

ISSN: 2582-6433



INTERNATIONAL JOURNAL FOR LEGAL RESEARCH AND ANALYSIS

Open Access, Refereed Journal Multi Disciplinary
Peer Reviewed 6th Edition

VOLUME 2 ISSUE 7

www.ijlra.com

DISCLAIMER

No part of this publication may be reproduced or copied in any form by any means without prior written permission of Managing Editor of IJLRA. The views expressed in this publication are purely personal opinions of the authors and do not reflect the views of the Editorial Team of IJLRA.

Though every effort has been made to ensure that the information in Volume 2 Issue 7 is accurate and appropriately cited/referenced, neither the Editorial Board nor IJLRA shall be held liable or responsible in any manner whatsoever for any consequences for any action taken by anyone on the basis of information in the Journal.

Copyright © International Journal for Legal Research & Analysis



IJLRA

EDITORIAL TEAM

EDITORS

Megha Middha



Megha Middha, Assistant Professor of Law in Mody University of Science and Technology, Lakshmangarh, Sikar

Megha Middha, is working as an Assistant Professor of Law in Mody University of Science and Technology, Lakshmangarh, Sikar (Rajasthan). She has an experience in the teaching of almost 3 years. She has completed her graduation in BBA LL.B (H) from Amity University, Rajasthan (Gold Medalist) and did her post-graduation (LL.M in Business Laws) from NLSIU, Bengaluru. Currently, she is enrolled in a Ph.D. course in the Department of Law at Mohanlal Sukhadia University, Udaipur (Rajasthan). She wishes to excel in academics and research and contribute as much as she can to society. Through her interactions with the students, she tries to inculcate a sense of deep thinking power in her students and enlighten and guide them to the fact how they can bring a change to the society

Dr. Samrat Datta

Dr. Samrat Datta Seedling School of Law and Governance, Jaipur National University, Jaipur. Dr. Samrat Datta is currently associated with Seedling School of Law and Governance, Jaipur National University, Jaipur. Dr. Datta has completed his graduation i.e., B.A.LL.B. from Law College Dehradun, Hemvati Nandan Bahuguna Garhwal University, Srinagar, Uttarakhand. He is an alumnus of KIIT University, Bhubaneswar where he pursued his post-graduation (LL.M.) in Criminal Law and subsequently completed his Ph.D. in Police Law and Information Technology from the Pacific Academy of Higher Education and Research University, Udaipur in 2020. His area of interest and research is Criminal and Police Law. Dr. Datta has a teaching experience of 7 years in various law schools across North India and has held administrative positions like Academic Coordinator, Centre Superintendent for Examinations, Deputy Controller of Examinations, Member of the Proctorial Board



Dr. Namita Jain



Head & Associate Professor

School of Law, JECRC University, Jaipur Ph.D. (Commercial Law) LL.M., UGC -NET Post Graduation Diploma in Taxation law and Practice, Bachelor of Commerce.

Teaching Experience: 12 years, AWARDS AND RECOGNITION of Dr. Namita Jain are - ICF Global Excellence Award 2020 in the category of educationalist by I Can Foundation, India. India Women Empowerment Award in the category of "Emerging Excellence in Academics by Prime Time & Utkrisht Bharat Foundation, New Delhi.(2020). Conferred in FL Book of Top 21 Record Holders in the category of education by Fashion Lifestyle Magazine, New Delhi. (2020). Certificate of Appreciation for organizing and managing the Professional Development Training Program on IPR in Collaboration with Trade Innovations Services, Jaipur on March 14th, 2019

Mrs.S.Kalpana

Assistant professor of Law

Mrs.S.Kalpana, presently Assistant professor of Law, VelTech Rangarajan Dr. Sagunthala R & D Institute of Science and Technology, Avadi. Formerly Assistant professor of Law, Vels University in the year 2019 to 2020, Worked as Guest Faculty, Chennai Dr. Ambedkar Law College, Pudupakkam. Published one book. Published 8 Articles in various reputed Law Journals. Conducted 1 Moot court competition and participated in nearly 80 National and International seminars and webinars conducted on various subjects of Law. Did ML in Criminal Law and Criminal Justice Administration. 10 paper presentations in various National and International seminars. Attended more than 10 FDP programs. Ph.D. in Law pursuing.



Avinash Kumar



Avinash Kumar has completed his Ph.D. in International Investment Law from the Dept. of Law & Governance, Central University of South Bihar. His research work is on "International Investment Agreement and State's right to regulate Foreign Investment." He qualified UGC-NET and has been selected for the prestigious ICSSR Doctoral Fellowship. He is an alumnus of the Faculty of Law, University of Delhi. Formerly he has been elected as Students Union President of Law Centre-1, University of Delhi. Moreover, he completed his LL.M. from the University of Delhi (2014-16), dissertation on "Cross-border Merger & Acquisition"; LL.B. from the University of Delhi (2011-14), and B.A. (Hons.) from Maharaja Agrasen College, University of Delhi. He has also obtained P.G. Diploma in IPR from the Indian Society of International Law, New Delhi. He has qualified UGC - NET examination and has been awarded ICSSR - Doctoral Fellowship. He has published six-plus articles and presented 9 plus papers in national and international seminars/conferences. He participated in several workshops on research methodology and teaching and learning.

ABOUT US

INTERNATIONAL JOURNAL FOR LEGAL RESEARCH & ANALYSIS ISSN 2582-6433 is an Online Journal is Monthly, Peer Review, Academic Journal, Published online, that seeks to provide an interactive platform for the publication of Short Articles, Long Articles, Book Review, Case Comments, Research Papers, Essay in the field of Law & Multidisciplinary issue. Our aim is to upgrade the level of interaction and discourse about contemporary issues of law. We are eager to become a highly cited academic publication, through quality contributions from students, academics, professionals from the industry, the bar and the bench. INTERNATIONAL JOURNAL FOR LEGAL RESEARCH & ANALYSIS ISSN 2582-6433 welcomes contributions from all legal branches, as long as the work is original, unpublished and is in consonance with the submission guidelines.

USE OF GENETICALLY MODIFIED FOODS CROPS/SEEDS IN INDIA PROBLEM AND PROSPECTS

Authored by - Maheshwari.S.Patil

2022-2023 Semester-iii

Law, Science And Technology

Progressive Education Society's

Modern Law College, Pune.

1. ABSTRACT

The genetic engineering is one of the great marvels of 21st century human. It allowed for precise control over the genetic changes introduced into an organism. Today, we can incorporate new genes from one species into a completely unrelated species through genetic engineering, optimizing agricultural performance. India introduced Bt cotton seeds in 2002. It has greatly reduced the use of toxic pesticides. Bt cotton produces a common soil bacterium, *Bacillus thuringiensis* (Bt). It is a natural pest repelling bacteria that is toxic to many worms and pests that can harm the crop but is not hazardous to humans. Bt is widely sprayed on crops by organic farmers as a pesticide. As a result of the adoption of Bt cotton, India is now the largest cotton producer in the world. It reduces the use of pesticide and insecticide during farming that might be great moves for the betterment of the food supply. It can feed a rapidly increasing population because it shows dramatically increased yields. In India, GM plants like GM cotton, Bt brinjal and GM mustard are experimented, but the government refused to allow it to be commercialized¹.

KEYWORDS: Genetically modified foods, Genetically Engineered Foods, Biotechnology.

2. INTRODUCTION: -

Biotechnology can be viewed as a group of useful, enabling technologies with wide and diverse applications in industry, commerce and the environment. Historically, biotechnology evolved as an artisanal skill rather than a science, exemplified in the manufacture of beers, wines, cheeses etc. where the techniques of manufacture were well understood but the molecular mechanisms went unknown. In more recent times, with the advances in the understanding of microbiology and biochemistry, all of these empirically derived processes have become better understood and as a result improved. The traditional biotechnology products have now been added to with antibiotics, vaccines, mono- clonal antibodies and many others, the production of which has been optimised by improved fermentation procedures and novel downstream processing It is clear that biotechnology has its roots in the distant past and has large, highly profitable, modern industrial outlets of great value to society.²

Examples: the fermentation, biopharmaceuticals, and food industries.

1. GMO'S (GENETICALLY MODIFIED ORGANISMS)

Genetic Modification is a biological technique that effects alterations in the genetic machinery of all kinds of living organisms. GMO is defined as follows by WHO (World Health Organization): "Organisms (i.e., plants, animals or microorganisms) in which the genetic material (DNA) has been altered in a way that does not occur naturally by mating and/or natural recombination". The definition seeks to distinguish the direct manipulation of genetic material from the millennial-old practice of improvement in the genetic stock of plants and animals by selective breeding. With DNA recombinant technology, genes from one organism can be transferred into another, usually unrelated, organism³.

2. Sudha Rani M, History, status and impact of genetically modified crops in India https://www.researchgate.net/publication/346029213_History_status_and_impact_of_genetically_modified_crops_in_India (last visited 26, November 2022)

3. khan, Introduction to biotechnology, <https://www.khanacademy.org/science/ap-biology/gene-expression-and-regulation/biotechnology/a/intro-to-biotechnology> (last visited 25, November 2022)

3. Why We Need GMO Crops in Agriculture,

Melvin J. Olive <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6173531/> (last visited 27, November 2022)

4. **CLASSIFICATION OF GM CROPS:**

The first-generation application of genetic engineering to crop agriculture has been targeted towards the generation of plants expressing foreign genes that confer resistance to virus, insects, herbicides or pest harvest deterioration and accumulation of useful modified storage product.

The classification of GM crops has been discussed below:

I-Resistance to biotic (that is living: used to describe the features of a natural system that are living) stresses;

II-Herbicide resistance;

III-Resistance to abiotic (ecology physical not biological: used to describe the physical and chemical aspects of an organism's environment) stresses; and

IV-Other strategies ⁴.

5.**LEGAL FRAMEWORK FOR THE REGULATION OF GMO'S CROPS:**

A) International Regulation: There are five main elements of international regulation relating to research into, and the trade and use of GM crops:

i) Agreements by the World Trade Organization (WTO) which aim to control barriers to international trade. It is within this framework that the US and a number of other countries have most recently challenged the EU on the authorisation of GM crops.

ii) The Codex Alimentarius, a set of international codes of practice, guidelines and recommendations pertaining to food safety. The WTO currently relies upon the Codex in making its adjudications.

- iii) The International Treaty on Plant Genetic Resources for Food and Agriculture by the UN FAO, a multilateral agreement relating to any genetic material of plant origin of value for food and agriculture (not yet entered into force).
- iv) Directives and Regulations by the EU and its regional policies on agriculture, environment and genetically modified organisms (GMOs) (Nuffield Council on Bioethics, 2004)⁵.

6. REGULATION OF GM CROPS IN INDIA:

The government regulates the seed industry and the seed trade in various respects. The Seed Act of 1966, the Seeds Control Order of 1983, and the Seeds Policy of 1988 are the major components of policy specific to the industry. The Seed Act of 1966 and the Seeds Control Order of 1983 provide statutory backing to the system of variety release, seed certification and seed testing. Varieties are released after evaluation at multi-location trials for a minimum of three years. Varieties approved are “notified” which is an obligatory for certification. While all public sector varieties go through this process, it is not compulsory for private varieties (Guidelines for Research in Transgenic Plants, 1998). Major changes in this system of regulation are proposed in the National Seeds Policy of 2002. Under this policy, variety registration (i.e., notification) is mandatory for all varieties, new and extant. The evaluation is done over three seasons of field trials. Besides regulating quality, the government has also controlled imports and exports of seed. The Seed Policy of 1988 allowed limited imports of commercial seed.

The emphasis on registration in the new seeds policy ties in with the demands of the Plant Variety Protection and Farmer’s Rights Act passed in 2001. This Act provides for plant breeder’s rights, which requires extant and new plant varieties to be registered on the basis of characteristics relating to novelty, distinctiveness, uniformity and stability.

The other major change in intellectual property protection has been the change in patent laws. The Trade Related Aspects of Intellectual Property Rights (TRIPs) Agreement came into force in WTO member countries in 1995. This requires member countries to comply with fixed minimum standards for intellectual property rights protection. As a result, India has amended its Patent Act in 1999, 2002 and 2005⁵.

- a. Recombinant DNA Guidelines, 1990:** Department of Biotechnology had formulated Recombinant DNA Guidelines in 1990. These guidelines were further revised in 1994 to cover R&D activities on GMOs, transgenic crops, large-scale production and deliberate release of GMOs, plants, animals and products into the environment, shipment and importation of GMOs for laboratory research.
- b. Guidelines for Research in Transgenic Plants, 1998:** In 1998, DBT brought out separate guidelines for carrying out research in transgenic plants called the Revised Guidelines for Research in Transgenic Plants. These also include the guidelines for toxicity and allergenicity of transgenic seeds, plants and plant parts.
- c. The Seed Policy, 2002:** The Seed Policy 2002 issued by Ministry of Agriculture, Government of India contains a separate section (No. 6) on transgenic plant varieties. It has been stated that all genetically engineered crops/varieties will be tested for environment and biosafety before their commercial release as per the regulations on guidelines of the EPA, 1986. Seeds of transgenic plant varieties for research purposes will be imported only through the National Bureau of Plant Genetic Resources (NBPGR) as per the EPA, 1986.
- d. The Food Safety and Standards Bill, 2005:** The “genetically modified food” has been defined in the Bill as the food, which is produced through techniques in which the genetic material has been altered in a way that does not occur naturally by mating or having adequate human intervention or both. Techniques of Genetic Engineering or modification include, but are not limited to recombinant DNA, cell fusion, micro and macro injection, gene deletion, addition and doubling. The Bill has also mooted the establishment of a Food Safety Appellate Tribunal to hear the appeals of disputed parties (Food Safety and Standards Bill, 2005).

7. OVERVIEW OF MINISTRIES AND DEPARTMENTS INVOLVED IN REGULATION OF GM FOODS IN INDIA:

Several central ministries and departments are involved in India's program of food quality and safety and hence each one of them has a role to play in the activities related to GM foods in India. These include:

- a. Ministry of Environment and Forest: This ministry holds the Secretariat of the Genetic Engineering Approval Committee, the apex body that gives approval for manufacture, sale, import and export of all GMOs and products thereof including foodstuff, ingredients in foodstuff and additives using genetically modified (GM) organisms or cells.
- b. Department of Biotechnology: This department holds the Secretariat of the Review Committee on Genetically Modification that gives approval for research and small scale field trials involving GMOs and products thereof. It also interacts with the Institutional Biosafety Committees (IBSCs) set up in all organizations undertaking activities involves GMOs.
- c. Department of Health in the Ministry of Health and Family Welfare: Department of Health is responsible for implementation of the PFA Act under which the quality and safety of food is regulated.
- d. The officials from ICAR and Ministry of Agriculture have an important role to play in the approval of GM crops as per Seed Policy, 2002.

The goal of the Indian regulatory system is to ensure that their genetically modified crops pose no major risk to food safety, environmental safety, agricultural production, and that there are no adverse economic impacts on farmers ⁶.

6. Shri Hem Kumar, Regulatory Framework of GM, http://www.geacindia.gov.in/resource-documents/13_2_Regulatory_Framework_for_GE_Plants_in_India.pdf (Last visited 28, November 2022. GM technology could

8. PROBLEMS OF GMO'S CROPS:

a. Environmental concerns: They can reduce species diversity. For example, Insect-resistant plants might kill insects that are not their intended target and thus result in destruction of that particular species.

also allow the transfer of genes from one crop to another, creating “super weeds”, which will be immune to common control methods.

- Viral genes added to crops to confer resistance might be transferred to other viral pathogens, which can lead to new and more virulent virus strains.

b. Economic Concerns:

- Introduction of a GM crop to market is a lengthy and costly process.
- It does not result in high yields as promised. For instance, the highest yields in mustard are from the five countries which do not grow GM mustard - U.K., France, Poland, Germany and Czech Republic - and not from the GM-growing U.S. or Canada.
- Critics claim that patent laws give developers of the GM crops a dangerous degree of control over the food supply. The concern is over domination of world food production by a few companies

c. Ethical Concerns:

- Violation of natural organisms' intrinsic values by mixing among species
- There have also been objections to consuming animal genes in plants ⁷.

GM Crops in India:

BT Cotton:

- The Maharashtra Hybrids Seed Company (Mahyco) jointly with the US seed company Monsanto developed the genetically modified Bt Cotton to tackle the bollworm problem

that had devastated cotton crops in the past.

- In 2002, Bt Cotton became the first and only transgenic crop approved by the GEAC for commercial cultivation in six States namely, Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra and Tamil Nadu.

ISSUE OF PINK BOLLWORM INFESTATION:

In March 2018, the Indian government had cut royalties that local seed companies pay to Monsanto, for the second times in two years. This was in the backdrop of pink bollworm infestation plaguing cotton farmers.

Even though Monsanto's second generation insecticidal technology for cotton, was supposed to protect crops against the pink bollworm, the pest has grown resistant to the toxins produced by this trait. As a result, farmers now spend more on pesticides to control infestations. This along with the high cost of Bt seeds, is driving farmers to indigence.

BT Brinjal:

- It was developed by Mahyco (Maharashtra Hybrid Seeds Company) in collaboration with the Dharward University of Agricultural Sciences and the Tamil Nadu Agricultural University.
- The GEAC in 2007, recommended the commercial release of Bt Brinjal. The initiative was blocked in 2010.

HT Mustard:

- Dhara Mustard Hybrid (DMH-11) is an indigenously developed transgenic mustard. It is genetically modified variety of Herbicide Tolerant (HT) mustard. It was created by using "barnase/barstar" technology for genetic modification by adding genes from soil bacterium that makes mustard self-pollinating plant.
- In 2017, the Genetic Engineering Appraisal Committee recommended the commercial approval of the HT Mustard crop.

SC JUDGMENTS:

1. The SC stayed commercial release of HT Mustard and asked the Central Government to seek public opinion.
2. Guidelines given by the Supreme Court with respect to GM crops:
 - Increasing the isolation distance between the GM-planted fields and regular field to at least 200 meters from 20 meters.
 - A designated scientist would be made responsible for ensuring that all the conditions were complied with during the field trials of GM seeds.

9. PROSPECTS OF GM CROPS:

a. RISKS AND CONTEROVERSY:

There are controversies around GM food on several levels, including whether food produced with it is safe, whether it should be labelled and if so how, whether agricultural biotechnology and it is needed to address world hunger now or in the future, and more specifically with respect to intellectual property and market dynamics, environmental effects of GM crops and GM crops' role in industrial agricultural more generally.

Many problems, viz. the risks of “tampering with Mother Nature”, the health concerns that consumers should be aware of and the benefits of recombinant technology, also arise with pest-resistant and herbicide-resistant plants. The evolution of resistant pests and weeds termed superbugs and super weeds is another problem. Resistance can evolve whenever selective pressure is strong enough. If these cultivars are planted on a commercial scale, there will be strong selective pressure in that habitat, which could cause the evolution of resistant insects in a few years and nullify the effects of the transgenic.

7. GM Crops in India, <https://blog.forumias.com/gm-crops-in-india-issues-and-challenges/#:~:text=Potential%20impact%20on%20human%20health,destruction%20of%20that%20particular%20s>pecies (Last visited on 27, November 2022)

Likewise, if spraying of herbicides becomes more regular due to new cultivars, surrounding weeds could develop a resistance to the herbicide tolerant by the crop. This would cause an increase in herbicide dose or change in herbicide, as well as an increase in the amount and types of herbicides on crop plants. Ironically, chemical companies that sell weed killers are a driving force behind this research (Steinbrecher [1996](#)).

Another issue is the uncertainty in whether the pest-resistant characteristic of these crops can escape to their weedy relatives causing resistant and increased weeds (Louda [1999](#)). It is also possible that if insect-resistant plants cause increased death in one particular pest, it may decrease competition and invite minor pests to become a major problem. In addition, it could cause the pest population to shift to another plant population that was once unthreatened. These effects can branch out much further. A study of Bt crops showed that “beneficial insects, so named because they prey on crop pests, were also exposed to harmful quantities of Bt.” It was stated that it is possible for the effects to reach further up the food web to effect plants and animals consumed by humans (Brian [1999](#)). Also, from a toxicological standpoint, further investigation is required to determine if residues from herbicide or pest resistant plants could harm key groups of organisms found in surrounding soil, such as bacteria, fungi, nematodes, and other microorganisms (Allison and Palma [1997](#)).

The potential risks accompanied by disease resistant plants deal mostly with viral resistance. It is possible that viral resistance can lead to the formation of new viruses and therefore new diseases. It has been reported that naturally occurring viruses can recombine with viral fragments that are introduced to create transgenic plants, forming new viruses. Additionally, there can be many variations of this newly formed virus (Steinbrecher [1996](#)).

Health risks associated with GM foods are concerned with toxins, allergens, or genetic hazards. The mechanisms of food hazards fall into three main categories (Conner and Jacobs [1999](#)). They are inserted genes and their expression products, secondary and pleiotropic effects of gene expression and the insertional mutagenesis resulting from gene integration. With regards to the first category, it is not the transferred gene itself that would pose a health risk. It should be the expression of the gene and the effects of the gene product that are considered. New proteins can be synthesized that can produce unpredictable allergenic effects. For example, bean plants that

were genetically modified to increase cysteine and methionine content were discarded after the discovery that the expressed protein of the transgene was highly allergenic (Butler and Reichhardt 1999). Due attention should be taken for foods engineered with genes from foods that commonly cause allergies, such as milk, eggs, nuts, wheat, legumes, fish, molluscs and crustacean (Maryanski 1997). However, since the products of the transgenic are usually previously identified, the amount and effects of the product can be assessed before public consumption. Also, any potential risk, immunological, allergenic, toxic or genetically hazardous, could be recognized and evaluated if health concerns arise.

More concern comes with secondary and pleiotropic effects. For example, many transgenes encode an enzyme that alters biochemical pathways. This could cause an increase or decrease in certain biochemicals. Also, the presence of a new enzyme could cause depletion in the enzymatic substrate and subsequent buildup of the enzymatic product. In addition, newly expressed enzymes may cause metabolites to diverge from one secondary metabolic pathway to another (Conner and Jacobs 1999). These changes in metabolism can lead to an increase in toxin concentrations. Assessing toxins is a more difficult task due to limitations of animal models. Animals have high variation between experimental groups and it is challenging to attain relevant doses of transgenic foods in animals that would provide results comparable to humans (Butler and Reichhardt 1999). Consequently, biochemical and regulatory pathways in plants are poorly understood.

Insertional mutagenesis can disrupt or change the expression of existing genes in a host plant. Random insertion can cause inactivation of endogenous genes, producing mutant plants. Moreover, fusion proteins can be made from plant DNA and inserted DNA. Many of these genes create nonsense products or are eliminated in crop selection due to incorrect appearance. However, of most concern is the activation or up regulation of silent or low expressed genes. This is due to the fact that it is possible to activate “genes that encode enzymes in biochemical pathways toward the production of toxic secondary compounds” (Conner and Jacobs 1999). This becomes a greater issue when the new protein or toxic compound is expressed in the edible portion of the plant, so that the food is no longer substantially equal to its traditional counterpart.

b. FUTURE DEVELOPMENTS

The GM foods have the potential to solve many of the world's hunger and malnutrition problems, and to help protect and preserve the environment by increasing yield and reducing reliance upon synthetic pesticides and herbicides. Challenges ahead lie in many areas viz. safety testing, regulation, policies and food labelling. Many people feel that genetic engineering is the inevitable wave of the future and that we cannot afford to ignore a technology that has such enormous potential benefits.

Future also envisages that applications of GMOs are diverse and include drugs in food, bananas that produce human vaccines against infectious diseases such as Hepatitis B (Kumar et al. 2005), metabolically engineered fish that mature more quickly, fruit and nut trees that yield years earlier, foods no longer containing properties associated with common intolerances, and plants that produce new biodegradable plastics with unique properties (van Beilen and Yves 2008).

While their practicality or efficacy in commercial production has yet to be fully tested, the next decade may see exponential increases in GM product development as researchers gain increasing access to genomic resources that are applicable to organisms beyond the scope of individual projects³.

10. WAY FORWARD

- A major challenge today is to develop low-input, high-output agriculture. This cannot be achieved without technology. However, to assure technology does not undermine human and environmental health, there needs to be extensive research.
- The Indian government must take decisions on GM technologies on the basis of scientific evidence. It should adopt a participatory approach in order to bring together all stakeholders to develop regulatory protocols. This would ensure trust in the entire process.
- Any new technology adopted in the farming sector must be in the interest of the farmers without undermining the rights of consumers.
- The most important job lies on the promoters of GM technology to convince consumers,

environmental activists and farmers that among various alternatives available for sustainable food production, GM technology is one of the best option to improve crop yields and address India's food security.

- The Food and Agriculture Organization (FAO) has rightly pointed out in 2004, "Science cannot declare any technology completely risk free. Genetically engineered crops can reduce some environmental risks associated with conventional agriculture, but will also introduce new challenges that must be addressed".

11. CONCLUSION:

The wide advantages of transgenic crops for a society to solve food security or nutrition security issues have been well established. Many added benefits such as higher nutritional value, herbicide tolerance, virus resistance, tolerance to various abiotic stresses, increase the shelf life of a fruit and thus, can account for a good market for farmers. There is an urgent need for India to carry on its GM crop research program to sustain its food and nutrition security targets.

Debate on GM crops about safe or unsafe will never end although there is hardly any substantial scientific evidence against safety of GM foods. Surprisingly, few public sector intuitions also showed their concerns for GM foods. Intuitions funded by GOI should follow same broad policies of Indian Government and must show their strength with the government to fight poverty and malnutrition. This valid point is raised due to opposite views of the members of Technical Expert Committee appointed by the Supreme Court of India for Safety and Guidelines for GM crop research and make recommendations for future of GM crop research in India.

Although, this is a fact that India does not have basic infrastructure and stringent guidelines for GM crop research and risk assessment but taking in to account India,s urgent need, we cannot halt this program. Ideally, India must continue on its research on GM crop and its deregulation along with building basic infrastructure facilities and preparing stringent biosafety and marketing guidelines. Although portals like GEAC, IGMORIS (Indian GMO Research Information System), Biosafety Clearing House are doing their role for assessing biosafety and their regulation of GM crops but there is an urgent need to build a single window system and online portal for assessment, control, regulations and approval of GM crops.

BIBLIOGRAPHY

Websites

- https://www.researchgate.net/publication/346029213_History_status_and_impact_of_genetically_modified_crops_in_India
- <https://www.khanacademy.org/science/ap-biology/gene-expression-and-regulation/biotechnology/a/intro-to-biotechnology>
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3791249/>
- <https://shodhganga.inflibnet.ac.in/bitstream/10603/28652/8/08>
- http://www.geacindia.gov.in/resource-documents/13_2_Regulatory_Framework_for_GE_Plants_in_India.pdf
- <https://blog.forumias.com/gm-crops-in-india-issues-and-challenges/#:~:text=Potential%20impact%20on%20human%20health,destruction%20of%20that%20particular%20species>

Books

- MOLECULAR CELL BIOLOGY (EIGHTH EDITION)
- PRINCIPLES AND TECHNIQUES OF BIOCHEMISTRY AND MOLECULAR BIOLOGY (SEVENTH EDITION)