

Presentation on Biosafety



**Ministry of Environment, Forest and Climate Change
Government of India**

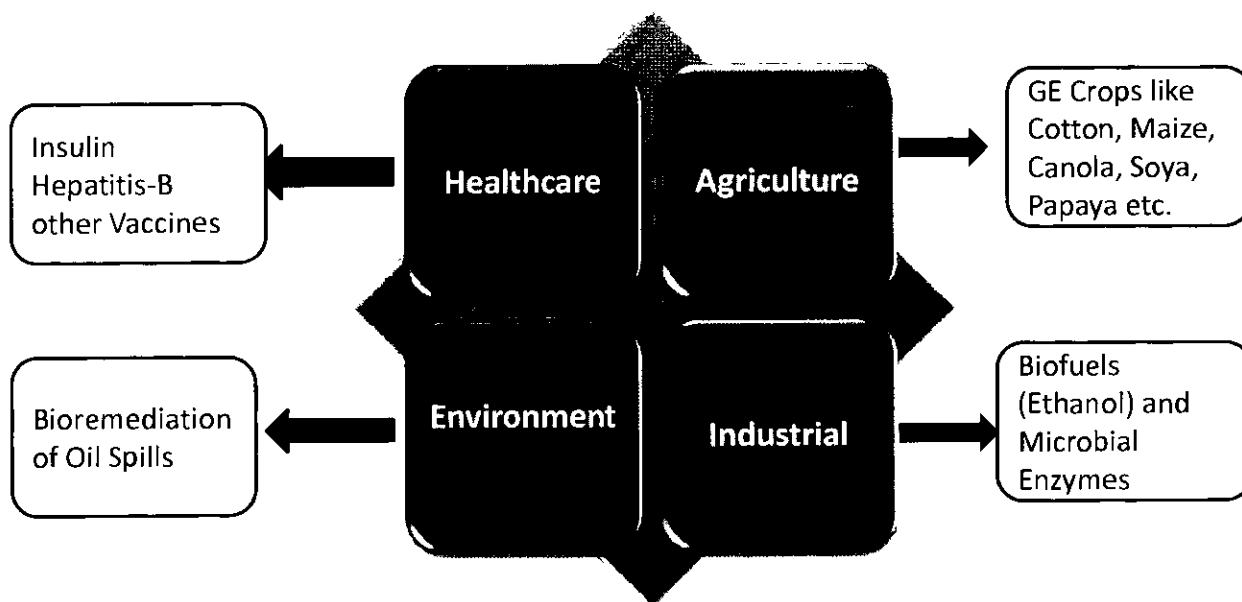
Activities in Biosafety

- Regulation of Genetically Modified Organisms (GMOs) and products thereof in India

- Implementation of Cartagena Protocol on Biosafety (CPB) and Nagoya- Kuala Lumpur Supplementary Protocol on Liability and Redress to the CPB

- Capacity Building in Biosafety

Genetically Engineered Organisms and their Application



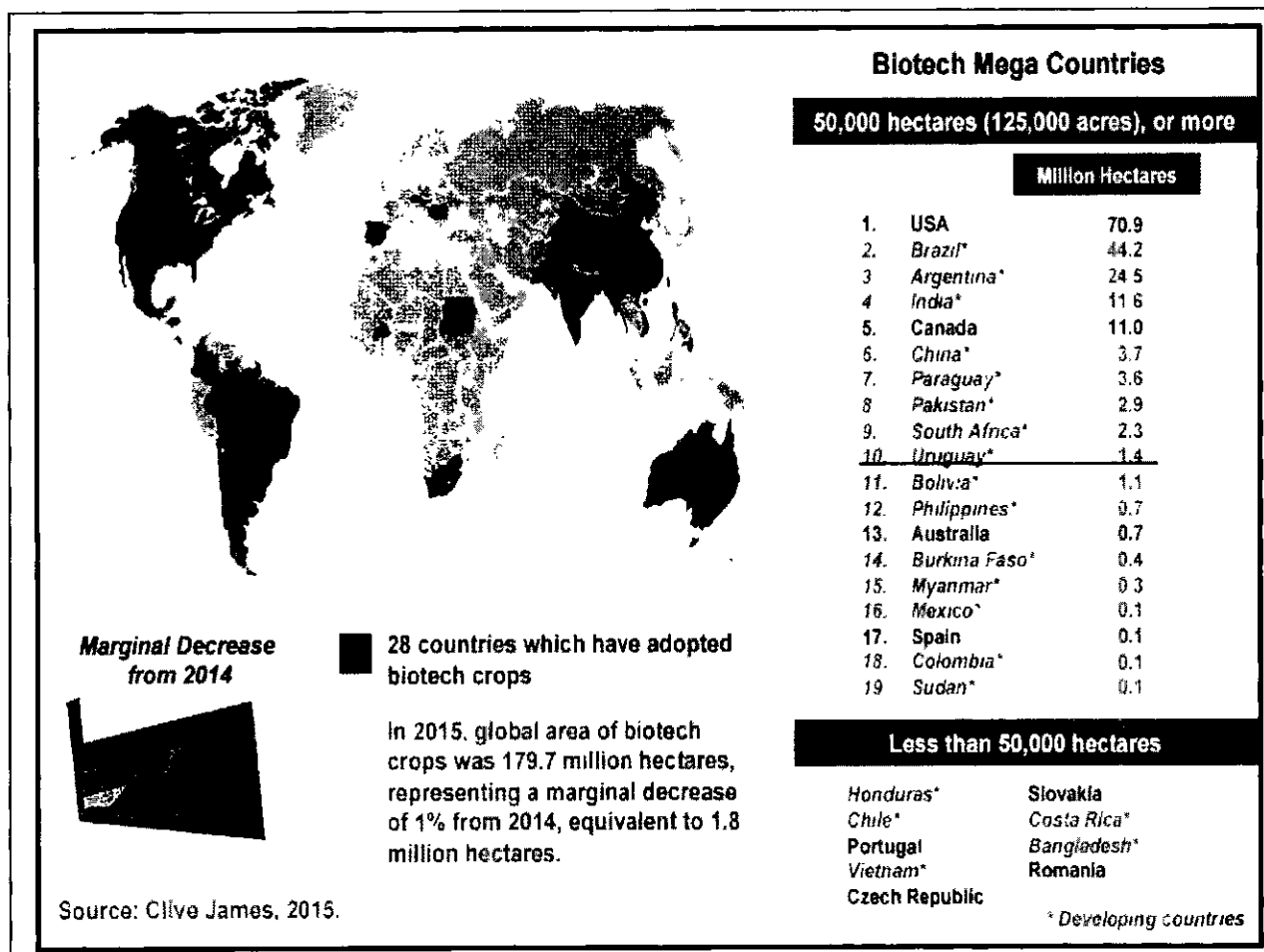
Positive Impact of GE Technology

A. Development of research in Biotechnology sector especially related to medicine

- Indian share in pharma exports boosted to 65%
- Every 2nd child in the world receives Indian vaccine
- Cost in reduction of important vaccines such as
 - ✓ Hepatitis-B Vaccine cost reduced from Rs. 800 to Rs.30 per Dose
 - ✓ Rotavirus Vaccine cost reduced from Rs. 1150 to Rs. 63 per Dose

B. Research and Development in Agriculture addressing problems of Climate Change impact (Drought/ Salinity etc.)

C. Capacity of Public Sector Laboratories of ICAR and CSIR enhanced



Biotech Mega Countries

50,000 hectares (125,000 acres), or more

Million Hectares

1.	USA	70.9
2.	Brazil*	44.2
3.	Argentina*	24.5
4.	India*	11.6
5.	Canada	11.0
6.	China*	3.7
7.	Paraguay*	3.6
8.	Pakistan*	2.9
9.	South Africa*	2.3
10.	Uruguay*	1.4
11.	Bolivia*	1.1
12.	Philippines*	0.7
13.	Australia	0.7
14.	Burkina Faso*	0.4
15.	Myanmar*	0.3
16.	Mexico*	0.1
17.	Spain	0.1
18.	Colombia*	0.1
19.	Sudan*	0.1

Less than 50,000 hectares

Honduras*	Slovakia
Chile*	Costa Rica*
Portugal	Bangladesh*
Vietnam*	Romania
Czech Republic	

* Developing countries

Status of approval for cultivation of GE plants in various countries in 2014			
S.N.	GE Plants	Traits/Uses	Countries where approved
1.	Alfalfa	Herbicide tolerance	USA
2.	Apple	Anti-bruising and anti-browning	USA
3.	Beet pepper	Virus Resistance	China
4.	Canola	Herbicide tolerance and improved protection against weeds	Canada, USA, Australia, Chile
5.	Carnation	Modified flower colour and herbicide tolerance	Australia, Colombia
6.	Cotton	Improved insect protection, herbicide tolerance and improved protection against weeds	Australia, USA, China, Mexico, South Africa, Argentina, India, Colombia, Burkina Faso, Sudan, Pakistan, Brazil, Myanmar, Paraguay, Costa Rica
7.	Egg Plant (Brinjal)	Insect resistance	Bangladesh
8.	Maize	Improved insect protection and herbicide tolerance for efficient weed management.	Canada, USA, Argentina, Brazil, South Africa, Uruguay, Philippines, Chile, Colombia, Honduras, Spain, Portugal, Paraguay, Cuba, Czech Republic, Romania, Slovakia
9.	Papaya	Virus resistance	USA, China
10.	Petunia	Modified flower color	China
11.	Poplar	Insect resistance	China
12.	Potato	Improved quality, anti-bruising and anti-browning	USA
13.	Soybean	Improved insect protection and herbicide tolerance for efficient weed management.	USA, Argentina, Canada, Paraguay, Mexico, Bolivia, Brazil, Chile, South Africa, Romania, Uruguay, Costa Rica
14.	Squash	Resistance against watermelon mosaic virus and zucchini yellow mosaic virus	USA
15.	Sugar beet	Herbicide tolerance	USA and Canada
16.	Tomato	Delayed Ripening, Virus resistance	China

Source: ISAAA Global Status of Commercialized Biotech/GM crops, 2014

Cartagena Protocol on Biosafety

Reducing the Environmental Risks of Modern Biotechnology



What is Cartagena Protocol on Biosafety (CPB) ?

The Cartagena Protocol on Biosafety to the Convention on Biological Diversity is an international treaty governing the movements of living modified organisms (LMOs) resulting from modern biotechnology from one country to another.

Key Features:

- ✓ An agreement between different countries negotiated under the Convention on Biological Diversity (CBD)
- ✓ Adopted on 29 January 2000 after 4 years of intense negotiations
- ✓ Entry into force on 9 September 2003 and India ratified this Protocol on September 11, 2003
- ✓ Till date 170 countries have ratified this Protocol

Objective of the Protocol

To contribute to ensuring the safe transfer, handling and use of LMOs resulting from modern biotechnology that may have adverse effects on the biological diversity, taking also into account risks to human health

Applies to: Transboundary movement, transit, handling and use of all LMOs that may have adverse effects on biodiversity, taking also into account risks to human health

Exclusion: Pharmaceuticals for humans that are addressed by other international Agreements or organizations

As Parties to the Protocol have certain obligations for ensuring safe transfer of LMOs as per various Articles of CPB

Nagoya – Kuala Lumpur Supplementary Protocol on Liability and Redress to the Cartagena Protocol on Biosafety



NAGOYA – KUALA LUMPUR
SUPPLEMENTARY PROTOCOL
ON LIABILITY AND REDRESS
TO THE CARTAGENA PROTOCOL
ON BIOSAFETY

- The objective of the Supplementary Protocol is to contribute to the conservation and sustainable use of biological diversity by providing international rules and procedures for liability and redress in the event of damage resulting from LMOs.
- Adopted on October 15, 2010 by the fifth meeting of the COP-MOP, which took place in Nagoya, Japan
- Only 37 countries ratified. Needed 40 for its implementation

Capacity Building on Biosafety

- MoEFCC is actively engaged in Capacity building in biosafety using National and International resources
- Several capacity building activities undertaken by MoEFCC in association with other concerned Ministries like DBT, MoA, ICAR, Research Institutions, State Department of Agriculture, State Agricultural Universities etc.
- MoEFCC is implementing UNEP/GEF supported Phase-II Capacity Building Project on Biosafety (2012-2016) and nearing completion

Phase-II Biosafety Project: Key Points

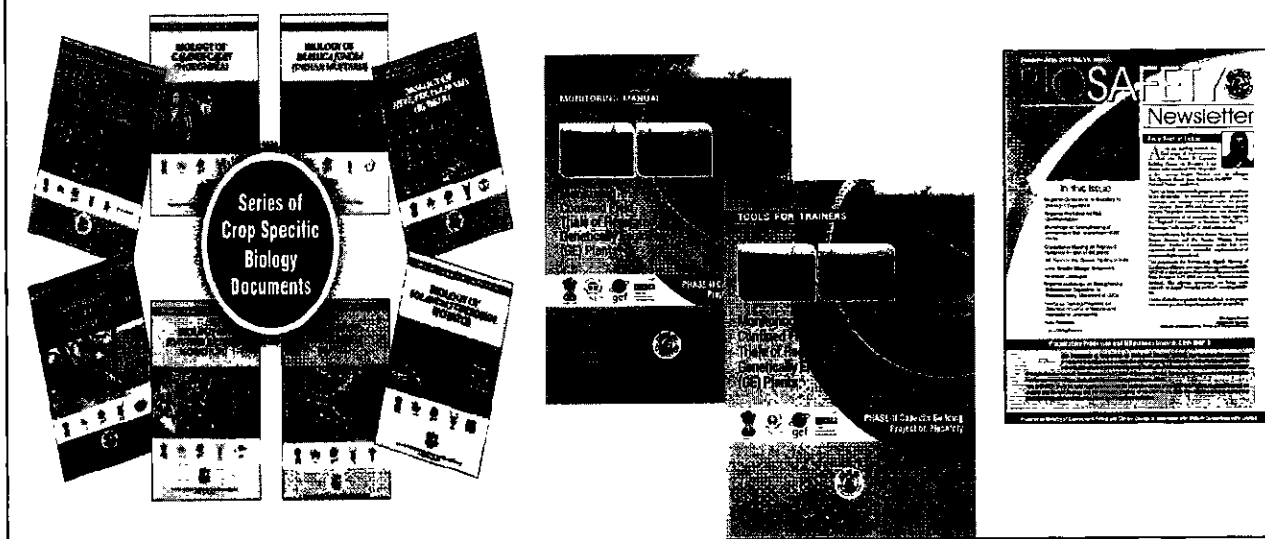
- India has accessed US\$ 3.0 million from GEF for the biosafety program with US\$ 6.0 million from GOI as Co-Financing
- Ministry of Environment, Forest and Climate Change is the Nodal Ministry for Implementation of the Project
- Project Time Frame: 4 years (2012-2016)

Thrust Areas



Resource Documents

- Series of **Crop specific Biology Documents** – To provide baseline information for environmental risk assessment
- **Monitoring Manual for Confined Field Trials** – To provide guidance to members of Central Compliance Committees etc.
- **Quarterly Biosafety Newsletter** – Circulated electronically



International Regulatory Regimes

Developed Countries	Developing Countries	SAARC
USA (1993-94) <ul style="list-style-type: none"> • Environment Protection Agency (EPA) • USDA-APHIS • FDA 	India (1989) <ul style="list-style-type: none"> • GEAC & RCGM (under 1989 rules made under EPA act 1986) 	Bangladesh (2012) Ministry of Environment and Forest
Australia (2001) <ul style="list-style-type: none"> • The Office of the Gene Technology Regulator (OGTR) 	South Africa (1997) <ul style="list-style-type: none"> • Department of Agriculture, Environment, Science & Technology, Health, Labour and Industry 	Bhutan (2015) <ul style="list-style-type: none"> • Bhutan Agricultural and Food Regulatory Authority (BAFRA)
European Union (2001) <ul style="list-style-type: none"> • European Food Safety Authority (EFSA) 	Argentina (1991) Agricultural Directorate of the Secretariat Agriculture, Livestock, Fisheries and food	Sri Lanka (Not Yet Done) <ul style="list-style-type: none"> • Ministry of Mahaweli Development and Environment Sri Lanka
Canada (1993) <ul style="list-style-type: none"> • Environment Canada • Canadian Food Inspection Agency • Health Canada 	Vietnam (2006) <ul style="list-style-type: none"> • Vietnam Environment Agency 	Pakistan (Not very organized) <ul style="list-style-type: none"> • Ministry of Environment

Biosafety Regulatory Framework

Rules 1989

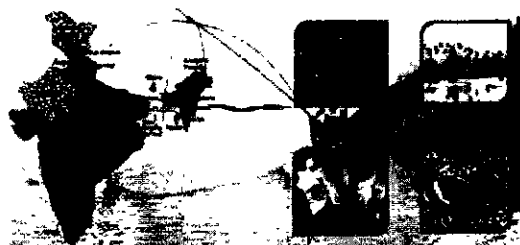
In India all GMOs including GE plants are regulated as per the Rules for the Manufacture, Use, Import, Export and Storage of Hazardous micro-organisms / Genetically engineered organisms or cells (Rules 1989) notified under the Environment (Protection) Act, 1986

Role of Various Ministries in Regulation of GE Crops

Ministry of Environment, Forest & Climate Change	<ul style="list-style-type: none"> ▪ Nodal agency for implementing Rules, 1989 and the International Agreements (CBD and CPB)
Department of Biotechnology (Ministry of Science & T)	<ul style="list-style-type: none"> ▪ Provides scientific support in implementation of biosafety regulations
Ministry of Agriculture	<ul style="list-style-type: none"> ▪ ICAR responsible for monitoring agronomic benefits of GE technology. ▪ Post release performance of GE crops.
Ministry of Health and Family Welfare	<ul style="list-style-type: none"> ▪ Support for regulating GE foods and protecting and monitoring human health
Ministry of Commerce and Industries	<ul style="list-style-type: none"> ▪ Nodal agency for implementing DGFT Notification on GE Organisms
Central Board of Excise and Customs	<ul style="list-style-type: none"> ▪ Enforcement of regulation pertaining to transboundary movement at point of entry

Legislations Relevant to Biosafety

- Environmental (Protection) Act, 1986
- Rules For The Manufacture, Use/Import/Export And Storage Of Hazardous Micro Organisms/ Genetically Engineered Organisms Or Cells, 1989
- The Biological Diversity Act, 2002
- Drugs and Cosmetic Act 1940
- Seed Act, 1966
- Protection of Plant Varieties and Farmers Rights, 2001
- Food Safety and Standards Act, 2006
- Plant Quarantine Order 2003
- Environmental Policy, 2006
- Sectoral Policies



Competent Authorities as per Rules 1989

Statutory Committee	Function	Administrating Agency
Genetic Engineering Appraisal Committee (GEAC)	Recommendation for environmental release and approval for EST & confined field trials	Ministry of Environment, Forest and Climate Change
r DNA Advisory Committee (r RDAC)	Advise on biosafety of emerging technologies	Department of Biotechnology, Ministry of Science And Technology
Review Committee on Genetic Manipulation (RCGM)	Scientific risk assessment of plants, animals, biopharma, microbes and Guidelines	
Institutional Biosafety Committee (IBSC)	R&D and Contained Experiments	Registered Institutions, Universities and Private Companies
State Biotechnology Coordination committee (SBCC)	For monitoring and supervision at state level	Concerned State Governments
District Level Committee (DLC)	Depending upon the need for local supervision and compliance	

Biosafety Guidelines for GE Crops

Contained Use (DBT)

- Recombinant DNA Safety Guidelines, 1990
- Recombinant DNA Safety Guidelines and Regulations, 1994
- Revised Guidelines for Research in Transgenic Plants, 1998

Confined Field Trials (MoEF&CC and DBT)

- Guidelines for Conduct of Confined Field Trials of Regulated GE Plants, 2008
- Standard Operating Procedures (SOPs) for CFTs of Regulated, GE Plants, 2008
- Guidelines for Monitoring of Confined Field Trials of Regulated GE Plants, 2008

Food Safety Assessment (DBT and ICMR)

- Guidelines for the Safety Assessment of Foods Derived from Genetically Engineered Plants, 2008 (Updated in 2012)
- Protocols for Food and Feed Safety Assessment of GE Crops, 2008

Environmental Safety Assessment (MoEF&CC)

- Guidelines for Environmental Risk Assessment (ERA) of GE Plants, 2016
- Risk Analysis Framework, 2016
- ERA of GE Plants: A Guide for Stakeholders, 2016

Genetic Engineering Appraisal Committee (GEAC)

- GEAC established under MoEFCC is the Apex body notified under Rules 1989 to accord approval of activities involving large scale use of hazardous microorganisms and recombinants in research and industrial production from the environmental angle.
 - ✓ Approval of proposals relating to release of GMOs and products into the environment including experimental field trials (Biosafety Research Level trial-I and II known as BRL-I and BRL-II).
 - ✓ To permit the use of GMOs and products thereof for commercial applications
 - ✓ To adopt procedures for restriction or prohibition, production, sale, import & use of GMOs both for research and applications under EPA
 - ✓ To authorize large scale production and release of GMOs and products thereof into the environment.

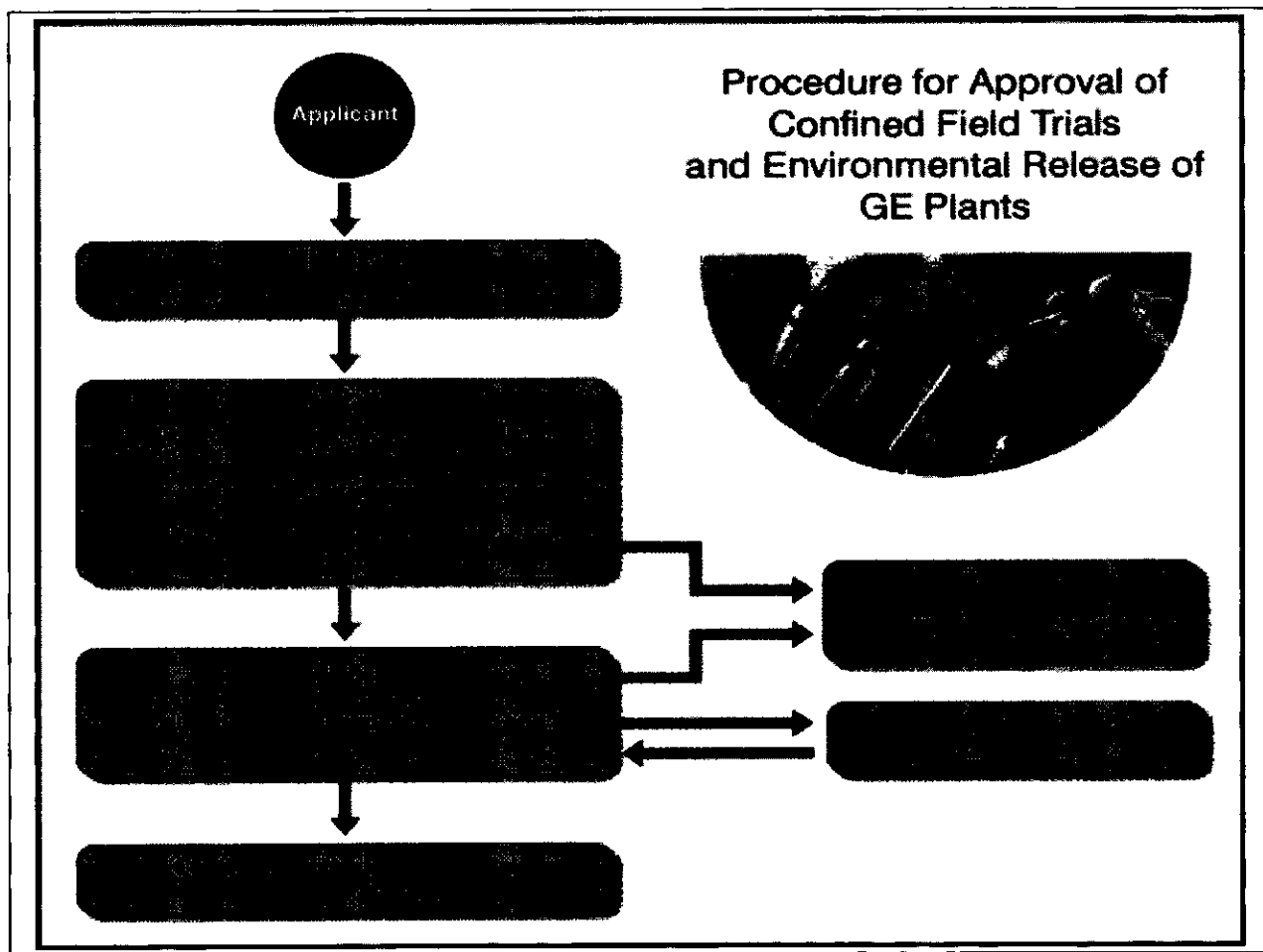
Composition of GEAC

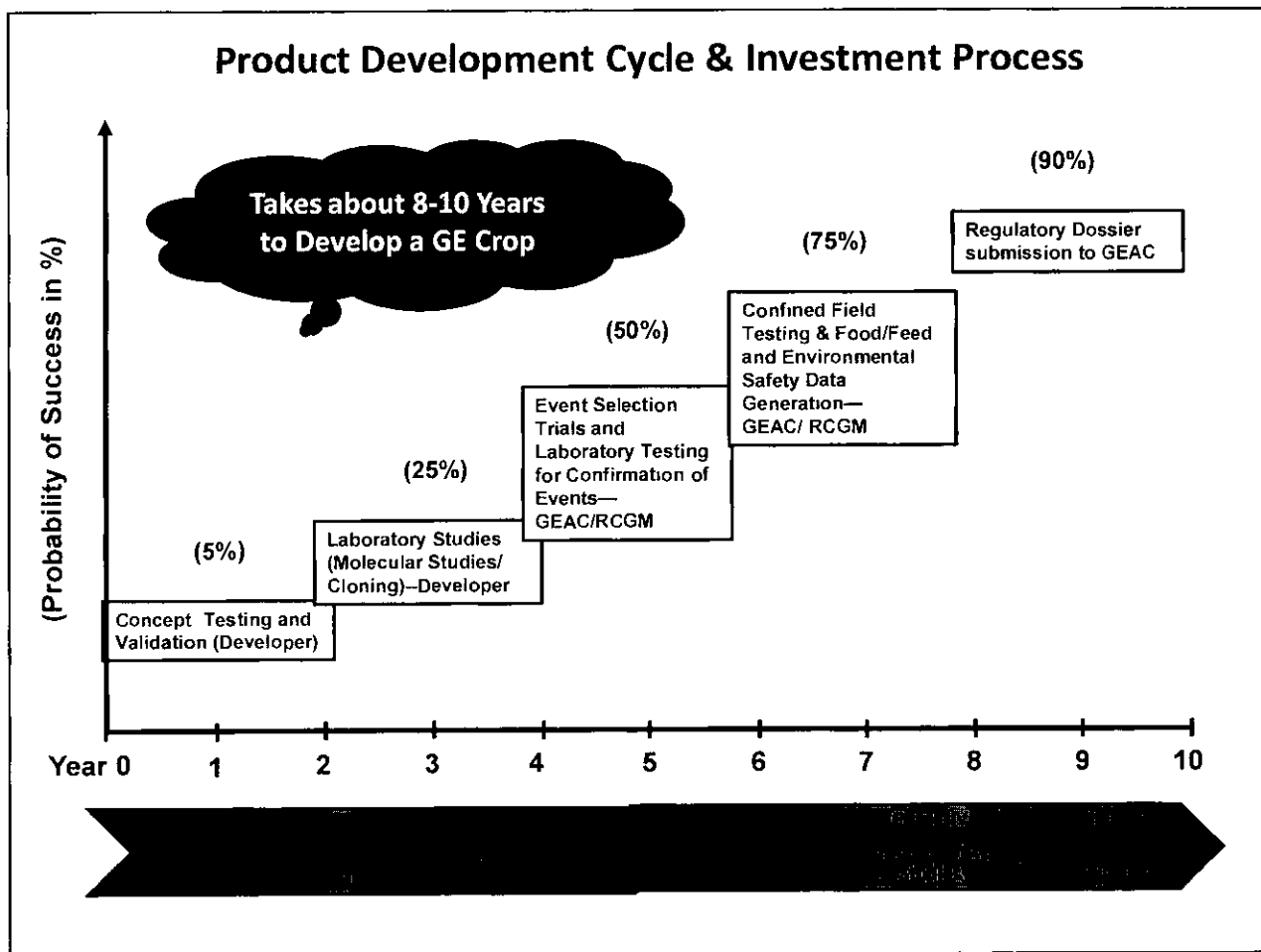
- (i) **Chairman** – Additional / Special Secretary, MoEFCC
Co-Chairman – Representative of Department of Bio-technology
Vice-Chairman – Joint Secretary, MoEFCC
- (ii) **Members:** Representatives of concerned Agencies and Departments, namely, Ministry of Industrial Development, Department of Biotechnology and the Department of Atomic Energy.
- (iii) **Expert Members** : Director General-Indian Council of Agricultural Research, Director General – Indian Council of Medical Research, Director General – Council of Scientific and Industrial Research, Director General-Health Services, Plant Protection Adviser, Directorate of Plant Protection, Quarantine and Storage, Chairman, Central Pollution Control Board and three outside experts in individual capacity.
- (iv) **Member Secretary** : An official of the Ministry of Environment, Forest and Climate Change.
- (v) **Co-opt: 13 Experts co-opted**

Types of Field Trials

Stage	Approval by	Size for each location	No. of trials
Event Selection Trials Biosafety Research Level- I (BRL-I) Trial	<ul style="list-style-type: none"> • Recommended by RCGM • Approved by GEAC • Permit Letter issued by RCGM • Trials Monitored by REGM through Central Compliance Committee (CCC) 	Less than or equal to 1 acre (0.4 ha)	Cumulative total not more than 20 acres (4 Zones)
Biosafety Research Level- II (BRL-II) Trial	<ul style="list-style-type: none"> • Approved by GEAC • Permit Letter issued by GEAC • Trials Monitored by GEAC through Central Compliance Committee (CCC) 	Less than or equal to 2.5 acre (1 ha)	Case by case
		Applicant needs to complete one of the following option before proceeding for Commercial Release	

This 2010 regulation is available on the website of the Government of India.





Tests performed to address Environmental and Health Concerns

Health Safety Assessment

- Compositional Analysis**
 - ✓ Alteration in Nutrient Composition of Leaf and Seed
 - ✓ Alteration in Toxin/ Anti-Nutrient Composition in Leaf and Seed
- Toxicity Potential**
 - ✓ Expression Levels of Introduced Protein
 - ✓ Acute Oral Toxicity of Purified Protein
 - ✓ Sub-Chronic Toxicity with edible parts
- Allergenicity Potential**
 - ✓ Bioinformatics Analysis of Proteins
 - ✓ Pepsin Digestibility
 - ✓ Thermal Stability

Environmental Safety Assessment

- Weediness Potential**
 - ✓ Seed Germination & Speed of Seed Germination
 - ✓ Seedling Vigour & Seed Size
 - ✓ Long Continuous Seed Production
 - ✓ Pod Shattering
- Crossability and Gene Flow**
 - ✓ Extent of Cross Pollination with related species
 - ✓ Extent of Cross Pollination with other plant species
 - ✓ Alteration in Pollen Viability
 - ✓ Alteration in Pollen Production
- Effect on Soil Microflora**
 - ✓ Alteration in abundance (CFU/gm)
 - ✓ Alteration in predominant species in the region
- Effect on Pests, Diseases and Beneficial Insects**
 - ✓ Change in the susceptibility for Insects and diseases
 - ✓ Change in predator abundance
 - ✓ Change in receptibility towards honeybees & any toxicity to honey bees

Status of GE Crops in India

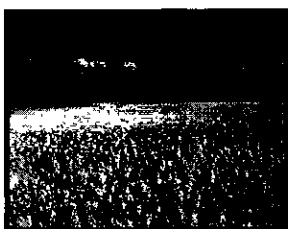
1. *Bt* Cotton



2. *Bt* Brinjal



3. GE Mustard



***Bt* Cotton in India**

- Bt-cotton, first and only GM crop approved in India (2002)
- Cultivated in more than 11.6 million hectares (more than 95%)
- Six Events and more than 1150 *Bt* cotton hybrids approved in India for about 50 companies
- India ranks first in global cotton production

Gene/ Events approved for Cultivation in India

1. *cry1Ac* gene (MON 531 Event), **MAHYCO**
2. *cry1Ab-Ac* gene (GFM *cry1A* Event), **Nath Seeds Ltd.**
3. *cry1Ac* gene (JK Event 1), **J.K. Agri Genetics Pvt. Ltd.**
4. *cry1Ac* & *cry2Ab* genes (MON 15985 Event), **MAHYCO**
5. *cry1C* (Event MLS 9124), **M/s. Metahelix Life Sciences Pvt Ltd.**



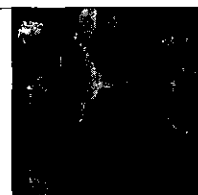
Impact of adoption of *Bt* Cotton In India

- Cotton production in India tripled from 13 million bales in 2003 to 40 million bales in 2015 (Total world cotton production is about 152 million bales). Yield gain of 31%.
- Insecticide sprays reduced from 24 sprays to 2-3 sprays in a season (Cotton alone consumes 46% of the total Indian Insecticide market). Usage decreased by 39%
- The production of cotton seed, and its byproducts as oil and meal, has increased manifold from 0.46 million tons in 2002-03 to 1.5 million tons in 2014-15

India ranked first in the global cotton production in 2016

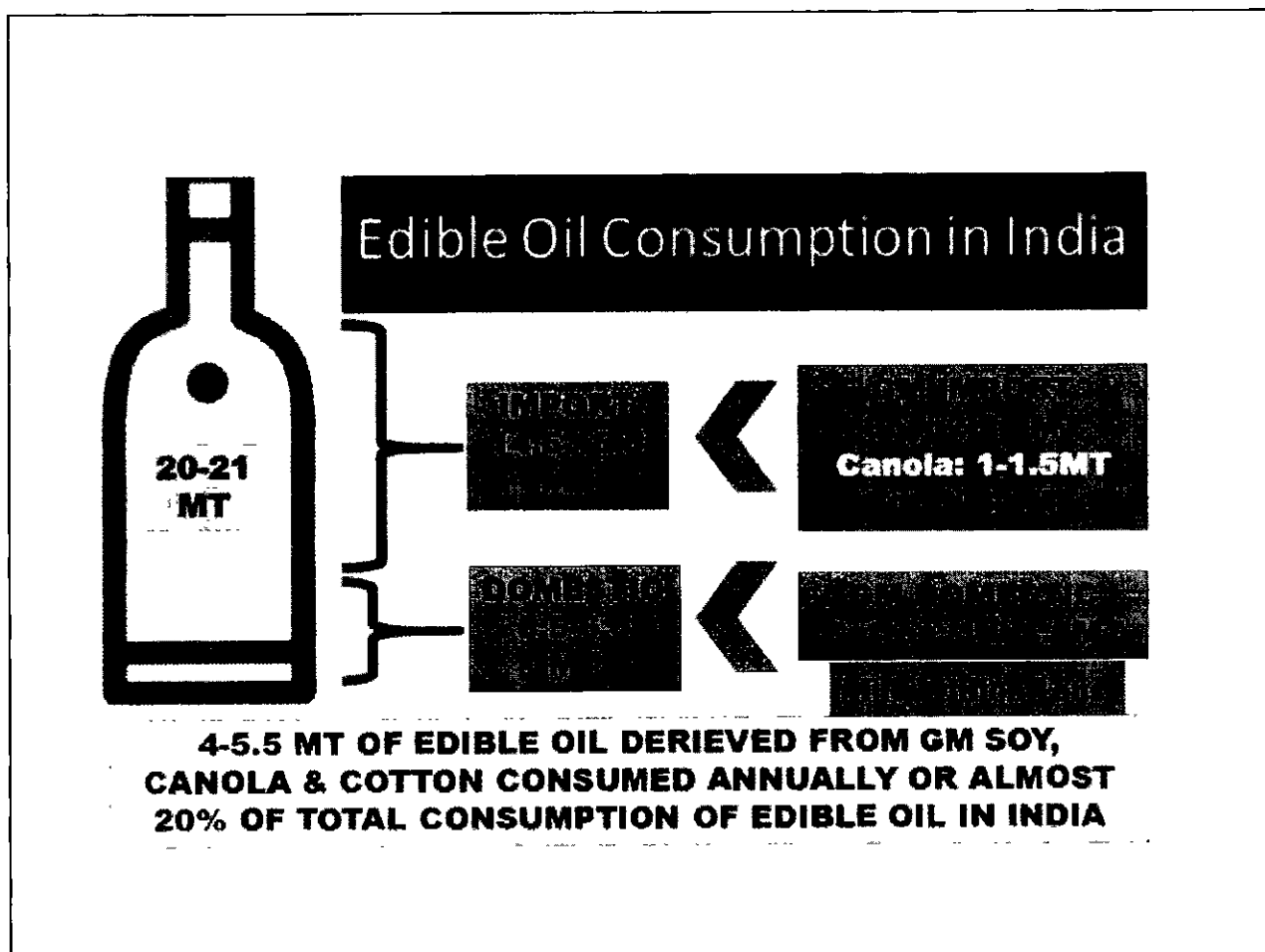
***Bt* Brinjal in India**

- Bt* brinjal is created by inserting a crystal protein gene (*Cry1Ac*) from soil bacteria *Bacillus thuringiensis* (*Bt*) and it is resistant to Fruit and Shoot Borer (*Leucinodes orbonalis*)
- In October 14, 2009, the GEAC recommended the approval of commercial cultivation of *Bt brinjal* (*eggplant*)
- On 9th February, 2010, the MoEF&CC announced a moratorium on the approval
- National Committee on Biosafety (NCB), Bangladesh has approved for limited scale cultivation of *Bt* Brinjal by farmers (2013).



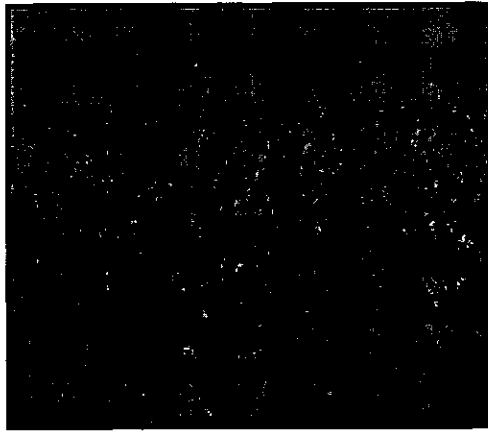
Chronology of *Bt* Brinjal Development

Concept approval and Lab Studies	2000-2001
Event Selection Trials/ BRL-I Trials and Laboratory Data Generation	2001-2002
Food, Feed and Environmental Safety Studies	2002-2006
BRL-II Trials/ Large Scale Field Trials	2007-2009
Application for Environmental Release	2009-2010
Moratorium on Release	2010



Genetically Engineered (GE) Mustard

- ❑ Technology developed by Centre for Genetic Manipulation of Crop Plants (CGMCP), University of Delhi (South Campus)
- ❑ GE Mustard, DMH-11, containing *Barnase-Barstar* system is under evaluation by Government of India



Chronology of GE Mustard Development

Evaluation of Concept and approval of IBSC	2000-2002
Laboratory / Green House Experimentation & Event Selection Trials	2002-2010
Biosafety Research Level-1 Trials	2010-2012
Evaluation of Food/ Feed and Environmental / Soil Microflora Safety Studies	2011-2015
Biosafety Research Level-2 Trials	2014-2015
Dossier/ Application submission to GEAC	September 2015
Report Submission by Sub-Committee	August 2016
Posting of AFES Document in Website for Public Comments	September 2016
Report from Sub-Committee	November 2016
GEAC recommendation for Environmental Release	11 May, 2017

Summary of Assessment studies

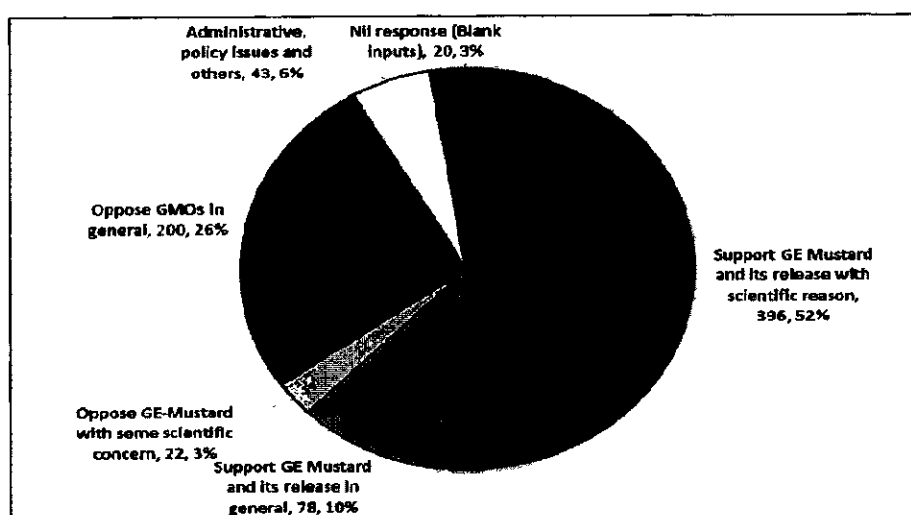
Assessment for biosafety	Comparison between GE and Non-GE counterpart	Risk assessed
Assessment for toxicity and allergenicity to humans and toxicity to animals		
Composition Analysis	Alteration in nutrient composition of leaf and seed	Nil/Negligible
	Alteration in total and nutrient composition in leaf and seed	Nil/Negligible
Toxicity potential	Expression levels of the introduced proteins i.e. Bar, Barnase and Barstar proteins in the edible plant parts (leaf and seed)	Nil/ Negligible
	Acute oral toxicity of the purified protein	Nil/ Negligible
	Sub-chronic toxicity with the edible plant parts (seed and leaf)	Nil/ Negligible
Allergenicity potential	Bioinformatic analysis of the Bar, Barnase and Barstar protein	Nil/ Negligible
	Pepsin digestibility	Nil/ Negligible
	Thermal stability	Nil/ Negligible
Environmental risk assessment		
Weediness potential	Seed termination	Nil/ Negligible
	Speed of Seed germination	Nil/ Negligible
	Seed vigour	Nil/ Negligible
	Small seed size	Nil/ Negligible
	Long continuous seed production	Nil/ Negligible
Crossability and gene flow	Pod shattering	Nil/ Negligible
	Extent of cross pollination between GE B.juncea hybrid DMH-11 and its related species	Negligible
	Extent of cross pollination between GE B.juncea hybrid DMH-11 and B. juncea variety Pusa bold as an adjoining crop (Pollen flow)	Negligible to low
	Alteration in pollen viability	Nil/ Negligible
	Alteration in pollen production	Nil/ Negligible
Effect on soil microflora	Alteration in abundance (CFU/gm) of bacteria, fungi and actinomycetes in rhizosphere	Nil/ Negligible
	Alteration in predominant bacterial species in rhizosphere	Nil/ Negligible
Effect on pests, diseases and beneficial insect	Change in the susceptibility to insects and diseases	Nil/ Negligible
	Change in the predators abundance	Nil/ Negligible
	Change in the receptibility towards honeybee and any toxicity to honeybee feeding on pollen and nectar	Nil/ Negligible

**STAKEHOLDER'S CONSULTATION IN
GE MUSTARD**

Public Consultations

- Meeting with Alliance for Sustainable & Holistic Agriculture (ASHA) on 18.07.2016 to listen their concerns.
- Assessment of Food & Environment Safety (AFES) was kept in Ministry's website for a period of 30 days from 05.09.2016 to 05.10.2016 and the entire dossier was also made available for review by public in MoEF&CC.
- 759 comments were received. Of the total 759 comments 418 responses were based on scientific statements. Of the 418 responses, 396 responses (95%) were in support of environmental release and about 22 responses (5%) opposed the same.
- 29 persons from different parts of the country including Haryana, Punjab, Gujarat, Karnataka, Uttar Pradesh, Orissa etc. came personally to review the dossier made available in MoEF&CC. There were researchers, farmers who studied the detailed dossier and gave comments.
- **All comments, concerns/views were examined by Sub-Committee of GEAC.**

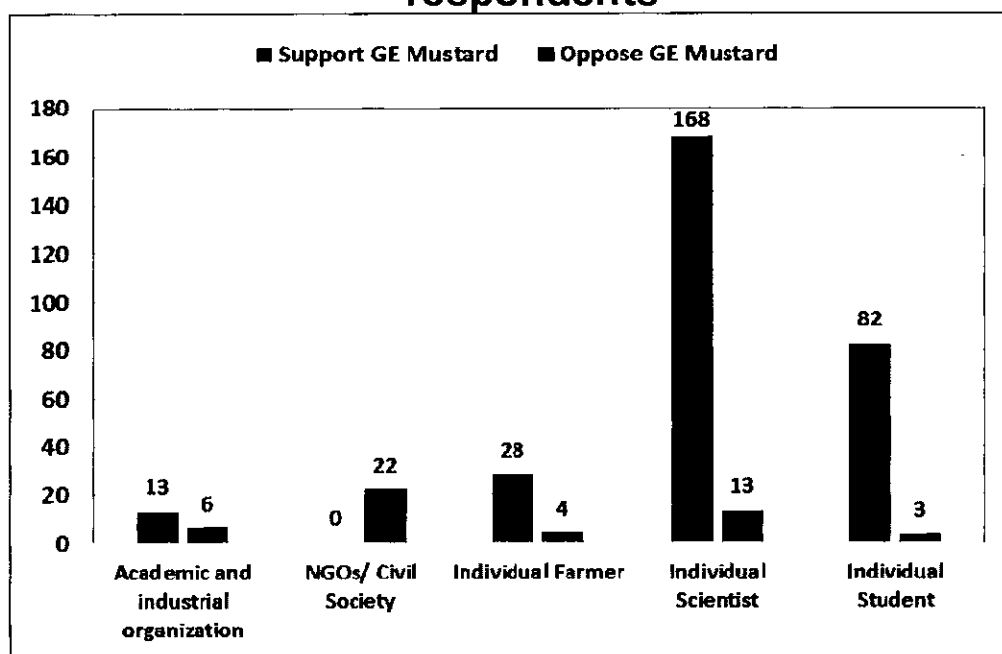
Overview of Total (759) Responses and Statistics



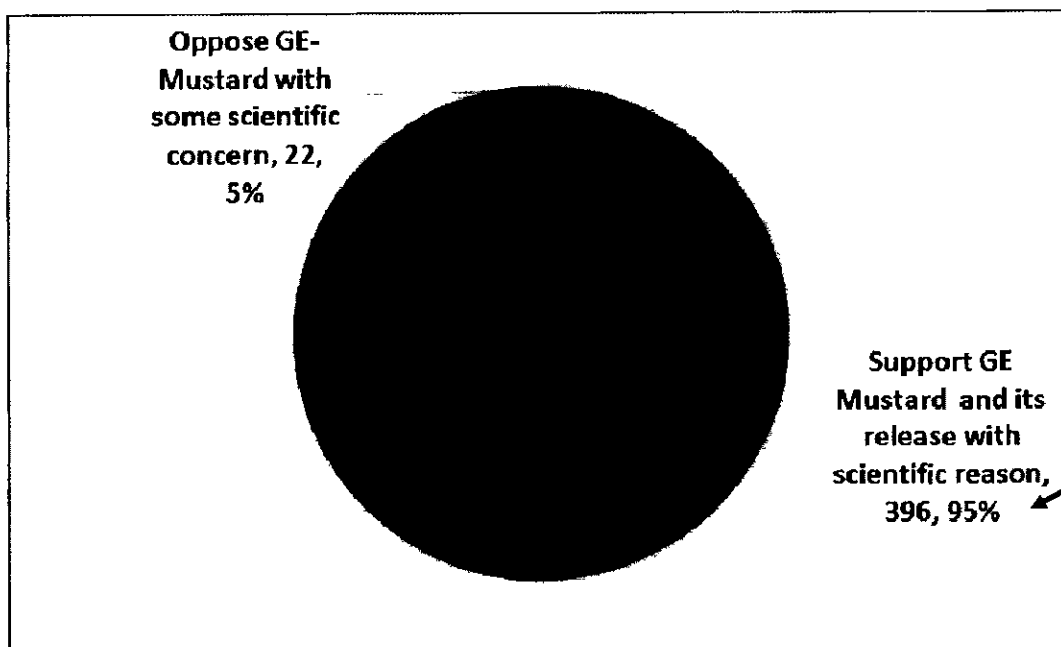
People who visited MOEF&CC

- **29 people** visited and accessed the GE mustard dossier at MOEF&CC office between 5th Oct – 5th Sep.
- They represented various organisations and individuals like National Academy of Agriculture Sciences (**NAAS**), Indian Agriculture Research Institute (**IARI**), **Farmers, Scientists** and **NGOs**.
- The representation was across the country i.e from **Delhi**; Vadodara, **Gujarat**; Bangalore, **Karnataka**, Patna, **Bihar**; Rewari, **Haryana**; Bhubaneswar, **Odisha**.

Representative categorization of feedbacks received based on the affiliations of the respondents



Categorization of 418 Responses with Scientific Inputs



GEAC Recommendation for GE Mustard

- Apprised on 11.05.2017
- Recommended environmental release subject to certain post release monitoring.

Grants received for development of GM Mustard

S.N.	Organization	Amount (in crores)	Remarks
1.	National Dairy Development Board (NDDB)	50	This money is given in 20 years for various activities including salaries, field activities etc.
2.	D/o Biotechnology (DBT)	03	For development of technology
3.	D/o Biotechnology (DBT)	22	Over a period of 25 years for various activities
4.	BIRAC	08	For Biosafety studies. BIRAC stands for Biotechnology Industry Research Assistance Council, which is a Public Sector Enterprise housed under DBT.
	Total	83	

Action Plan for Commercialization of GM Mustard

1. Current availability of parental lines and hybrids is as below:-

- *Varuna* - (Barnase) - 7 kg
- *EH2* (Barstar) - 10 kg
- *DMH 11 (GM Mustard)* - 15 kg

2. 2017-2018 :-

- 1 kg per acre of DMH 11 hybrid seeds will be planted in 5 different sites. Therefore, 5 kg DMH11 of seeds will be used for generation in an area of 5 acre.
- This will give about 2000 kg of DMH11.

3. 2018-2019 :-

- 1000 kg of DMH11, prepared in 2017-18, will be planted in 1000 acre land. This will generate 4 lac kg of DMH11.
- After this commercialization will be done.

Crops and Traits under Product Development Pipeline (2014-15)

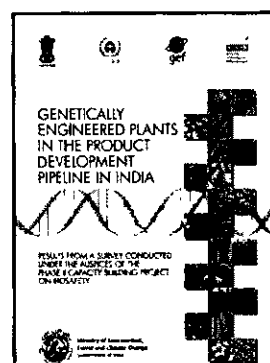
More than 85 crop species are under various stages of R&D in India

- ✓ Rice
- ✓ Cotton
- ✓ Brinjal
- ✓ Chickpea
- ✓ Banana
- ✓ Ground nut

More than 1150 Scientists from 350 Institutions were surveyed

Crop traits widely under investigation

- ✓ Insect resistance
- ✓ Drought resistance
- ✓ Fungal resistance



Public Research – GM Crop Trials

S.No	Crops	Year	Institute	Traits
1.	Brinjal	2006	IARI, New Delhi	Insect resistance
2.	Castor	2006	Directorate of Oilseeds Research, Hyderabad	Insect resistance
3.	Groundnut	2006	ICRISAT, Hyderabad	Virus resistance
4.	Potato	2006	Central Potato Research Institute, Shimla	Fungal resistance
5.	Rice	2006	IARI, New Delhi	Insect resistance
6.	Rice	2006	TNAU, Coimbatore	Disease resistance
7.	Tomato	2006	IARI, New Delhi	Virus resistance
8.	Brinjal	2007	UAS, Bangalore	Insect resistance
9.	Brinjal	2007	TNAU, Coimbatore	Insect resistance
10.	Potato	2009	Central Potato Research Institute, Shimla	Tuber sweetening
11.	Chickpea	2009	ICRISAT, Hyderabad	Abiotic stress tolerance
12.	Sorghum	2009	National Research Centre for Sorghum, Hyderabad	Insect resistance
13.	Watermelon	2010	Indian Institute of Horticultural Research	Virus resistance
14.	Tomato	2010	Indian Institute of Horticultural Research	Virus resistance
15.	Tomato	2010	IIVR, Varanasi	Insect resistance
16.	Tomato	2010	NRCPB, New Delhi	Fruit ripening
17.	Papaya	2010	Indian Institute of Horticulture Research	Virus resistance
18.	Sugarcane	2010	Sugarcane Breeding Institute	Insect resistance
19.	Sorghum	2010	Central Research Institute for Dryland Agriculture	Abiotic stress tolerance
20.	Groundnut	2010	University of Agricultural Sciences, Bangalore	Abiotic stress tolerance
21.	Mustard	2010	NRCPB, New Delhi	Abiotic stress tolerance
22.	Mustard	2010	University of Delhi South Campus, Delhi	Heterosis
23.	Groundnut	2011	ICRISAT, Hyderabad	Fungal resistance
24.	Rubber	2011	Rubber Research Institute, Kottayam	Abiotic stress tolerance

Private Research – GM Crop Trials

S.No	Crops	Year	Institute	Traits
1	Brinjal	2006	Sungro Seeds, New Delhi	Insect resistance
2	Brinjal	2006	Mahyco, Mumbai	Insect resistance
3	Cabbage	2006	M/s Nunhems, Gurgaon	Insect resistance
4	Cauliflower	2006	Sungro Seeds, New Delhi	Insect resistance
5	Cauliflower	2006	M/s Nunhems, Gurgaon	Insect resistance
6	Corn	2006	Monsanto, Mumbai	Insect resistance
7	Okra	2006	Mahyco, Mumbai	Insect resistance
8	Rice	2006	Mahyco, Mumbai	Insect resistance
9	Tomato	2006	Mahyco, Mumbai	Insect resistance
10	Okra	2007	Mahyco, Mumbai	Insect resistance
11	Rice	2008	Bayer Bioscience Pvt. Ltd.	Insect resistance
12	Tomato	2008	Avesthagen Ltd.	Nutritional quality
13	Corn	2008	Monsanto India Ltd.	Insect resistance, Herbicide tolerance
14	Brinjal	2009	Bejo Sheetal Seeds, Jalna	Insect resistance
15	Corn	2009	Pioneer Overseas Corporation	Insect resistance, Herbicide tolerance
16	Corn	2009	Dow Agro.	Insect resistance
17	Rice	2009	Bayer Bioscience.	Insect resistance
18	Rice	2009	Mahyco, Jalna	Insect resistance, Herbicide tolerance
19	Rice	2010	E.I. DuPont	Heterosis
20	Rice	2010	Bayer Bioscience	Insect resistance
21	Rice	2010	Metahelix Life Sciences	Insect resistance
22	Rice	2010	BASF India Ltd.	Insect resistance
23	Maize	2010	Pioneer Overseas Corporation	Insect resistance and Herbicide tolerance
24	Corn	2010	Dow AgroSciences	Insect resistance
25	Corn	2010	Syngenta Biosciences	Insect resistance
26	Cotton	2011	Bayer	Insect resistance
27	Cotton	2011	Syngenta Biosciences	Insect resistance and herbicide tolerance
28	Cotton	2011	Pioneer	Insect resistance and herbicide tolerance
29	Cotton	2012	Bayer	Herbicide tolerance

Ease of Doing Business

- Launch of new GEAC Website
- Regular meetings of GEAC
- 129th GEAC decided that NOC for CFT should be in 90 days
- Exemption of NOC for EST-The GEAC in its 130th meeting held on 11.08.2016 decided that since, Event Selection Trials (ESTs) are small scale experiments conducted strictly within the institutional premises, requirement of NOC may be exempted for conduct of ESTs.



Thank You