VOL 17 NO 06 JUNE 2020

South Asia Biosafety Program

NEWSLETTER FOR PRIVATE CIRCULATION ONLY – NOT FOR SALE

BANGLADESH

Genetically Modified Mosquitoes as a Strategy to Control Mosquito Borne Diseases

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Mosquito sucking flower nector (© Amit Rane | Dreamstime.com)

Mosquitoes comprise a group of about 3,500 species of small insects. A handful of these species of tiny insects spread diseases that are among the leading causes of mortality and morbidity in humans. However, mosquitoes are not lethal by themselves—they harbor various pathogenic viruses, bacteria, and parasites which transmit through their bites. According to the World Health Organization (WHO), around one million people die of mosquito-borne diseases every year. This is why mosquitoes are considered one of the deadliest living creatures, and with the advent of globalization, urbanization, international travel, migration, and climate change, mosquito borne infections are distributed worldwide.

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Mosquitoes are responsible for transmission of diseases such as dengue fever, zika fever, and chikungunya. To fight such diseases, only a few effective drugs or vaccines are available. Therefore, the current control strategy of these diseases is based on controlling populations of mosquitoes, including through the application of broad-spectrum insecticides, which eventually leads to the harm of other insects, humans, and the environment.

In recent years, as with applications in other sectors, genetic modification has been considered as a technique to control mosquitoes and limit their transmission of diseases. Genetically modified (GM) mosquitoes are mosquitoes that have been modified to contain a gene or genetic construct that was not originally present or naturally occurring in wild type mosquitoes. One strategy is based on a concept known as gene drive, where a mosquito population biologically able to transmit pathogens is replaced by one that is unable to transmit pathogens. Another strategy is to reduce the mosquito populations so that there are fewer mosquitoes to pass on the pathogen. This concept has been applied by Prof. Luke Alphey, from the Department of Zoology at the University of Oxford. The process relies on a female-specific dominant lethal gene, where a very small amount of DNA containing a lethal gene known as tetracycline-repressible

Continued on page 2

Continued from page 1

transcriptional activator is injected into the mosquito egg. These modified male mosquitoes require an antibiotic called tetracycline to develop beyond their larval stage and the antibiotic is impossible to obtain from natural sources in their habitat. These male mosquitoes would be released into the wild to mate with the wild population where their offspring's inability to grow to adulthood would lower the population of mosquitoes. The concept was patented in 1999[1].

The main aim of developing GM mosquitoes is to reduce the spread of infections, as well as the use of potentially harmful chemicals. The GM mosquitoes have the potential to be a much greener and more environmentally friendly control mechanism. These mosquitoes don't spread their genes to other species and the lethal gene only has a small impact on the overall DNA of wild populations of mosquitoes. However, as with most GM technologies, there are some potential concerns. The possibility that introduced genetic elements may lead to mutations in wild mosquito populations, or that engineered mosquitoes intended to decline in the environment may instead thrive, have led some to call for more field testing or restrictions on the use of the technology.

Experience with GM mosquitos is growing but remains somewhat limited. Engineered *Aedes aegypti* mosquitoes were first released in 2009 in the Cayman Islands. Further releases have occurred in Malaysia and Brazil. Burkina Faso released engineered *Anopheles* mosquitoes, which are the first in the African continent[2]. In 2015, field trials involving recurring releases of GM mosquitoes demonstrated a reduction of nearly 95 percent of target populations in Brazil[3], and Brazil's biosafety regulatory committee, CTNBio, approved the use of these mosquitoes. Subsequent research has reported that some of the genes from the genetically modified mosquitoes had transferred to the native population, suggesting some of the offspring from sterile male releases had survived and were viable enough to reproduce[4].

Living modified organisms are subject to country specific regulatory regimes where the biosafety issues are addressed and evaluated. Regulatory considerations around GM mosquitoes have been considered in international forums, including the Cartagena Protocol on Biosafety and the World Health Organization[5,6]. With the help of a robust and effective regulatory process, the benefit from GM mosquitoes may be realized without harming communities or the environment.

GM technology has the potential to control mosquito-borne diseases and intense research and field trials are underway for its safe and effective implementation. Future research should be aimed to reverse the current alarming global disease trend with cost effectiveness, public acceptance, and epidemiological evidence.

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[5] Marshall, J.M., 2010. The Cartagena Protocol and genetically modified mosquitoes. Nature biotechnology, 28(9), pp.896-897.

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BIOSAFETY DISCOURSES

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BANGLADESH

Virtual Meeting on Way Forward with GM Cotton Confined Field Trials

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Ripe cotton (Gossypium hirsutum) *seed pods (© Sarot Chamnankit | Dreamstime.com).*

On May 12, 2020, the South Asia Biosafety Program (SABP) organized the virtual meeting *Way Forward with GM Cotton Confined Field Trials (CFT)* with the Cotton Development Board (CDB), which aimed to talk about how to proceed with the confined field trials for Bt cotton in the coming season in Bangladesh. After a brief introduction by Dr. Andrew F. Roberts (Vice President, Agriculture & Food Systems Institute), Dr. Md. Kamrul Islam (Senior Scientific Officer, CDB) delivered a brief presentation about the progress made in Bt cotton research in Bangladesh, emphasizing the urgent need for the development of Standard Operating Procedures (SOPs).

According to Dr. Islam, CDB signed an MOU with JK Agri Genetics Limited (JKAL), India for Bt cotton hybrids (Bt gene truncated *Cry1Ac*) in February 2018. After receiving the seeds from JKAL, CDB conducted a contained field trial at Bangladesh Agriculture Research Institute

Continued on page 3

Continued from page 2

(BARI). During the efficacy study, the transgenic lines, JKCH-1947 and JKCH-1050, showed resistance against American bollworm, *Helicoverpa armigera*. Subsequently, CDB applied for permission to conduct a CFT through the Ministry of Agriculture. On March 4, 2020, the National Committee on Biosafety (NCB) at the Ministry of Environment, Forest and Climate Change, at its 11th meeting, gave CDB permission for the CFT. At present, CDB is preparing for the trial.

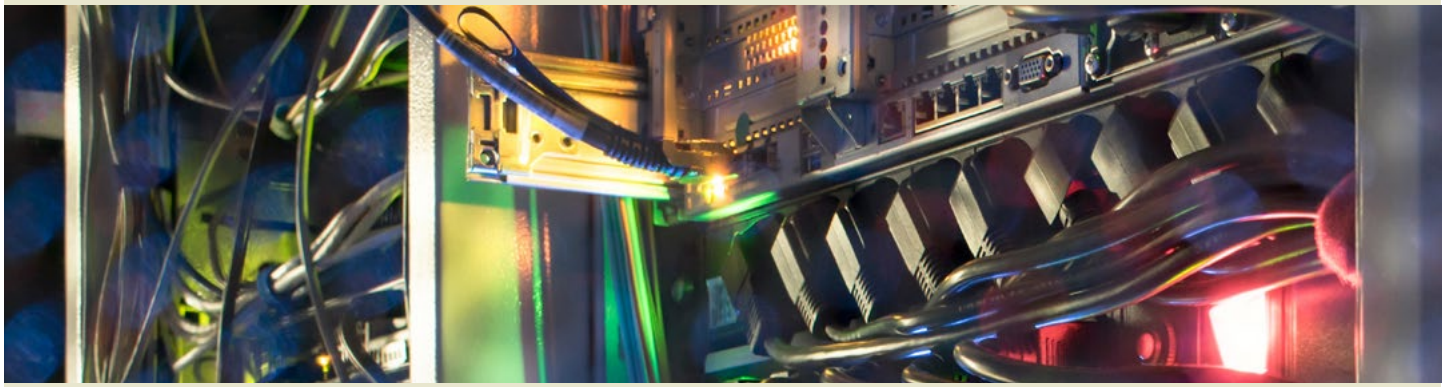
The need to develop SOPs was identified, and it was decided that SABP and CDB will work together to develop these documents.

Dr. Andrew F. Roberts delivered a presentation on the elements of SOPs for conducting a CFT for Bt cotton. During the virtual meeting, discussions focused on how to proceed with the CFT. The need to develop SOPs was identified, and it was decided that SABP and CDB will work together to develop these documents.

The meeting was attended by Dr. Farid Uddin (Executive Director, CDB), Dr. Kamrul Islam (Senior Scientific Officer, CDB), Dr. Gyanendra Shukla (President & Director, JKAL, India), Dr. Manjul Anand (Head – International Business, JKAL, India), Dr. Mithun Chacraborty (Head – R&D, Biotech, JKAL, India), Dr. Andrew F. Roberts (Vice President, Agriculture and Food Systems Institute), Dr. Vibha Ahuja (Senior Adviser, SABP), and Dr. Aparna Islam (Country Manager, SABP). The CDB team was led by Dr. Farid Uddin, while Dr. Andrew F. Roberts led the SABP team.

ANNOUNCEMENT

Indian Biological Data Centre



Rapid advances in DNA sequencing and other high-throughput technologies, along with the lowering of sequencing costs, have enabled government agencies to fund research towards the generation of large volumes of biological data in various sectors of the biosciences. A wealth of information, representing scientific disciplines in healthcare, genomics, proteomics, metabolomics, microbiomes, protein structures, natural compounds, agriculture, and population genetics, is being generated in India. In order to accrue maximum benefits from public investment in the generation of data and to address concerns regarding protection of privacy and confidentiality, data quality, storage and security, and public engagement and complaints, sharing of data must be done in a responsible and ethical manner. Modalities in which data are shared must protect privacy, confidentiality, security and should be non-discriminatory and fair.

Accordingly, the Department of Biotechnology (DBT) has formulated the *Biological Data Storage, Access and Sharing Policy of India* through extensive expert consultation with different government agencies and stakeholders. It is also imperative for India to put the right infrastructure to store, manage, archive, and distribute all biological data. Therefore, DBT has established the country's first national *Indian Biological Data Centre (IBDC)* for the deposition, storage, annotation, and sharing of biological data generated in the country through extensive funding from various government organizations.

Impact of the Indian Biological Data Centre

A pilot phase-I project was sanctioned on March 13, 2020 for a period of two years to the Regional Centre For Biotechnology (RCB), Faridabad for setting up the Indian Biological Data Centre, with the following objectives:

- Setting up the required IT platform (hardware/software) for storage/distribution of biological data and development of the appropriate web portal for data deposition/retrieval.
- Development of standard operating procedures (SOPs) and training of staff for storing the data as per the Findable, Accessible, Interoperable, Reusable (FAIR) principle, performing quality control, curation/annotation of data, data backup, and management of the data life cycle.
- Development/installation of software for the analysis of stored datasets by researchers on the IBDC portal and development of web-based tools/APIs for data sharing/retrieval.
- Organization of training programs on high throughput data analysis and performance of outreach activities for sensitizing researchers on benefits of data sharing.

The IBDC will enable life science researchers to deposit biological data in a central repository and thus, safeguard data generated using public resources from loss. It will perform quality control, curation, and annotation of data. These efforts will help establish benchmarks for the quality of data deposited and thus improve the quality of experimental research conducted in the country. It will also facilitate distribution of biological data to researchers for further analysis and the discovery of emergent properties in biological systems. IBDC will also conduct training programs on data storage and analytics to help increase the manpower skilled in data science in the country.

Source : http://dbtindia.gov.in/hi/latest-announcement/indian-biological-data-centre-ibdc#

CALENDAR OF EVENTS

EVENT	ORGANIZED BY	DATE	WEBSITE
INDIA			
Webinar: The Persistent Dangers Posed by Mosquito Borne Diseases	Tata Institute of Genetics and Society (TIGS)	June 17, 2020 Online	https://us02web.zoom.us/webinar/register/6GgwoCsKTWmBq7fBEw4d4Q
India Bio @ Bengaluru Tech Summit	Department of Information Technology Biotechnology and Science and Technology, Government of Karnataka	September 21-23, 2020 Bengaluru, Karnataka	http://www.indiabio.in/
4th International Conference on NANOFORAGRI 2020 - Application of Nanotechnology for Sustainable, Productive and Safer Agriculture and Food System	The Energy and Resources Institute	November 5-6, 2020 Gurugram, Haryana	https://www.teriin.org/event/4th-international-conference-nanoforagri-2020-application-nanotechnology-sustainable
Indian Seed Congress 2021	National Seed Association of India	February 24-26, 2021 Bengaluru	https://isc2021.nsai.co.in/
INTERNATIONAL			
24th Meeting of the Subsidiary Body on Scientific, Technical, and Technological Advice	Secretariat of the Convention on Biological Diversity	August 17-22, 2020 Montreal, Canada	https://www.cbd.int/meetings/?thm=CPB
5th International Conference on Genome Editing and Gene Therapy	Meetings International	August 19-20, 2020 Osaka, Japan	https://www.meetingsint.com/conferences/genomeediting
3rd Meeting of the Subsidiary Body on Implementation	Secretariat of the Convention on Biological Diversity	August 24-29, 2020 Montreal, Canada	https://www.cbd.int/meetings/?thm=CPB
7th Plant Genomics and Gene Editing Congress: Asia	Global Engage Ltd.	September 14-15, 2020 Bangkok, Thailand	http://www.global-engage.com/event/plant-genomics-asia/
The 3rd Asian Horticultural Congress 2020 (AHC 2020)	Horticultural Science Society of Thailand, International Society for Horticultural Science, Department of Agriculture, Department of Agricultural Extension, Ministry of Agriculture, Kasetsart University, and VNU Exhibitions Asia Pacific	December 15-17, 2020 Bangkok, Thailand	http://ahc2020.org/

SOUTH ASIA BIOSAFETY PROGRAM

The South Asia Biosafety Program (SABP) is an international developmental program implemented in India and Bangladesh with support from the United States Agency for International Development. 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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