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South Asia Biosafety Program

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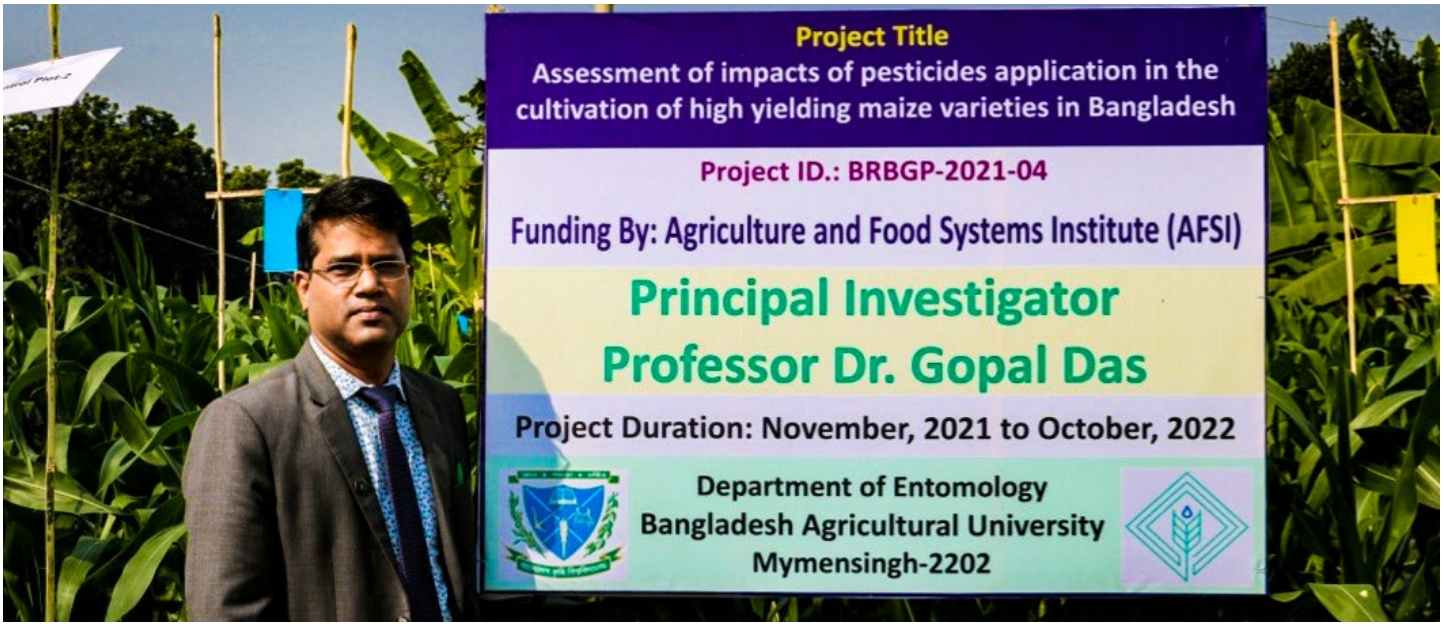
BANGLADESH

Assessment of Impacts of Pesticide Application in the Cultivation of High Yielding Maize Varieties in Bangladesh

Prof. Dr. Gopal Das, Department of Entomology, Bangladesh Agricultural University

BRBGP 2021 GRANT RECIPIENT

The Biosafety Research in Bangladesh Grants Program (BRBGP) is managed by the Agriculture & Food Systems Institute (AFSI) as part of the USAID-funded South Asia Biosafety Program. Recognizing the need for biosafety research as part of a broader effort to support science-based decision-making and policy development, the BRBGP funded research in 2019-2021 that considered the potential impacts of agricultural biotechnology, particularly genetically engineered crops, on the environment and biodiversity in Bangladesh.



Prof. Dr. Gopal Das, Department of Entomology, Bangladesh Agricultural University.

Maize is an emerging cereal crop in Bangladesh after rice and wheat. Its production area is expanding annually because it provides better net returns to farmers than wheat and it has high demand in the fish and poultry sectors. Over the last 10 years, maize production in Bangladesh grew substantially from 1,954 to 4,400 thousand tonnes, rising at an increasing annual rate that reached a maximum of 17.14% in 2019. High yielding hybrid maize varieties are being cultivated by most of the maize farmers in Bangladesh and these hybrid varieties are reported to be highly susceptible to different insect pests, including fall armyworm, common cutworm, common armyworm, corn earworm, and aphids. To control these insect pests, maize farmers routinely spray different broad-spectrum synthetic insecticides from different groups, such as organophosphates, organocarbamates, pyrethroids, neonicotinoids, and avermectins. It is noteworthy that the majority of maize growers are applying these insecticides without any protective clothing. Due to inadequate or no use of protective tools during spraying of pesticides, pesticide droplets enter in the body through contact, ingestion, and inhalation, likely causing short to long term health illness. Moreover, injudicious and indiscriminate use of pesticides on maize crops may adversely affect the abundance and biodiversity of non-target arthropods in the maize ecosystem.

PROJECT OBJECTIVES

- To identify the pesticides or pesticide groups used on maize crop for controlling insect pests.
- To investigate the handling practices, doses, and frequency of pesticide application and farmers' perception regarding pesticide uses through a face-to-face survey study.

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- To assess the effect of pesticide application on the abundance and biodiversity of beneficial arthropods in the maize ecosystem.

METHODOLOGY

Study-1: Baseline Survey Study on Pesticide Use and Their Handling Practices in the Cultivation of Maize

Pesticide-related baseline information will be collected from maize growers/farmers of 8 major maize growing districts of Bangladesh *viz*. Chuadanga, Meherpur, Bogura, Gaibandha, Sirajganj, Dinajpur, Jamalpur, and Sherpur. A representative number of samples will be selected from all 8 districts using the simple random sampling method. Since the size of the target population is large and unknown in the study locations, it is therefore estimated that the selection of 383 samples is optimum for a 95% confidence interval. However, for greater authentication, 400 representative farmers will be selected from all 8 districts, with the size of 50 farmers/district. A semi-structured questionnaire, consisting of necessary information, will be used in this study and data will be collected through a survey conducted through face-to-face interviews.

Study-2: Assessment of Biodiversity of Beneficial Arthropods in Farmers' Maize Fields of Different Locations (Districts) of Bangladesh (Following Farmers' Practice Condition)

The study will be conducted in two major maize growing districts of Bangladesh, namely Chuadanga and Dinajpur. Studies will be conducted both in farmers' practice and control conditions. In each study area, a total of 8 plots will be established, 4 for the pesticide group and 4 for the control or non-pesticide group. The size of each of the plots is 200 m^2. Beneficial arthropods will be collected from pesticide and control plots through three methods *viz*. sweeping net, pitfall trap, and sticky trap. Data will be collected at 10-day intervals. Collected specimens will be sorted, counted, and identified at the family level, as well as assigned to various functional groups based on similar functional behavior and food acquisition strategies.

EXPECTED OUTCOME

The proposed study will generate baseline data on the use, composition, and handling practices of pesticides used in the cultivation of high yielding maize varieties in Bangladesh. The detrimental effect of pesticide use on beneficial arthropod biodiversity in the maize ecosystem will also be known. Moreover, this study will provide valuable information on pesticide-induced health illness of maize growers or farmers due to careless use of pesticides. From this study, lower numbers of beneficial arthropod communities are expected to be recorded in pesticide-treated maize fields than in control fields, and thus, these results may help our government or the concerned authority formulate new "pesticide usage policy or guidelines" for the farmers' safe handling and use of pesticides. Overall, the proposed study will help to devise environmentally friendly sustainable agricultural development interventions. Considering these expected outcomes, the study will thus help examine the feasibility of adoption of genetically modified or transgenic maize in Bangladesh in the future. In addition, the researchers, students, and other staff from the institutions engaged in implementing the project are expected to gain skills in carrying out research activities of this sort and will develop expertise in this specific field.

The proposed study will help to devise environmentally friendly sustainable agricultural development interventions [...] and thus help examine the feasibility of adoption of genetically modified or transgenic maize in Bangladesh in the future.

Women collecting maize in Bangladesh © Jahangir Alam Onuchcha | Dreamstime.com

Second Workshop of the IBO Training Program

Mahmuda Khatun, Principal Scientific Officer and Mohammad Kamrul Hasan, Senior Scientific Officer, Biotechnology Division, Bangladesh Agricultural Research Institute (BARI)

Speakers and a selection of participants at the second workshop of the IBO training program (February 17, 2022)

The Second Workshop of the Institutional Biosafety Officer (IBO) Training Program was held virtually on February 17, 2022 due to the Covid-19 resurgence. Twenty participants from National Agricultural Research Institutes, the National Institute of Biotechnology (NIB), and universities participated in this workshop. The Ministry of Agriculture, Government of the People's Republic of Bangladesh organized this workshop in collaboration with the South Asia Biosafety Program (SABP), Agriculture & Food Systems Institute (AFSI), and Biotech Consortium India Limited (BCIL).

Dr. Rakha Hari Sarker, Country Coordinator, SABP and Professor, University of Dhaka, welcomed all the participants to the workshop and provided a recap of the first IBO workshop, which was held on December 2, 2021 at the Hotel Sarina in Dhaka.

Dr. Aparna Islam, Professor, Brac University, presented a detailed overview of the feedback received from the participants of the first IBO workshop regarding the research activities of the respective institutes towards the development of genetically engineered (GE) crops in Bangladesh. Dr. Islam talked about the existing facilities, capabilities, and commercialization strategy to carry out the ongoing research on GE crops at the Bangladesh Agricultural Research Institute, Bangladesh Rice Research Institute, Cotton Development Board, Bangladesh Institute of Nuclear Agriculture, National Institute of Biotechnology, Dhaka University, Jahangirnagar University, and Bangladesh Agricultural University. She pointed out that all the institutes are actively involved in research on the development of GE crops and almost all the institutes provided a positive response, indicating their intention for commercialization of GE products. She also mentioned that the scientists from most of the organizations require biosafety-related training in the areas of environmental/food safety assessment, as well as advanced training in regulatory aspects for GE crop development.

Twenty participants from National Agricultural Research Institutes, the National Institute of Biotechnology (NIB), and universities participated in this workshop.

Dr. Andrew Roberts, Chief Executive Officer, AFSI delivered a presentation on the key components of biosafety compliance in contained facilities for GM crop development. He highlighted the importance of research using contained facilities, biosafety goals, and principles for contained use. The primary goal of biosafety measures is to protect human health and the environment from potentially harmful organisms. Dr. Roberts also discussed good research laboratory practices, tools, and techniques for ensuring biosafety compliance that includes trained personnel who work with GE materials, proper labeling of all the GE materials, maintaining records, and verification. He pointed out that one of the goals of this program is to understand the application of Standard Operating Procedures (SOPs) and documentation ensuring biosafety protocols when working with GE plants.

Following Dr. Roberts' presentation, Dr. Rakha Hari Sarker conducted a group exercise with active involvement of all participants. The participants took part in four cases related to different biosafety aspects of laboratory and contained trials of GE crops. The exercise session was wrapped up with useful comments from the expert resource persons.

The next presentation on "Working with GE Plants: Laboratory and Beyond" was delivered by Dr. Bhavneet Bajaj, Manager–Scientific Programs, AFSI, during which Dr. Bajaj pointed out the safety measures and requirement of SOPs for laboratory and contained trials of GE crops. She also discussed the benefits and importance of having crop-specific SOPs. Moreover, she pointed out that institutes working with GE plants should establish and follow SOPs as and when required. Dr. Bajaj also pointed out several references to the establishment of SOPs for biosafety work in the Bangladesh biosafety guidelines.

Subsequently, Mr. Sium Ahmed, Biosafety Officer, SABP discussed recording formats elaborately. He presented record keeping methods and highlighted their importance. Recording is required for GE research to maintain compliance with regulatory regimes and to maintain integrity of research at every stage of GE crop development. He also presented some examples of recording formats and mentioned that record keeping in light of SOPs would be helpful for researchers.

The final technical presentation was delivered by Dr. Vibha Ahuja, Chief General Manager, BCIL & Senior Advisor, SABP. Dr. Ahuja discussed

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the critical control points while managing the integrity of GE products. She went through a stepwise guidance for each step of GE crop research, with their critical control points and development of quality management systems. Lastly, she talked about Excellence Through Stewardship (ETS) and the relevant technical resources. She mentioned that ETS Guides provide direction on how to develop and implement stewardship programs and quality management systems from discovery through commercialization and post-market activities. There was a thorough discussion of the topics and the program concluded with a question-and-answer session.

BANGLADESH

Virtual Academy Lecture on Understanding Molecular Plant-Microbe Interaction for Biorational Management of Plant Health

Paritosh Chandra Roy, Hossain Sohrawardy, Abdullah Al Rahat, Abu Naim Md. Muzahid, SM Fajle Rabby, Fatema, and Dipali Rani Gupta, Institute of Biotechnology and Genetic Engineering, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh

Speakers and a selection of participants at the virtual academy lecture on Understanding Molecular Plant-Microbe Interaction for Biorational Management of Plant Health (January 24, 2022).

Bangladesh Academy of Sciences (BAS) organized a virtual academy lecture on Understanding Molecular Plant-Microbe Interaction for Biorational Management of Plant Health on January 24, 2022. The speaker was Prof. Dr. Tofazzal Islam, who is a Fellow of BAS and The World Academy of Sciences (TWAS), and a Professor at the Institute of Biotechnology and Genetic Engineering (IBGE), Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Bangladesh.

During the academy lecture, Prof. Islam presented several of his discoveries over the 27 years of his research career, covering signaling and communications between plant and peronosporomycete phytopathogens, plant-beneficial bacteria interactions and their usage in crop production and bioprospecting, and genomic analyses of plant-microbe interactions and biotechnological application of the discovered knowledge for durable management of plant health.

Prof. Islam described how signaling molecules help pathogens to locate the host or stay away from non-host plants. The perenosporomycetes are a group of microorganisms that include some of the most devastating plant pathogens under the genera of *Phytophthora*, *Plasmopara*, and *Aphanomyces*. Prof. Islam identified and elucidated the structure of host-specific kairomone signal, cochliophilin A in the root exudates of host plants like spinach of a damping-off disease causing *Aphanomyces cochlioides*. Cochliophilin A guides the *A. cochlioides* zoospores to find the host root and also triggers essential differentiation of zoospores through dynamic polymerization and depolymerization of the filamentous actin. He also discovered a large number of zoospore-inhibitory compounds (chemical-weapons) in the non-host plants and environmental microorganisms that are likely to ward-off zoosporic pathogens.

Prof. Islam highlighted his discoveries on molecular cross-talks between plant and probiotic bacteria in the second part of the lecture. Plant probiotic bacteria are powerful bioagents of practical applications as biofertilizers, biopesticides, and bioprospecting. His team discovered more than 700 probiotic bacteria such as epiphyte, endophyte, and rhizobacteria from native major crop plants. Some strains under the genera of *Lysobacter. Bacillus, Paraburkholderia, Delftia,* etc. increase crop yield and protect the host plants from the destructive pathogens by using various mechanisms, including secretion of phytohormones, fixation of atmospheric nitrogen, solubilization of essential nutrients in soils, and secretion of antimicrobial substances. Xanthobaccin A secreted by *Lysobacter* sp. SB-K88 disrupts the ultrastructure and cytoskeletal networks of the damping-off pathogens.

In the last part, Prof. Islam narrated his exciting journey of tackling the first epidemic outbreak of wheat blast disease in Bangladesh in 2016. In a rapid response, he led 31 researchers from 4 continents and precisely determined the genetic identity and origin of the wheat blast fungus using field pathogenomics, open data sharing, and open science approaches. His team discovered a novel method for rapid detection of wheat blast fungus using genome-specific primers and revolutionary CRISPR-Cas technology with an effective collaboration of the scientists in the United States and China. This technology could be utilized in quarantine offices, research labs, and in fields around the world to prevent the spread of wheat blast disease to major wheat growing countries. He also presented his research on the application of CRISPR-Cas genome editing technology for development of durable blast-resistant wheat varieties and introgression of resistance genes to commercial varieties for mitigation of wheat blast.

Prof. Islam narrated his exciting journey of tackling the first epidemic outbreak of wheat blast disease in Bangladesh in 2016.

Prof. Islam highlighted his group's success in biocontrol of wheat blast by probiotic bacteria (*Bacillus* sp. BLK6A, *Bacillus* sp. BTS3, *Bacillus valezensis* BTS3 etc.). He also presented their findings on reduction of chemical (N, P, and K) fertilizers in rice by using their probiotic bacte-

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rial technology, which was funded jointly by BAS and USDA. Prof. Islam stated that application of these renewable beneficial bacteria remarkably reduce the dependency on agrochemicals and promote sustainable agriculture for safe food production in the country.

An interactive discussion session followed the presentation, during which many prominent scientists in the country, including Prof. Dr. Ziauddin Ahmed, Dr. MA Hamid Mia, Prof. Dr. Haseena Khan, Prof. Ahmed Abdullah Azad, Dr. Abdul Latif, Prof. Dr. Zeba Islam Seraj, and others participated. Dr. Miah advised providing a list of the probiotic bacteria to the BAS that are suitable for utilization as biofertilizers and biopesticides. Prof. Dr. Hasan said that the contributions of Prof. Islam in generating new knowledge for solving real problems in agriculture and food security are outstanding and exemplary. In the closing remarks, the chair of the lecture, Dr. Zahurul Karim, expressed his appreciation of Prof. Islam for becoming a champion researcher in the field of agro-biotechnology. He emphasized the need for basic research to solve new problems that are constantly faced by farmers in crop production due to various reasons, including global climate change, and advised intensifying collaboration with researchers of the NARS institutes for faster practical application. A total of 80 participants, including the Fellows of the BAS and TWAS, professors, scientists, and students participated in the virtual academy lecture.

BANGLADESH

Agricultural Innovation: Modern Tools to Ensure Food Security

Rezina D. Costa, Farming Future Bangladesh

Speakers and a selection of participants at the virtual media tour Agricultural Innovation: Modern Tools to Ensure Food Security (February 8, 2022)

With a view to improving access to modern agricultural innovations for sustainable food security, a virtual media tour was held on February 8, 2022 at the U.S. Embassy in Bangladesh. The media tour was organized using the Zoom platform and shared evidence-based information about social, economic, and environmental benefits of modern agricultural innovations. It also shared the application of biotechnology to breed crops in order to give farmers and consumers access to safer, healthier, and more nutritious food.

The media tour was organized by the U.S. State Department in collaboration with the U.S. Department of Agriculture (USDA) and U.S. Agency for International Development (USAID). Farming Future Bangladesh (FFB), a science-based communication and community engagement organization, facilitated the tour.

The virtual tour [...] provided an overview of communication practices in agricultural reporting, as well as the current status and importance of agricultural biotechnology in Bangladesh.

Senior journalists from seven print and electronic media outlets attended the media tour. Interacting with speakers, media personnel shared their views on the status, prospects, and challenges of agricultural biotechnology. The tour was organized mainly to discuss science-based reporting on innovative agricultural technologies, including biotechnology, with media professionals and the vast potential of this innovative technology to improve outcomes for farmers, the environment, and consumers. Md Arif Hossain, CEO, and Executive Director of FFB, moderated the virtual tour.

At the beginning of the inaugural session, Md Arif Hossain expressed his greetings to all participants and welcomed them to the workshop. Media personnel interacted with speakers and shared their views on the status, prospects, and challenges of agricultural biotechnology. Participating journalists expressed that agricultural news needs to be data-driven and correctly represent science. Besides, they noted the importance of media staying updated with the fast-paced innovations in agriculture at the national and international levels. U.S. Embassy Agricultural Attaché, Megan Francic, said that those new technologies promised to speed up crop development by ensuring farmers have access to more sustainable solutions and give consumers safe, affordable access to food.

In a session titled, "Agricultural Biotechnology Research and Development: Impacts, Challenges, and Opportunities in Bangladesh," Dr. Rakha Hari Sarker, Country Coordinator, South Asia Biosafety Program (SABP), Bangladesh and Professor, Department of Botany, University of Dhaka and Dr. Aparna Islam, Professor, Department of Mathematics and Natural Sciences, Brac University, talked about the significance of advancements in agricultural biotechnology and its potential to mitigate the effects of climate change and address "hidden hunger," or nutrient deficiency. They also emphasized the role of the media and communication professionals in disseminating evidence-based information.

This virtual tour was part of a series of events to be organized in Bangladesh, Indonesia, and the Philippines. It provided an overview of communication practices in agricultural reporting, as well as the current status and importance of agricultural biotechnology in Bangladesh. Specific topics, such as genome editing, productivity, biosafety, food safety, consumption, diversified use, and regulatory challenges were included in their conversation.

Following the discussion, there was a lively question and answer session. The session closed with a brief overview of future activities and some wonderful stories like one from Milon Mia, a farmer from Bogura, who shared his positive experience of planting genetically engineered eggplant.

CALENDAR OF EVENTS

EVENT	ORGANIZED BY	DATE	WEBSITE
INDIA			
7th National Youth Convention - Food Security to Nutritional Security: Youth Perspective	All India Agricultural Students Association (AIASA), Indian Council of Agricultural Research (ICAR), and Tamil Nadu Agricultural University (TNAU)	March 24-25, 2022 Coimbatore (in person and online)	https://tnau.ac.in/news-events/
ICGEB-DBT Workshop: Re-Designing Smart Crops for Sustainable Agriculture - Dynamics of CRISPR-Cas Breeding, NGS, and Beyond	International Centre for Genetic Engineering and Biotechnology (ICGEB) & Department of Biotechnology, Government of India	March 22-28, 2022 New Delhi	https://www.icgeb.org/wp-content/uploads/2021/11/2022Calendar_29Oct21.pdf
2nd Indian Horticulture Summit - 2022: Horticulture for Prosperity and Health Security	Society for Horticultural Research and Development (SHRD) and Navsari Agricultural University	April 27-29, 2022 Navsari, Gujarat	https://nau.in/index
43rd Annual Meeting of the Plant Tissue Culture Association-India (PTCA-I) & International Symposium on Advances in Plant Biotechnology and Nutritional Security (APBNS-2022)	ICAR-National Institute for Plant Biotechnology	April 28-30, 2022 New Delhi (in person and online)	http://www.nrcpb.res.in/
National Symposium: Remembering Gregor Johann Mendel on His Bicentennial Birth Year - From Scratch to Factor to Gene to Genome	Plant Breeding & Genetics Society, Department of Genetics & Plant Breeding, College of Agriculture, G. B. Pant University of Agriculture & Technology	May 5-6, 2022 Pantnagar	https://gbpuat.ac.in/trainings_conferences/index.html
ICGEB-DBT Workshop: Re-Designing Smart Crops for Sustainable Agriculture - Dynamics of CRISPR-Cas Breeding, NGS, and Beyond	ICGEB and DBT	May 23-27, 2022 New Delhi	https://www.icgeb.org/wp-content/uploads/2021/11/2022Calendar_29Oct21.pdf
INTERNATIONAL			
24th Meeting of the Subsidiary Body on Scientific, Technical, and Technological Advice	Secretariat of the Convention on Biological Diversity	March 14-29, 2022 Geneva, Switzerland	https://www.cbd.int/meetings/
3rd Meeting of the Subsidiary Body on Implementation			
3rd of the Open-Ended Working Group on the Post-2020 Global Biodiversity Framework			

SOUTH ASIA BIOSAFETY PROGRAM

The South Asia Biosafety Program (SABP) is an international development program implemented in India and Bangladesh with support from the United States Agency for International Development (USAID). SABP aims to work with national governmental agencies and other public sector partners to facilitate the implementation of transparent, efficient, and responsive regulatory frameworks for products of modern biotechnology that meet national goals as regards the safety of novel foods and feeds, and environmental protection.

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