttings of 87 selected tea clones from 13 tea estates was collected and raising them in 03 nurseries. The growth performance of cuttings was recorded with environmental parameters. The highest survivability rate was observed in ML9Y1 (88%) whereas the highest mortality rate was recorded in ML8Y1 and SAU3Y1 (44%). ML6Y1 showed the best result in leaf number (07 nos.) and leaf length (10.2 cm) whereas SAU4Y1 showed the best result in leaf breadth (3.9cm). The highest number of branches was recorded in LK2Y1 (04 nos.). In case of shoot length, LK3Y1 recorded the highest (17.7cm). The survivability study of 30 selected tea clones with 03 check varieties (BT2, BT19, Teenali) was started in controlled condition (screen house) and field condition with two treatments—regular watering (35-45% field capacity) and supplementary watering (15-25% field capacity) with 03 replications. We arranged 264 soil pots (33 × 4 × 2) in each screen house. Pot size is 12 inches in diameter and 10 inches in depth containing 15 kg of soil. One of our main objectives is to evaluate the drought tolerance of the clones studied. So, we studied root performance under different watering treatments from the initiation of the root. ML4Y1 showed the highest number of roots (15 nos.) whereas SAU3Y1 showed the highest length of roots (10.2cm). The data logger is being used to record the microclimatic data. Field and laboratory evaluation will be done to develop tea clones having better growth performance and improved aroma (liquor) quality. Bangladesh's tea industry has been facing many challenges and drought is the major one. To increase the production of tea, it is necessary to develop high-yielding varieties containing biotic and abiotic stress-tolerant properties, premium liquor quality with good aroma, attractive color, and appropriate production and protection technologies.

Key words: Tea, drought stress, clones

Aerobic composting of poultry litter wastes using different bulking agents

Ummeh Esha Zannatun Kobra, Abu Khayer Md Muktadirul Bari Chowdhury*, Md. Mamunur Rashid and Md. Maniruzzaman Bahadur

Department of Crop Physiology and Ecology, HSTU, Dinajpur-5200, Bangladesh.
*Correspondence: minarbari07@gmail.com

Abstract

Till today raw poultry litter is used for fish cultivation (directly used in the pond) and/ or directly used as fertilizer in soil for crop production, which is detrimental to the environment and human health. In the context of Bangladesh, the composting of poultry waste is not well documented in the literature though it contains high organic fertilizer values. To consider this view, one pilot-scale experiment was carried out to produce good quality, low-cost composting technology from poultry litter (PL) using rice husk ash (RHA) and saw dust (SD) as bulking agents. For this experiment, three square-shaped bins were used with the dimensions of 0.95 m long, 0.93 m wide and 0.83 m high and a total volume of 0.679 m3. To monitor the composting process and evaluate compost quality, some physicochemical parameters such as temperature, moisture content, pH, electrical conductivity, organic matter, volatile solids, total solid, total organic carbon, total Kjeldahl nitrogen, total phosphorus, potassium were measured at different composting phases. The composting period lasted 75-80 days. Experimental results showed that even after short composting periods, the quality of the final product remained high. To achieve good quality compost, poultry litter should be used in higher ratios (1.5:1) with bulking agents (RHA and SD). The amount (volume of humidifying agents) and time (frequency) of moisture addition also played an important role during composting. Poultry litter can produce a high quality soil amender having no phytotoxicity. Nevertheless, composting duration and bulking agents and their ratios are crucial factors that determine the quality of the final product. A full-scale compost unit was designed based on the experimental results. For a typical small-sized poultry farm, having 1500-2000 poultry birds, a total area of about 10 m2 is needed to compost the entire annual produced poultry waste.

Keywords: Poultry litter wastes, composting, bulking agent, and phytotoxicity

Challenges and opportunities of C_4 rice bioengineering for rice food security

Md. Sazzadur Rahman[1]*, SM Hisam Al Rabbi[2], Hirendra Nath Barman[1], Munnujan Khanam[3], Md. Hridoy Hossain[1], Mst. Salma Pervin[1], Zeba I. Seraj[4] and Md. Shahjahan Kabir[5]

[1]Plant Physiology Division, [2]Biotechnology Division, [5]Director General, Bangladesh Rice Research Institute (BRRI), Gazipur-1701.[3]Coordinator for Advanced Studies and Research; [4]Department of Biochemistry and Molecular Biology, University of Dhaka
*Correspondence: sazzadur.phys@brri.gov.bd

Abstract

Rice is more than just a grain; it is a necessity for nearly half of the world's population, including Bangladesh. In the face of a rising population, depleting natural resources, and climate change risks, Bangladesh faces a significant challenge in maintaining sustainable rice production. Until now, rice breeders have primarily focused on combining favorable alleles to create high yielding inbred and hybrid varieties. Mining for yield-enhancing alleles has become more difficult as rice genetic bases have been narrowed by releasing and cultivating similar foundational parents and derived varieties such as IR8 and WA-CMS for inbreds and hybrids, respectively. As a result, it is crucial to look into alternative sources of yield-boosting techniques. One way to significantly improve global food security is to incorporate C_4 photosynthesis into C_3 rice. Because of differences in canopy photosynthesis, the radiation uses efficiencies of C_3 and C4 plants differ by about 50%. The radical idea of incorporating the C_4 photosynthesis pathway into rice has been sparked. When grown in hot and dry conditions, the C_4 photosynthesis system in C_3 rice can provide immediate benefits by increasing photosynthesis by about 50% and thus improving nitrogen and water use efficiencies. Regarding the evolution of C_4 photosynthesis, there are two contrasting hypotheses: the master switch hypothesis and the incremental gain hypothesis. Two distinct research strategies must be pursued in parallel to maximize the success of C_4 engineering. To develop a C_4 rice, the essential elements of C_4 photosynthesis, primarily the C_4 metabolic pathways, must first be engineered into a common rice cultivar, followed by manipulation of the leaf anatomy and related metabolite transport process to meet the high efficiency requirement. This approach is limited due to a lack of understanding about genetic control of Kranz anatomy, dimorphic chloroplast formation, cellular metabolism regulation, and metabolite trafficking. According to the "master switch" hypothesis, the key to developing C_4 rice is locating the master switch that initiates a cascade of actions that differentiated it. BRRI has taken the first steps toward its lofty goal of developing C_4 rice. Researchers recently claimed that Uri dhan (*Oryza coarctata*) has C_4 properties based on anatomical, cell ultrastructure, and molecular evidence. We've started looking into the anatomical differences between Uri dhan and rice leaves based on this information. According to our findings, Uri dhan has more veins and a denser vascular bundle. The mesophyll cells and vascular bundle in Uri dhan were both well-organized and highly composed in comparison to rice. Since Uri dhan is an allo-tetraploid species, hybridization with modern diploid rice is difficult. However, we have begun hybridizing Uri dhan with an induced auto-tetraploid Latisail, followed by embryo rescue, to produce hybrid progenies. This attempt, along with editing the hexokinase gene OsHXK1 of Uri dhan using CRISPR/Cas9, could bring us closer to developing the first C_4 prototype. Although developing C_4 rice is a worthy goal, optimism can be found in the polyphyletic evolution of C_4 photosynthesis.

Keywords: C_3, C_4, photosynthesis, C_4 rice

Application of diverse marker systems to track SNP linked to qHTSF4.1: a quantitative trait locus for rice heat tolerance

Mamunul Hasan[1], Md. Hridoy Hussain[2], Munnujan Khanam[2], Avijit Biswas[2], Tuhin Halder[2], Hirendra Nath Barman[2], Mst. Salma Pervin[2], Ujjal Kumar Nath[1], Zeba I. Seraj[3] and Md. Sazzadur Rahman[2]*

[1]Department of Genetics and Plant Breeding, Bangladesh Agricultural University, Mymensingh - 2202, Bangladesh
[2]Plant Physiology Division, Bangladesh Rice Research Institute, Gazipur-1701
[3]Department of Biochemistry and Molecular Biology, University of Dhaka
*Correspondence: sazzadur.phys@brri.gov.bd

Abstract

The importance of ensuring food security and ending hunger was acknowledged as a top priority at COP27, along with the unique exposures of food production systems to climate change's negative impacts. Bangladesh faces significant challenges in ensuring the long-term viability of its rice production due to the country's rising population, dwindling natural resources, and exposure to the effects of climate change. High temperature or heat stress is a serious problem for rice crops in Bangladesh during all growing seasons. Heat stress is most harmful during the anthesis and the grain filling stages, when the temperatures rise>35 ℃ and >25 ℃during the day and night time, respectively. It can significantly reduce rice yield and quality. The current study sought to introgress a previously identified heat tolerant QTL, qHTSF4.1, to improve the heat tolerance of currently popular modern rice varieties. As it is difficult to use, we employed multiple strategies to track this QTL in breeding. Firstly, we searched genomic databases for available SSRs and InDels near the genomic position of qHTSF4.1. A close InDel (R4M30) was chosen to screen backcross populations. Then, based on the linked SNP, we designed a CAPS marker that requires the restriction enzyme AluI [A/T]GCT. R4M30 was therefore solely utilized to identify the genomic region containing qHTSF4.1, while designed CAPS was used to confirm its existence. However, this technique is time-consuming and costly, and some QTL positive lines may be missed during screening and often showed monomorphic for some parental combinations while using R4M30. So, we changed our genotyping strategy once again. Recently, the KASP (Kompetitive Allele Specific PCR) genotyping technique was developed for breeding. This method is gel-free, but it requires Real-Time PCR. A total of 36, 17, 7 BC1F1 progenies of BRRI dhna48, BRRI dhan62, and BRRI dhan71 were genotyped. Among the tested progenies, 8 from BRRI dhan48 were shown to be heterozygous by using R4M30, but an extra one progeny was discovered when using KASP. However, progenies of BRRI dhan62 displayed a monomorphic band in the gel for R4M30, but KASP showed polymorphically and was able to identify 10 of them as heterozygous. Again, for the progenies of BRRI dhan71, 5 were identified as heterozygous by R4M30; however, while the population was tested through KASP, all possessed the same SNP as the donor parent N22. Based on this evidence, the KASP system can be considered a potential genotyping tool to be used in breeding programs for the improvement of crops.

Keywords: QTL, KASP, heat stress, rice

Morpho-physiological responses of rice to salicylic acid under drought stress

Md. Tofail Hosain[1], Md. Saidur Rahman[1] , Mohammed Nuruzzaman[2], Mostarak Hossain Munshi[3] and A.S.M. Fazle Bari[4]

[1]Department of Agricultural Botany, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka-1207
[2]Department of Agriculture, Faculty of Science, Noakhali Science and Technology University, Noakhali-3814
[3]Department of Soil Science, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka-1207
[4]Global Centre for Environmental Remediation GCER, Faculty of Science, The University of Newcastle, Callaghan, NSW 2308, Australia
*Correspondence: saidur34@sau.edu.bd

Abstract

Drought stress is one of the foremost devastating abiotic stresses negatively affecting the acute growth of rice and biological processes. The exogenous application of salicylic acid (SA) acts as an endogenous phytohormone and functions as a signal molecule that controls plant physiological processes enhancing drought tolerance. 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 investigate the impact of exogenous application of salicylic acid on morpho-physiological responses in rice plants under drought conditions. Oryza sativa L. cv. BRRI dhan28 was used as a test crop. The field experiment was arranged under a two factorial randomized complete block design (RCBD) containing three replications. The SA treatments consisted of 0, 250, 500, 750 and 1000 µM concentrations and drought stresses were slight, moderate and severe. Treatments (SA) were applied in three installments at 20, 30 and 40 days after transplanting (DAT). Exposure of plants to drought stress significantly diminishes the leaf number, leaf area index, leaf water potential, relative water contents, leaf membrane stability index and pigment content. In contrary, exogenous application of SA during drought stress has growth-promoting and stress priming effects on rice plants, hence reducing yield limitation. Following the treatments, higher leaf number, leaf area index, relative water content, leaf membrane stability index and pigment content were obtained in 750 µM of SA application compared to the alternative treatments and management of plants. As a result, SA treated rice plants showed improved growth and morphology attributes under drought stress. The findings of the study imply that SA can be utilized as a protective agent to increase water use efficiency, osmotic management, and pigment content reducing the negative effects of drought stress on rice growth and physiology, resulting in optimum yield.

Keywords: Rice, drought, salicylic acid, foliar application, pigment content

Chlorophyll fluorescence and gas exchange appraisals of wheat under terminal heat stress condition

Md. Mehedi Hasan[1,2*], M A Baset Mia[1], Jalal Uddin Ahmed[1], AKM Aminul Islam[3], M. Abdul Karim[4]

[1] Department of Crop Botany, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur 1706, Bangladesh;
[2] Department of Crop Botany and Tea Production Technology, Sylhet Agricultural University, Sylhet 3100, Bangladesh;
[3] Department of Genetics and Plant Breeding, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur 1706, Bangladesh;
[4] Department of Agronomy, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur 1706, Bangladesh.
*Correspondence: mehedi.cbot@sau.ac.bd

Abstract

Global wheat production is severely affected by elevated atmospheric temperature. An understanding of vital physiological processes regarding yield limitation under late sown conditions would be crucial for formulating appropriate mitigation strategies. Accordingly, a field experiment was conducted with 14 wheat genotypes sown in two conditions (29 November 2021 as timely sowing and 29 December as late sowing) under split-plot design to identify whether the yield inferiority of wheat is due to impairment in photosystem II (PSII) or the stomatal limitation or in a combination of both under late sowing stage. Out results revealed that all the chlorophyll fluorescence parameters and few gas exchange attributes were significantly affected under late sown conditions. The pheatmap, based on relative values, grouped the genotypes into three clusters and the linear discriminant analysis (LDA) confirmed that the genotypes were grouped appropriately. The genotypes under cluster 3 were relatively tolerant with a lesser amount of injuries and better yield performance. The genotypes with lower yield performance were mainly characterized by increased non-photochemical quenching (NPQ), intercellular CO_2 concentration (C_i) and vapor pressure deficit (VPD) and lower grain filling duration. The pheatmap and principal component analysis (PCA) altogether concluded that the contribution of chlorophyll fluorescence attributes is more prominent than the subsequent gas exchange traits in explaining the overall performance of wheat under elevated temperature conditions. The studied traits were more significantly correlated under heat stress conditions than in the optimum growing environment. Our findings concluded that the yield performance of wheat is seriously affected under late sowing conditions and additionally, the application of plant nutrients that will alleviate the PSII impairment would cut a good figure in sustaining wheat yield.

Keywords: Grain yield, high temperature, multivariate analysis, PSII efficiency, stomatal attributes

Investigation of salinity tolerance through chlorophyll fluorescence at seedling stage in rice (*Oryza sativa* L.)

Md. Monir Hosain[1], Md. Hridoy Hussain[2], Kamrun Nahar[1], Md. Sazzadur Rahman[2]*

[1]Department of Agricultural Botany, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh.
[2]Plant Physiology Division, Bangladesh Rice Research Institute, Gazipur-1701.
*Correspondence: sazzadur.phys@brri.gov.bd

Abstract

Salinity is a serious environmental stress that limits the growth and yield of many cultivated crops, including rice. Developing and cultivating salinity tolerant rice varieties could be an excellent way to boost productivity in this fragile ecosystem. Recent progress in phenomics, particularly chlorophyll fluorescence imaging, has shown great promise in elucidating changes in PSII photosynthetic efficiencies under salinity stresses. In light of the aforementioned information, a study using some tolerant (BRRI dhan47, BRRI dhan67, BRRI dhan97, and IR58443) and one sensitive (IRRI154) genotype under different salinity stress were carried out. All tested varieties attempted to maintain a normal Fv/Fm (photochemical efficiency of PSII), but after 48 hours of stress application, it dropped significantly until 72 hours. The Fv/Fm began to recover gradually 72 hours after the stress application. At 120 hours of stress application, the tolerant genotypes recovered significantly faster. The Fv/Fm values for the known tolerant genotypes varied at different times after stress application, indicating combinations of tolerant traits and genomic makeup. Two genotypes (IR58443 and BRRI dhan47) consistently had a higher Fv/Fm after 120 hours of stress application and even after 120 hours of recovery. The findings indicated that Fv/Fm could be a reliable predictor of the variability among different salinity tolerances.

Keywords: Salinity tolerance, chlorophyll fluorescence, rice

Phytodiversity in the family Apocynaceae at Bangladesh Agricultural University Botanical Garden

Manjuma Ferdous Jeem, Md Jahid Hasan Jone, Md Ashrafuzzaman*

Department of Crop Botany,
Bangladesh Agricultural University, Mymensingh-2202
*Correspondence: ashrafcbot@bau.edu.bd

Abstract

Apocynaceae is a family of flowering plants that includes trees, shrubs, herbs, stem succulents, and vines. A survey was conducted to update the list of plants of the family Apocynaceae conserved at the Bangladesh Agricultural University Botanical Garden. A total of 72 species belonging to 44 genera were identified where four species namely Arrow poison, Kanak Suda, Gurmar, and Shwet-duti are new additions to the flora of Bangladesh. *Hoya* and *Dischidia* contain the greatest number of species (6), followed by Plumeria, and Wrightia with four species. *Allamanda*, *Pachypodium*, and *Rauvolfia* with three species apiece. *Alstonia*, Calotropis, *Ceropegia, Cynanchum, Huernia,* and *Tabernaemontana* each contain two species; and the remaining 31 species are distributed among 31 different genera. *Adenium obesum, Allamanda cathartica, A. blanchetii, Cascabela thevetia, Catharanthus roseus, Plumeria alba, Plumeria rubra* and *Tabernaemontana divaricata* have more than one variety. According to habit formation, 36.11% are climbers, 34.72% are shrubs, 15.28% are trees, 8.33% are succulents and 5.56% are herbs. In the case of uses, 31.9% of species were found as medicinal, while 25% of species are both medicinal and ornamental. Medicinal and commercial plants, medicinal and poison-making plants, and medicinal and fruiting plants cover 4.17% of plant species while 23.94% of species are used only for ornamental purposes. *Cerbera odollam* is used commercially only. *Pachypodium lealii* is used in poison-making. *Tabernaemontana divaricata* is a medicinal, ornamental, and commercial plant. A total of 35 species (47.88%) were classified as Least Concerned, the highest number among all categories. Seventeen species are Not Evaluated, three species (4.22%) were classified as Conservation Dependent, two species (2.82%) as Vulnerable, one species (1.4%) as Critically Endangered, and two species, *Wrightia arborea, Wrightia coccinea* (2.82%) were categorized as Nearly Threatened.

Keywords: Apocynaceae, phyto-diversity, botanical garden, medicinal plants, ornamental plants

Scaling the pressure and release model to address climate shock hazards and disaster risk reduction approaches in the northeast haor basin of Bangladesh

Md. Abdul Awal

Laboratory of Plant Ecology, Department of Crop Botany, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh
*Correspondence: awalma7@bau.edu.bd

Abstract

The haor basin in northeast Bangladesh covers almost one fifth of its total land area, produces about 20 percent of country's total staple food grain (rice) and supports the livelihood of twenty million people. However, the areas are regularly affected by flood hits with an enormous loss of crops, fodders, and other food commodities, and earning sources that make the people living therein vulnerable. Proper attention is not paid yet to explain the disaster that occurs in the areas and overcome the hazard risks with a holistic model. Therefore, the study aims to explain the progression of vulnerability and hazardous situations due to flood shocks in haor areas with a popular conceptual framework like the Pressure and Release (PAR) model. Important drivers of the root causes, dynamic pressures and unsafe conditions respond to the progress of the vulnerability (Pressure model) are identified by collecting both secondary and primary sources of data from published, unpublished and grey literature, consulting with various categories of stakeholders, and focus group discussion meeting with flood victim's farmers. The possible determinants (relief drivers) towards the progression of safety and disaster mitigation as a whole are pinpointed in the Release model which can be utilized in the Disaster Risk Reduction (DRR) or Management (DRM) programs. The geo-morphological setting of haor areas and early heavy rain especially in the highly elevated upstream catchments like Cherrapunji, Meghalaya of India, and poor and un-time management of embankments are identified as proximal drivers for early flash flood hits which lead to inundate and damage of pre-matured Boro paddy. Early transplantation of Boro seedlings with cool-tolerant and short life span cultivar which is trying to develop could assist to minimize the disaster risk to a great extent. The determinants can be categorized as performing immediate actions, short and medium-term measures and long-term planning. The analysis integrates the entire package of both social and physical components, and the results of the study can be utilized in government or policy planning.

Keywords: Cherrapunji, disaster, emergency response, flash flood, hazard, Pressure model, rainfall, Release model, risk, Upstream catchment, vulnerability

Popularization of short duration varieties for safer Boro-rice production escaping flash flood damage in the haor areas of Kishoregonj

Md Abu Hasan Chowdhury and Md Habibur Rahman Pramanik*

Department of Crop Botany
Bangladesh Agricultural University
Mymensingh 2202
*Correspondence: habiburp@yahoo.com

Abstract

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

Keywords: Haors, boro-rice cultivars, flash flood

Diversity of the genus *Clerodendrum* (Lamiaceae) in Bangladesh Agricultural University Botanical Garden

Khadija Khatun Keya, Nasrin Akhter, Md Jahid Hasan Jone and Md Ashrafuzzaman*

Department of Crop Botany,
Bangladesh Agricultural University, Mymensingh-2202
*Correspondence: ashrafcbot@bau.edu.bd

Abstract

The genus *Clerodendrum* belongs to the family Lamiaceae and encompasses herbs, shrubs, and trees distributed in subtropical and tropical regions of the world. To date, about 500 species of the genus *Clerodendrum* have been identified. Plants of this genus are used for the curing of several natural life-menacing ailments i.e. Syphilis, typhoid, cancer, jaundice, and hypertension in the traditional medicine systems of the Chinese, Indian, Japanese, Korean, and Thailand. Important metabolites reported from this genus include phenolics, steroids, di- and triterpenes, flavonoids, volatile oils, etc. A survey was conducted to catalog all the species of the genus *Clerodendrum* of Bangladesh Agricultural University Botanical Garden (BAUBG) and found a total of 13 species that were collected, preserved, identified, and classified. Among them, four species are the new addition to the flora of Bangladesh which are *Clerodendrum laevifolium* Blume, *Clerodendrum schmidtii* C.B.Clarke, *Clerodendrum incisum* Klotzsch and *Clerodendrum calamitosum* L. The correct nomenclature of each species, brief description, ethnobotanical uses of the available species, photo plates and other relevant notes are also highlighted. A comparative study of leaf area, dry weight, and fresh weight of the collected samples of the studied species are also recorded which shows that among the thirteen species of the genus *Clerodendrum; Clerodendrum gladulosum* lindl. has the highest leaf area, leaf fresh and dry weight whereas *Clerodendrum incisum* Kuntze has the lowest leaf area, leaf fresh, and dry weight. Thus, comprehensive research of this genus can comprehend the potential uses of its plants in ethnomedicine and beyond.

Keywords: *Clerodendrum*, Lamiaceae, ethnomedicine, cancer, conservation, hypertension

Screening of coloured rice genotypes based on morpho-physiological traits and yield attributes

A. K. M. Golam Sarwar[1], Jannatul Ferdous, Most. Morsada Khatun, Md. Kabir Uddin, Sagarika Khatun and Md. Solaiman Ali Fakir

Department of Crop Botany, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh.
*Correspondence: drsarwar@bau.edu.bd

Abstract

Recently, coloured rice (*Oryza sativa* L.) is becoming increasingly popular due to its uses as a functional food and nutritional and health benefits. Scanty information exists on the morpho-physiological, phenological and yield forming descriptors in coloured rice required for the selection of the genotypes. A survey was conducted to collect coloured grain rice germplasms from different parts of Bangladesh for subsequent selection for further studies. Thirty-three rice genotypes(/cultivars) with brown, red and black grains were collected from the different regions of Bangladesh using a semi structure questionnaire. Thirty-four rice genotypes (33 coloured including a white grained control) were grown in pots and processed from 13 April-December 2021 following CRD with three replications and standard cultural protocols. Plant height, phenological data (flowering and maturity time), leaf and tiller numbers, biomass and paddy yield and yield attributes plant^{-1} basis was recorded. Data were analyzed using Minitab and means are adjudged by DMRT. Results revealed that wide variations in spikelet and seed colour, hairiness on spikelet and grain size (length, width & their ratios) existed among rice genotypes. Among these 34 rice genotypes, 9 genotypes failed to produce inflorescence, which might be due to photo and/or thermo-sensitivity. Canopy trait (plant height & tiller production), flag leaf size (length & width) and phenology (days to flowering) also varied significantly among the genotypes. The magnitude of yield traits, viz. panicle size, inflorescence branching, spikelet production and seed size varied to a good extent. Based on colour of spikelet & grain, and magnitude of 1000-seed weight, and biomass & grain yields hill^{-1}, eleven viz. 5 black, 4 red and 2 white-grained rice genotypes were selected for the subsequent detail experimentations.

Keywords: Rice, coloured-endosperm, phenology, selection, morpho-physiological descriptors

Morpho-physiological traits and grain yield of rice as influenced by synchronization of phosphorus application and mycorrhizal fungi inoculation under drought stress

Debesh Das[1,2]*, Hayat Ullah[1] and Avishek Datta[1]

[1]Agricultural Systems and Engineering, Department of Food, Agriculture and Bioresources, School of Environment, Resources and Development, Asian Institute of Technology, Thailand
[2]Agrotechnology Discipline, Khulna University, Khulna 9208, Bangladesh
*Correspondence: debeshdasat@gmail.com

Abstract

Climate change and agricultural malpractices are exacerbating drought in many parts of the world causing a substantial loss in agricultural production. The improvement of drought tolerance in rice is crucial for maintaining productivity and ensuring global food security. Alternate wetting and drying (AWD) irrigation along with plant-microbe interaction through arbuscular mycorrhizal fungi (AMF) is a potential approach for enhancing rice production through AMF-induced up-regulation of tolerance and resilience against drought. Therefore, the ameliorative role of AMF inoculation and phosphorus (P) application on growth, physiological traits and grain yield of rice was evaluated under drought stress imposed through AWD irrigation. Factorial experiment consisting of three factors namely four fertilizer treatments [where the P percentage varied along with the recommended dose of nitrogen (N) (P_{100} as the control, P_{100} + AMF, P_{75} + AMF, and P_{50} + AMF)], three soil water potential levels (0, –20, and –40 kPa), and two cultivation methods (wet direct seeding and transplanting) was conducted in a polyhouse. The subscript values of 100, 75, and 50 under P represent 100%, 75%, and 50% of the recommended field application dose. Data were collected on selected growth parameters, physiological traits, grain yield, and water productivity of rice. The results revealed that P_{100} + AMF inoculated plants had 11%, 14%, 74%, and 54% higher leaf greenness, leaf relative water content, net photosynthetic rate, and grain yield, respectively, for wet direct-seeded plants at reduced soil water potential (–40 kPa) compared with non-inoculated plants (P_{100}). Free proline accumulation gradually enhanced with reducing soil water potential, which was maximized by 77% at –40 kPa compared with 0 kPa for P_{50} + AMF (transplanted plants). Free proline accumulation was also higher with decreasing soil water potential in AMF-inoculated plants than in non-inoculated plants regardless of cultivation methods. Leaf osmotic potential was reduced by –0.5 to –1.2 MPa at –40 kPa compared with 0 kPa under different fertilizer doses. However, AMF inoculation (P_{100} + AMF and P_{75} + AMF) improved the leaf osmotic potential of plants under severe water stress (–40 kPa) resulting in better osmotic adjustment than non-inoculated plants. AMF inoculated plants responded positively regarding most of the evaluated physiological traits of rice and enhanced grain yield with higher P availability (even with a 25% reduction in its recommended dose) in the rhizosphere under drought conditions. Finally, it can be concluded that AMF inoculation coupled with judicious P management is a promising approach for improving morpho-physiological traits, grain yield, and water productivity of rice under drought stress irrespective of cultivation methods.

Keywords: Drought stress, rice, grain yield, Arbuscular mycorrhizal fungi, Rhizosphere

Diversity of *Ficus* L. (Moraceae) Species at Bangladesh Agricultural University Botanical Garden

Maisha Fahmida, Md. Polas Ahmed and Md Ashrafuzzaman*

Department of Crop Botany, Bangladesh Agricultural University, Mymensingh-2202
*Correspondence: ashrafcbot@bau.edu.bd

Abstract

Ficus L., commonly known as fig, belongs to the family Moraceae, which is distributed in diverse ecosystems, especially in tropical and temperate regions. This study was carried out at Bangladesh Agricultural University Botanical Garden (BAUBG), Mymensingh, and twenty-two (22) species of Ficus L. were recorded based on the morphological observations of taxonomically significant characteristics. The species were *Ficus altissima variegata, F. auriculata, F. benghalensis, F. benjamina "Pandora", F. carica, F. elastica, F. fistulosa, F. heterophylla var. assamica, F. hirta, F. hispida, F. lyrata, F. krishnae, F. maclellandii, F. racemosa, F. microcarpa var. Ginseng, F. microcarpa var. nitida, F. microcarpa var. green island, F. natalensis lepriurii, F. pumila. F. religiosa, F. rumphii* and *F. semicordata*. It was found that sixteen of these species were trees, four were shrubs, and two were climbers. *F. auriculata* had the largest leaves, measuring 25-30×30 cm, followed by *F. semicordata* (25-28×10 cm) and *F. bengalensis* (18-20×8-15cm), while F. microcarpa var. Ginseng had the smallest leaves, measuring 3-7×1-2cm. Most species have both therapeutic and commercial uses and some are grown for decoration. According to the criteria of IUCN, two species *F. fistulosa* and *F. hirta* were classified as data deficient, five species as rare, two species as near threatened and thirteen species as least concerned. This pioneering study on the species diversity of the genus Ficus will provide a useful starting point for future conservation and management efforts and will serve as the baseline for future research.

Keywords: Plant diversity, conservation, Ficus, Moraceae

Effect of kitchen waste biochar and compost on growth and yield of three winter vegetables

Gowtam Das[1], Tasfia Tahzin, Md. Moudud Ahmod and Md. Masudur Rahman*

Department of Crop Botany and Tea Production Technology, Faculty of Agriculture, Sylhet Agricultural University, Sylhet 3100, Bangladesh
[1]Presenting author
*Correspondence: masudur.cbot@sau.ac.bd

Abstract

Biochar increases fertilizer use efficiency and improves soil quality hence could be a potential material for sustainable crop production. But there are still uncertainties about the nutritional effects of biochar on short-cycle crops. Thus, this research aimed to evaluate the effect of biochar alone and in combination with compost on the agronomic development of red amaranth (*Amaranthus tricolor* L.) radish (*Raphanus sativus* L.) and spinach (*Spinacia oleracea* L.). Both biochar and compost were prepared from the kitchen wastes and ComBio was prepared by co-composting with biochar. A field experiment was carried out with these three vegetables following a randomized complete block design with three replication and four fertilizer management. The fertilizer managements were T_1 = Recommended dose of chemical fertilizer (RDF) for each crop, T_2 =50% RDF + Biochar (20t ha^{-1}), T_3 = 50% RDF + Compost (15t ha^{-1}) & T_4 = 50% RDF + ComBio (15t ha^{-1}). Plant data like root length, shoot length, no. of Leaf/plant, root diameter, root weight, shoot weight, leaf chlorophyll content and yield were recorded after harvesting. The proximate components i.e- crude protein (CP), ether extracts (EE), fiber, ash, dry matter (DM) and nitrogen-free extracts (NFE) were measured in the leaf of radish and spinach. Results revealed significant differences among the parameters measured in radish, red amaranth and spinach. In radish root size, number of leaves per plant, root weight and chlorophyll content were higher in the T_2 treatment than others. In red amaranth, root length and shoot length were lower in T_1 while yield was lower in the T_4 treatment than in others. In spinach, root length and number of leaves per plant were higher in the T_3 treatment than in others. Ash content in radish was found lower in the T_2 treatment while CP EE, fiber, DM and NFE were similar among the treatments. In spinach, EE was higher while fiber and ash content were lower in T_2 treatment. In conclusion, the use of kitchen waste as biochar and ComBio has the potential to reduce chemical fertilizer; which additionally provides benefits of efficient management of kitchen waste.

Keywords: Soil fertility, charcoal, waste management, fertilizer use efficiency.

Physiological role of allantoin in conferring arsenic-induced oxidative stress in rice (*Oryza sativa* L.)

Ayesha Siddika[1], Md. Mahabub Alam, Md. Rakib Hossain Raihan and Mirza Hasanuzzaman*

Department of Agronomy, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh
*Correspondence: mhzsauag@yahoo.com

Abstract

Arsenic (As) is a naturally-occurred metalloid that is non-essential but toxic if accumulated in plants to higher levels. Allantoin (AL) is a nitrogen metabolite that can improve several abiotic stress tolerances in plants. We aimed at investigating the role of AL in the detoxification of As toxicity in rice. Rice (*Oryza sativa* L. cv. BRRI dhan75) was used as the test variety. Twenty-five-day-old seedlings were transplanted and grown in pots with or without irrigation with 0.25 mM sodium arsenate solution for 20 days. A set of plants were treated with AL (0.5 and 1 mM) as a foliar spray at a regular interval of 7 days. Arsenic exhibited increased oxidative stress indicators (lipid peroxidation, hydrogen peroxide, electrolyte leakage) and proline content. Moreover, the antioxidant defense system of rice consisting of non-enzyme antioxidant contents and enzyme activities was decreased as a result of As toxicity. The damaging effect was prominent in plant height, biomass acquisition, tiller number and relative water content. Furthermore, chlorophyll and leaf area also exhibited a decreasing trend due to toxicity. Arsenic exposure also disrupted the glyoxalase system. However, the application of AL recovered the reactive oxygen species-induced damages in plants, upregulated the effectiveness of the ascorbate-glutathione pool, accelerated the activities of antioxidant enzymes and improved the glyoxalase system. These positive impacts of AL ultimately resulted in improved plant characteristics with better plant-water status and activated antioxidant defense system that conferred as stress tolerance of rice. So, it can be concluded that AL effectively mitigated As-induced physiological and oxidative damage in rice plants. Therefore, AL could be used as a potential biostimulant and soil amendment in As-contaminated rice fields.

Keywords: Heavy metal, arsenic, allantoin, oxidative Stress, glyoxalase system, rice

Investigations of selected underutilized plants as supplemental sources for carbohydrate and protein in Bangladesh

MSA Fakir*

Department of Crop Botany, Bangladesh Agricultural University, Mymensingh, Bangladesh
*Correspondence: fakirmsa@gmail.com

Abstract

Increased population and decreased cultivable land direct for searching alternative/ supplemental sources of staple starch and essential protein required for food and nutrition security. Further water requirement for paddy production is very high (to produce 1 kg paddy requires 2300 L H_2O) which further pinpoints additional resources of staple rice. This research paper highlights the potentialities of some underutilized plants viz., cassava (*Manihot esculenta*), quinoa (*Chenopodium quinoa*), buckwheat (*Fagopyrum esculentum*) as a supplemental source of starch, and Moringa (*Moringa Oleifera*), Pigeonpea (*Cajanus cajan*), Lignosus (*Dipogon lignosus*) and other beans as sources of vegetable proteins supplemental to expensive animal proteins. The above-named minor crops can easily be grown in homesteads, fallow lands, borders of a crop field, dyke, roadsides and in many unused lands which would not compete with rice lands. Under the climate change scenario, some of the above plant genetic resources appear to be tolerant to abiotic stresses like high temperature, drought and salinity, and these are currently prevalent stresses in Bangladesh. In summary, this article investigated yield potential, basic processing techniques, cultivation protocol, and nutritional qualities of important starch and protein-yielding crops. Such selected minor crops could be a potential supplemental source of starch and proteins compared to rice and animal proteins.

Keywords: Minor crops, supplemental CHO and protein, nutrition security

Morphological descriptors of Quinoa genotypes– a potential functional crop

Most. Morsada Khatun*, A.K.M. Golam Sarwar and Md. Solaiman Ali Fakir
Laboratory of Plant Systematics, Department of Crop Botany, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh
*Correspondence: morsada41309@bau.edu.bd

Abstract

Quinoa (*Chenopodium quinoa* Willd.), one of the oldest cultivated plants of Andes, has gained worldwide attention for its ability to grow in various stressful conditions and also due to its various health-promoting characteristics i.e., easy digestibility with high amounts of protein, vitamin B, omega-3 fatty acids, and others. The present research work was focused on a detailed study of morphological descriptors of four quinoa genotypes. The field experiment was conducted at the Field Laboratory of the Department of Crop Botany, Bangladesh Agricultural University during the Rabi season from November 2020 to March 2021 following a Randomized Completely Block Design with three replications. A spacing of 25cm ×10cm and standard cultural practices were used. Quinoa plants are characterized by the angular stem, red-green, leaf rhomboidal, green, panicle shape intermediate showing both shapes – glomerulate and amarantiform, panicle green at the flowering and became pink at the physiological maturity stages. Plant height and stem diameter ranged between 60.17-65.65 cm and 4.22-4.58 mm, respectively. The percentage of the red and red-green coloured stem, number of teeth/leaf and leaf area varied among genotypes and ranged between 20.00-46.58%, 53.31-80.00%, 5.60-9.10 and 4.84-6.01 $cm^{2,}$ respectively. Pollen grains are monads, medium in size, 42.99-51.30 µm, polypantoporate, scabrate, and exine thickness of 2.08-2.40 µm. Panicle length and width, 1000-seed weight and seed yield varied between 31.16-37.23 cm, 3.66-4.37 cm, 3.14-3.43 g and 2.66-3.86 g/plant, respectively. Qualitative morphological traits can be used as markers in the description and characterization of quinoa genotypes. The variation existing among the quinoa genotypes could prove useful in the breeding programs.

Keywords: *Chenopodium quinoa*, morphological traits, pollen

Seed quality and nutrient contents of five leafy vegetables (*Fagopyrum esculentum, Chenopodium quinoa, Malva verticillata, Hibiscus sabdariffa* and *Dipogon lignosus*)

MR Islam[1], AM Mojakker[2] and MSA Fakir [3]*

[1]Department of Seed Science & Technology,
[2]Office, Director General, Department of Agric. Extensions, Khamarbari, Dhaka,
[3]Department of Crop Botany, Bangladesh Agricultural University, Mymensingh,
*Correspondence: fakirmsa@gmail.com

Abstract

Scanty information exists in respect of the quality of seed and nutritional profile of leafy vegetables. A study was conducted to evaluate the seed quality (moisture content, germination, vigour, viability) and proximate composition of five important leafy vegetables. The leafy vegetables were *Fagopyrum esculentum* (Buckwheat), *Chenopodium quinoa* (Quinoa), *Malva verticillata* (Cluster mallow), *Hibiscus sabdariffa var. sabdariffa* (Roselle) and *Dipogon Lignosus* (Lignosus Bean) and these are the minor vegetable crops in Bangladesh. Two seed storage conditions were also employed- one set of freshly harvested seeds was considered at ambient and the other set was stored at 4 ^{0}C storage for one year. Ten treatments (5 seed species × 2 storage conditions) were set and analyzed in CRD design with four replications. Seed germination was carried out as per ISTA rule. In general, seeds contained lower moisture content under 4 ^{0}C and exhibited higher germination and vigour index, and seedling growth. The proximate analysis of leaves showed that a higher amount of crude protein, crude fiber and dry matter were observed in Buckwheat (31.07%), Roselle (8.95%) and Lignosus bean (9.65%), respectively. It may be concluded that Buckwheat and Quinoa seeds appeared to exhibit good quality when stored at 4 ^{0}C. The selected vegetable (Buckwheat, Quinoa, Lafa, Roselle and Lignosus bean) are nutritionally important specially Buckwheat leaves are a rich source of protein (31.07%).

Keywords: Seed germination, proximate composition, leafy vegetables

Phytonutritional and health importance of *Hibiscus sabdariffa* var. *sabdariffa*: Review and indication for research gaps

TR Raha[1]*, K Muktadir[2], MAH Chowdhury[3] and MSA Fakir[1]

[1]Department of Crop Botany, Bangladesh Agricultural University, Mymensingh
[2]Upazilla Health Complex, Kahaloo, Bogura,
[3]Horticulture Wing, Department of Agric. Extensions, Khamarbari, Dhaka
*Correspondence: tamannaraha258@gmail.com

Abstract

Hibiscus sabdariffa var. *sabdariffa* is known as 'chukur'/'tok-gach'/ 'jelly-gach' in Bangla; and Roselle/Sorrel in English. It is an annual woody herb/subshrub of Malvaceae that grows in tropical and subtropical regions including Bangladesh. Two morphotypes- Red and Green coloured plants as well as fruits are available. The plant height varies from 1-1.75m with 5-15 primary branches/plant, palmate deeply lobed simple leaf, capsules mature after 7-9 months from seed sowing. The plant is reputed worldwide for its sour leaf and fleshy calyx, remaining in the fruit, for the culinary, bakery and beverage. The young leaves and twigs are widely used as vegetables and souring curry; fresh/dried calyces for preparing jam, jelly, pudding, sauces, lozenges, pickles, drinks, tea, and many other beverages. The plant is blessed with numerous nutritional and phytochemicals of health benefits. The sourness is mainly due to various organic acids including citric, tartaric, and malic; and the elegant red colour of the calyx is due to the presence of water-soluble anthocyanins. Both leaves and calyx are rich in vitamins and minerals including beta carotene, vitamin C, iron and zinc which are usually deficient in the diet of rural Bangladeshi. Anthocyanins present in the calyx are a powerful antioxidant and the decoction of calyx yields various phytonutrients including anthocyanins. Thus, calyx has been widely utilized in the non-pharmacological treatment of many medical problems including the management of cardiovascular diseases, hypertension/high blood pressure, dyslipidemia/ hypercholesterolemia, diabetes mellitus, obesity and other ailments. Although huge literature on Roselle production, processing and uses is available abroad, scanty information on such aspects from Bangladesh's perspective demands research urgently. The review highlights the phytonutrient profile of the Roselle plant particularly the leaf, calyx and seeds emphasizing their health benefits.

Keywords: 'Chukur', leaf and calyx, nutrient contents, medicinal benefit

Diversity in Thunbergia species at Bangladesh Agricultural University Botanical Garden

Md Jahid Hasan Jone, Manjuma Ferdous Jeem and Md Ashrafuzzaman*

Laboratory of Medicinal Plant Resources, Department of Crop Botany, Bangladesh Agricultural University, Mymensingh-2202
*Correspondence: ashrafcbot@bau.edu.bd

Abstract

Thunbergia is one of the largest genera of the Acanthaceae family of flowering plants. It includes over 100 species of annuals, evergreen perennials, twining climbers, and shrubs growing to 2–8 m tall from Africa, Madagascar, and Asia. This research attempted to discourse the diversity of this Thunbergia Bangladesh Agricultural University Botanical Garden, focusing on their leaf morphological descriptors and is presented for the taxonomic usages. During this study, a total of nine (9) species from the genus were recorded including *Thunbergia alata* Bojer ex Sims, *T. coccinea* Wall. ex D. Don, *T. erecta* (Benth.) T. Anders., *T. erecta* "White", *T. grandiflora* Roxb, *T. kirkii* Hook. f., *T. laevis* Wall. Ex Nees, *T. laurifolia* Lindl., and *T. laurifolia* 'Variegata'. For this preliminary study, petiole length, leaf size, fresh weight, and dry weight of leaves were measured in addition to studying other taxonomic descriptors. *T. grandiflora* has the highest leaf area and fresh weight though *T. laurifolia* 'Variegata' has the highest dry weight while *T. kirkii* possesses the lowest values for each of the aforementioned parameters. The species' origin and distribution, flowering and fruiting seasons, habitats, modes of reproduction, economic benefits, medicinal attributes, and conservation status are all addressed in this article's brief taxonomic description.

Keywords: Thunbergia, Diversity, Taxonomy, Conservation

Salt tolerance of some selected tomato genotypes during seed germination and seedling growth

Umma Salma Ruba, Md Ashrafuzzaman*

Department of Crop Botany, Bangladesh Agricultural University, Mymensingh
*Correspondence: ashrafcbot@bau.edu.bd

Abstract

Tomato (*Solanum lycopersicum* L.), one of the versatile commodity vegetables, has recently been added to the list of the world's major food crops and it plays an important role in human health which benefits nutritional requirements. Being a herbaceous vegetable, it is susceptible to salt stress, and thus salt-tolerant tomato varieties are scanty in Bangladesh. So, an experiment was conducted at the Plant Physiology Laboratory of the Department of Crop Botany, Bangladesh Agricultural University, Mymensingh to evaluate the germination capability of some tomato genotypes viz, BARI Tomato 14, BARI Tomato 17, BARI F_1 Tomato 8, BARI F_1 Tomato 11, Binatomato 6, Binatomato 7, Binatomato 13 and Dipali (F1 hybrid) under different levels of salt stress (0, 4 and 8 dSm^{-1}) applied in two different ways. Data were recorded on germination percentage (GP), radicle and plumule length, seedling length, and their fresh and dry weight at different levels of salt stresses. The study reveals that salt stress significantly reduced seed germination, length and biomass of radicle and plumule in a concentration in a dependent manner. Among the genotypes, BARI Tomato 14 and Binatomato 7 showed higher salt tolerance followed by Dipali. These genotypes can be used for further breeding programs or cultivation in coastal saline-prone areas with further investigation.

Keywords: Salinity, Abiotic stress, vegetables, tomato

Assessment of genetic diversity of bread wheat genotypes for drought tolerance using canopy reflectance-based phenotyping and SSR marker-based genotyping

Mohammed Mohi-Ud-Din[1,2], Md. Motiar Rohman[3], Md. Nesar Uddin[1], Md Sabibul Haque[1]
Md. Alamgir Hossain[1]*

[1]Department of Crop Botany, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh
[2]Department of Crop Botany, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur 1706, Bangladesh
[3]Plant Breeding Division, Bangladesh Agricultural Research Institute, Gazipur 1701, Bangladesh
*Correspondence: alamgircbot@bau.edu.bd

Abstract

This study investigated the genetic diversity of bread wheat genotypes using canopy reflectance-based vegetation indices (VIs) and simple sequence repeat (SSR) maker based genotyping for drought tolerance. Fifty-six wheat genotypes were assessed using phenotypic traits (combination of VIs and yield traits) and thirty SSR markers data of phenotypic traits were averaged over two growing seasons under irrigated and drought-stressed field conditions. Phenotypic traits based hierarchical clustering of wheat genotypes unveiled three clusters differing in tolerance to drought. The genotypes under cluster 1 exhibited minimal changes in phenotypic traits, conferring higher drought tolerance and yield stability compared to those of clusters 2 and 3. The polymorphism information content (PIC) values for the SSR markers ranged from 0.434 to 0.932, with an average of 0.83. A total of 458 alleles (18.32 alleles per locus) were detected, with the most polymorphic markers, *wmc*177 and *wms*292, having the most alleles (24). A comparative study of SSR diversity among phenotypic clusters indicated that genotypes under cluster 1 had higher genetic diversity (0.879) and unique alleles (47%), suggesting that the inclusion of these genotypes in drought tolerance breeding programs can maximize genetic diversity. The unweighted neighbor-joining (NJ) tree grouped wheat genotypes into five major clusters. Wheat genotypes from all phenotypic clusters were distributed throughout all SSR-based clusters, indicating that genetically heterogeneous genotypes were allocated to different drought-tolerant groups. However, SSR-based clusters and model-based populations showed significant co-linearity (80.6%) in the present study. The findings of the present study suggested that combining reflectance-based indirect phenotyping with SSR-based genotyping might be an effective technique to assess genetic diversity to improve the drought tolerance of bread wheat genotypes.

Keywords: Bread wheat, drought tolerance, vegetation indices, SSR markers, genetic diversity, unique alleles, cluster analysis, population structure

Evaluation of salinity problems and suitable solutions for agricultural production in coastal areas of Satkhira and Khulna

Md. Rejaul Islam*, Md. Sakib Khan, Farhan Mahodi Noor and Md. Matiul Islam

Agrotechnology Discipline, Khulna University, Khulna-9208.
*Correspondence: rejaulku@gmail.com

Abstract

Salinity is a major issue in agricultural production in coastal areas of Bangladesh. The coastal region contains a significant proportion of the arable land of the country. Farmers face a variety of challenges when growing crops due to salinity. Some traditional solutions are used based on their limited knowledge. They should be concerned with appropriate management practices for reducing various salinity issues. Thus, the main purpose of the study was to assess the current salinity problems for crop production and suitable solutions to those problems. Data were collected from 95 farmers (50 from Shyamnagar and 45 from Dacope) in Satkhira and Khulna districts via personal interviews from August to December 2022. The dependent variables in the study were salinity symptoms, problems, and solution practices in agricultural production and the independent variables were the 11 selected characteristics of the respondents. The majority of respondents reported high (57.9%) salinity symptoms followed by medium (42.1%). The majority of respondents (84.2%) had severe problems while the other 15.8% had highly severe problems. The solution was identified as suitable to practice by the majority of respondents (68.4%), followed by highly suitable (26.3%) and mild suitable (5.3%). Among the respondents' selected characteristics, age has a significant positive relationship with salinity symptoms. Furthermore, extension contact has a significant negative relationship with the problem faced. Annual income, on the other hand, has a significant relationship with the solution practiced by the respondents. Knowledge has a highly significant negative relationship with the respondents' problems and a significant relationship with the respondents' solution practices. The presence of salt crust on topsoil was the first of ten selected symptoms, followed by a saline field with a distinct smell as the last factor that appeared in the field. Furthermore, salinity is high during the dry season, occupying the first position out of fifteen selected problems, and changes in soil structure and texture occur as the last factors that showed in the field. Finally, the rainy season reduces salinity, which is the first of eighteen selected solutions, and an embankment is established to protect land, which is the last factor that emerged in the field. Various scientific approaches to resolving salinity problems can serve as preventative measures for farmers.

Keywords: Salinity, respondents, knowledge, symptoms, problems, solutions

Structural and functional annotation of hypothetical protein OsI_04917 from *Oryza sativa* predicted to be involved in stress resistance

Kakon Chakma[ab], Saidur Rahman[ab*], Susmita Das Riya[b], Gowtam Das[bc], Pinki Debnath[b]

[a]Department of Genetics and Plant Breeding, Faculty of Agriculture, Sylhet Agricultural University, Sylhet-3100, Bangladesh.
[b]Faculty of Agriculture, Sylhet Agricultural University, Sylhet 3100, Bangladesh.
[c]Department of Crop Botany and Tea Production Technology, Faculty of Agriculture, Sylhet Agricultural University, Sylhet 3100, Bangladesh.
*Correspondence: saidurrahman.agri@gmail.com

Abstract

Rice is a well-studied monocot plant that acts as a model, and the genome sequence is accessible, allowing researchers to characterize the proteins. Although the gene products of the plant may provide significant insight regarding biology, still many proteins within this plant are uncharacterized and known as hypothetical proteins (HPs). This work was conducted using bio-informatics tools and databases to describe the physicochemical characteristics, predict a three-dimensional structure, annotate the functions, and gene expressions of a hypothetical protein OsI_04917 from *Oryza sativa* (Accession No.: EAY76959.1). Physicochemical properties and subcellular localization analysis showed HP is a stable and non-polar, and extracellular protein. To perform a phylogenetic analysis, homologous sequences from the NCBI database were retrieved using BLASTp and afterward aligned. The 2D structural analysis predicted random coils (49.28%) are the higher amount than extended strand (28.01%), alpha helix (12.86%), and beta turn (9.75%) in the secondary structure. The 3D structure of the HP was visualized in UCSF Chimera, which exhibited the random coils, extended strands, and alpha-helix in distinct colors. Following that, the model quality was examined, and it was discovered that the 3D structural quality was consistent and good. The active site of the HP was investigated using the CastP server, and the protein-protein interaction was investigated using the STRING server. Functional analysis using NCBI-CD indicated a selenium-binding family protein involved in methanethiol oxidation and intra-Golgi protein transport. Blastp in the plantPReS Database revealed 100% identity with one protein of wheat (*Triticum aestivum*): drought resistance, and two proteins of rice (*Oryza sativa*): cold, heat and *Magnaporthe oryzae* resistance. Gene expression analysis in the Rice eFP Browser showed that the expression was maximum on seedlings under drought compared to salt and cold stress. In conclusion, this HP was predicted to be a significant protein associated with various forms of stress resistance, which will improve understanding for future research. Furthermore, a laboratory-based in-vitro experiment is recommended to validate the research outcome.

Keywords: Functional annotation, hypothetical protein, *Oryza sativa*, In silico approach.

In silico identification and characterization of potential cross reactive endogenous allergens in cassava (*Manihot esculenta* Crantz)

Kakon Chakma[ab], Saidur Rahman[ab], Susmita Das Riya[b*], Sahinur Akter[c]

[a]Department of Genetics and Plant Breeding, Faculty of Agriculture, Sylhet Agricultural University, Sylhet-3100, Bangladesh
[b]Faculty of Agriculture, Sylhet Agricultural University, Sylhet
[c]School of Human Sciences, London Metropolitan University, 166-220 Holloway Road London N7 8DB, United Kingdom
*Correspondence: susmitariya44@gmail.com

Abstract

Food allergens are primarily proteins that elicit an aberrant IgE and non-IgE mediated immune response in susceptible individuals, which can potentially be fatal. Cassava is one of the most widely consumed crops in tropical countries which is also highly demandable in the bakery industry. However, allergic reactions associated with the cassava diet are still a major food safety concern for the cassava-based food industry. The presence of specific food allergenic substances in cassava has already been reported, but a genome-wide investigation is yet lacking. This study aimed to predict and characterize potential cross reactive allergens in the cassava genome which was based on two peer reviewed cassava allergens (NCBI Accession ID: AAM55492.1, AEE98392.1) identified from the Allergen Nomenclature database and the Food Allergy Research and Resource Program (FARRP) database. The whole genome sequence of cassava was retrieved from a publically available database (Phytozome: www.phytozome.jgi.doe.gov). Through In-silico approach, potential allergens were reported in terms of characteristics including chromosomal localization, subcellular localization, physicochemical properties, phylogenetic distance, gene structure, and motif. We identified four potential cross reactive allergens within two chromosomes (no. 12 and 13) of the cassava genome. These allergens were Blast against allergen database (FARRP) showed all allergens are highly identical (>60%) with allergenic-related protein Pt2L4 containing Ribonuclease E domain. The results of subcellular localization showed that all allergens were localized to the nucleus, cytoplasm, chloroplasts, and extracellular space. Among these four allergens, the highest values were observed in Allgn3 which are 534 bp coding sequence, 178 AA protein length, 18783.23 kDa molecular weight, 3.98 PI, 60.68 aliphatic indexes and -0.849 GRAVY. Allergens were categorized into two categories based on phylogenetic distance analyses, group-1 (Allgn1, and Allgn2) and group-2 (Allgn3, and Allgn4). Analysis of the gene structure revealed that 1 intron exists in Allgn1, Allgn2, and Allgn3, compared to 2 introns in Allgn4. Three conserved motifs were found through motif analysis to be common in all allergens. Overall, through bioinformatics tools, this study systematically reveals the information on allergens characteristics which will provide a theoretical foundation for further study regarding food allergens in cassava.

Keywords: Genome wide analysis, food allergens, Cassava allergens, In silico Approach

Seedling establishment of traditional tea (*Camellia sinensis* L.) clones grown at Sylhet region

Jarrin Yeasmin Senthi[1]*, Adiba Hossain Triza[1], A F M Saiful Islam[1] and Md. Abdul Maleque[2]

[1]Depertment of Crop Botany and Tea Production Technology, Faculty of Agriculture, Sylhet Agricultural University, Sylhet -3100, Bangladesh.
[2]Depertment of Entomology, Faculty of Agriculture, Sylhet Agricultural University, Sylhet -3100, Bangladesh.
*Correspondence: senthijarrin06@gmail.com

Abstract

In Bangladesh, tea (*Camellia sinensis* L.) is a valuable evergreen beverage crop. It is also predominantly one of the most popular agro-based crops in Bangladesh with export potential. The quality of the planting material is important for successful tea cultivation. It can be grown either from vegetatively propagated clones or seeds. The most efficient way of vegetative propagation is the use of single-node cuttings from the selected tea plant. In the present study, 18 traditional tea clones were examined to identify better clones in terms of survivability and growth performance of the cuttings and to identify the better planting material with a high potential for seedling establishment in nursery conditions. The study was conducted at Tea Germplasm Center, Sylhet Agricultural University from December 2021 to June 2022. At a 15-day interval, morphological parameters such as the number of live cuttings, number of branches, shoot length (cm), leaf number, length and width of 3rd leaf number of roots and root length (cm) were recorded. The results revealed that the ML6 clone had the maximum shoot length (9 cm), leaf number (7), leaf length (10.9 cm) and width (4.2 cm) and root number (12). However, the maximum root length (16.5 cm) was obtained in the SAU3 clone. ML2 clone had the highest survival rate, which was 58% followed by ML9 (50%) and ML6 (42%). Although SAU3 and ML2 clones performed better in terms of root development and survival, respectively, ML6 demonstrated superiority in terms of other morphological features and growth performance. No side branches were observed in any of the clones during the study period. The finding suggests that there might be a genetic connection between all of the characteristics. In conclusion, ML6 proved as the superior clone in nursery conditions regarding the shoot and root growth performances. These morphological characteristics might be important to identify tea clones that can tolerate stress conditions. However, additional field evaluation is required to validate the superiority of these tea clones.

Keywords: Tea reproduction, traditional tea plants, stress tolerant tea, tea production

Escalation growth and yield of mungbean crops by sink manipulation: A good opportunity to minimize pod picking episode

A.H.M.M.R. Talukder[1], F. Ahmed[2], I.M Ahmed[1], S.N Mahfuza[1], A.F.M.S. Ahsan[1], N. Mokarraoma[3], L. Nahar[4]

[1]Senior Scientific Officer, Plant Physiology Division, Bangladesh Agricultural Research Institute
[2]Chief Scientific Officer, Plant Physiology Division, Bangladesh Agricultural Research Institute
[3]Scientific Officer, Plant Physiology Division, Bangladesh Agricultural Research Institute
[4]Assisstant Professor, Agricultural Botany, Sher-e-Bangla Agricultural University, Bangladesh
*Correspondence: lutfun.sau@gmail.com; motiurbari@yahoo.com

Abstract

Farmers frequently experience difficulties with their Mungbean harvests due to continuous picking that elongates the pod picking episode and creates an economic crisis. To solve these issues, deflowering strategies (sink manipulation) were employed in this study following the RCB design. A series of deflowering strategies started from 40 days after sowing to 55 DAS; resulting in a reduced pod production as well as pod picking episode (3 to 4 times) with 6.8-36.8% seed yield compared to control. Deflowering at 55 DAS, can minimize seed yield reduction by up to 6.8%, and maximize gross margin up to Tk 1,12,800 ha^{-1}. Considering relative yield, yield reduction and gross margin, 50- or 55-days produced flower (which would be matured within 60-65 DAS) could be considered for obtaining the economic seed yield without sacrificing minimum seed yield (6.8%). So, farmers' should complete pod picking within 65 DAS without waiting for the maturity of the remaining pods.

Keywords: Growth, yield, sink manipulation, pod picking, episode

Morpho-physiological and yield contributing characteristics of black pepper (*Piper nigrum* L.) in Sylhet region

Md. Moudud Ahmod[1], Masuma Asha[1], Sayed Zahid Hasan[2], Mohammad Samiul Ahsan Talucder[2], Md. Masudur Rahman[1]*

[1]Department of Crop Botany and Tea Production Technology, Sylhet Agricultural University, Sylhet-3100, Bangladesh
[2]Department of Agroforestry and Environmental Science, Sylhet Agricultural University, Sylhet-3100, Bangladesh
*Correspondence: masudur.cbot@sau.ac.bd

Abstract

Black pepper (*Piper nigrum* L.) is a spice plant, essentially used in many cuisines around the world. Bangladesh has huge demands for black pepper and meets up its demands by importing. Though the black pepper plant is found in the northeastern areas of Bangladesh naturally, most of them grow in the homestead without proper management. There is no scientific report about the morpho-physiological and yield contributing character of the black pepper plant in Bangladesh. An experiment was carried out to evaluate the influence of different management practices on morpho-physiology and yield contributing characters in two locations of Sylhet starting from April 2021. Well decomposed cow dung (WDC) @10 kg/plant, N:P:K @50:50:150 g/plant, 50%WDC + %N:P:K and farmer's practice were considered as T0 T1, T2 and T3 treatments. Half of the plants were irrigated during the dry period (December to February). Morpho-physiological data have been collected at the flowering time of 2021 and 2022. Yield contributing data were collected in February 2022 from the matured inflorescence. Morpho-physiological data showed more variability in 2022 than in 2021. The parameters did not vary among treatments significantly in 2021 except leaf greenness (SPAD) and internode diameter (cm) and was maximum at T1 (SPAD-57.94 and 0.56 cm). A similar result was also observed in 2022, where leaf greenness was found to be maximum in T1 (SPAD-56.93) and internode diameter was maximum in T2 (0.56 cm). Irrigation increased leaf dry matter (%) in 2021 (27.98%) and internode dry matter (%) in 2022 (37.42%). Treatments did not influence the yield and yield contributing characters significantly in both year, irrigation significantly increased the number of viable fruits per inflorescence in 2021. Although more data are required to understand the effect of different managements on morpho-physiological and yield contributing characters, it seems management practices and irrigation are influencing morpho-physiological and yield contributing characteristics of Black pepper.

Keywords: Management, agronomic practice, spice, growth, fruiting

Genetic variability for resistance to Fall armyworm in maize

Shimul Das[a*], Toufiqur Rahman[a], Mahfuzur Rahman[b], Mahfuzur Rahman[c], Lyndon Porter[d], Prosanta Kumar Dash[a], and Md. Mostofa Kamal[e]

[a]Agrotechnology Discipline, Khulna University, Khulna-9208, Bangladesh.
[b]Horticulture Research Center, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur, Bangladesh.
[c]Extension Service, West Virginia University, WV 26506, USA.
[d]United States Department of Agriculture, Agricultural Research Service, Prosser, WA, USA.
[e]Faculty of Agriculture, Saga University, Honjo-Machi, Saga, Japan.
*Correspondence: shimul@at.ku.ac.bd

Abstract

Isolation of host-plant resistance is a critical tool of integrated pest management (IPM) for preventing the spread of invasive pests like fall armyworm (FAW: *Spodoptera frugiperda* J. E. Smith) which develops insecticide resistance rapidly. So, the current study field-screened 15 hybrid maize (*Zea mays* L.) genotypes widely grown in Bangladesh in 2020 and 2021 following a randomized complete block design with three replicates to characterize host-plant resistance to FAW. Plant height, ear length, kernel weight, and yield/plant all influenced maize yield/plant, as shown in the 4-variable bubble plot. A 3-D surface chart indicated that increased FAW infestation caused increased ear destruction lowering grain yield/ha. In principal component analysis, traits of the area under pest progress curve (AUPPC), mean infestation and ear damage explained the maximum variance in PC1 while yield/plant and ear number/plant contributed maximum variance to PC2. Cluster analysis created five groups of 15 maize genotypes, with BHM-6, BHM-7, and BHM-9 genotypes being the resistant genotypes. Kernel weight and grain yield/ha declined with the growth of AUPPC, as shown in linear regression. At 5% selection intensity, moderate to high genetic advance was recorded in 100-kernel weight, days to anthesis/silking, ear length and yield/plant. BHM-7, BHM-6, and BHM-9 maize genotypes could be used as prospective FAW-resistant maize sources for developing an elite genotype with resistance to FAW.

Keywords: Cluster analysis, FAW resistance, genetic variability analysis, maize genotypes, principal component analysis

Selection of red spider mite tolerant clones and management of red spider mites using bio-pesticides for sustainable tea production

Md. Simon Islam[1*], A F M Saiful Islam[1], M A Maleque[2]

[1]Department of Crop Botany and Tea Production Technology, Faculty of Agriculture, Sylhet Agricultural University, Sylhet-3100, Bangladesh
[2]Department of Entomology, Faculty of Agriculture, Sylhet Agricultural University, Sylhet-3100, Bangladesh.
*Correspondence: sionick56@gmail.com

Abstract

The red spider mite is one of the insects which accounts for about 10-12 % yield reduction of tea during the drought period in Bangladesh. Selection of Red spider mite tolerant tea clones and the management of red spider mites using some bio-pesticides were investigated in Nalua tea estate, Chunarughat, Habiganj and Sylhet Agricultural University in 2021 and the works are continuing. Thirty clones with three check variety (BT2, BT19, TeenAli) was collected from different tea estate of the Sylhet region to select the clones that are red spider mite tolerant. No choice test was employed to select red spider mite tolerant tea clones and each plot was covered with a net and red spider mite infested leaves were tied up with tea clones. A seasonal abundance of major pests of tea was observed under unshaded conditions, optimum shade conditions and shade conditions. No adult red spider mite per 1cm2 of the leaf was found higher in unshaded condition (3.98±0.70 nos) followed by optimum shade (1.62±0.45 nos.) and over shade condition (0.88±30 nos.). Among them, clones 6,7 and 15 showed promising results in comparison with others. Some selected bio-pesticides are applied with three replications where each plot size was 6m × 6m. Spiromesifen (T_4) showed promising results and a higher mortality rate (97.3±1.15%) against red spider mites followed by Matrine 0.5% (T_2) (82.1±1.86%), Abamectin (T_1) (81.9±2.84%), K-mite (T_3) (78.4±1.28%) and planters practice (T_5) (68.9±2.57%).

Keywords: red spider mite, bio-pesticides, integrated pest management, crop protection

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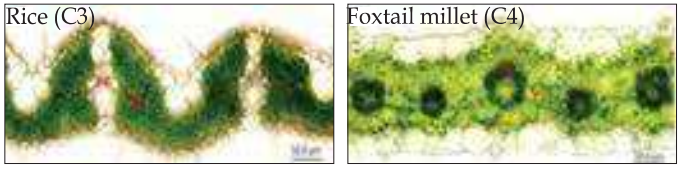
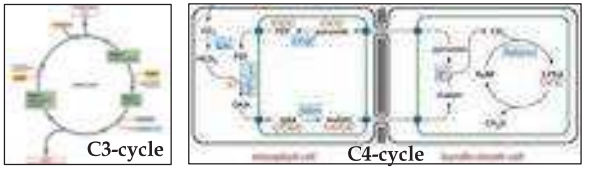
C4 Rice Research and Development

Rice will be less productive as a result of increasing photorespiration and other issues linked with climate change. Under changing conditions, C4 rice increases photosynthesis by 50 percent and also increases nitrogen and water use efficiency by 30-50 percent.

Anatomical changes required



Biochemical changes required



Objectives of this project

- Enhancing capacities for C4 rice research and development at BRRI.
- Strengthening photosynthesis research towards the improvement of photosynthetic efficiencies under changing climate.

Progress of the project

- Photosynthesis research enhanced by inclusion of Chlorophyll Fluorescence Imaging System, Licor portable photosynthesis system and different portable fluorometers.
- Established a genome editing and microscopy laboratory
- Proteomic laboratory having SDS-PAGE, Western Blotting and 2D-Gel electrophoresis is in progress

Bangladesh Rice Research Institute (BRRI)

ZAEEM - HASAN VILLA

Eight Storied Apartment Project @ Joydevpur

PROJECT BRIEF

Project name	: Zaeem-Hasan Villa
Address	: Plot-14, Road-03, Cadet College R/A, Joydevpur, Gazipur
Land area	: 4.15 Katha
Total floor	: G+7 (8 storied)
Facing	: South facing
Units per floor	: 02 units
Apartments	: 14 nos
Car parking	: 07 nos

Apartment size : **1250 sft**

Apartment contains:
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