zeroed in on the immediate steps that the country must follow, to minimize the enormity of similar disasters in future. The brainstorming at New Delhi helped to consolidate an action plan for a tsunami-warning centre, which is expected to take shape in the immediate future; discussions at Goa have successfully put forward feasible research programmes that will generate data and provide inputs for realizing this action plan as well as other coastal disasters and the Indo-Japan workshop has identified specific problems that researchers can indulge in, to understand the nature of earthquake recurrence, its effect on coastal regions and the use of modern technologies such as GPS-based tsunami-warning systems.

Indeed, the year 2004 ended with a catastrophe that caught us unawares; it has taught us that disasters may strike where it least expected and they can never be prevented. Perhaps, with the passage of time, at least some of them would become predictable, with reasonable reliability, thereby improving our level of preparedness. The outcome of these meetings will surely lead us in that direction, toward better appreciation of disasters looming in the horizon and to better preparedness – through improved database, better communication network and a pivotal system that will step into action in times of emergency.

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Genetically modified organisms – Biosafety aspects*

Genetically modified plants/organisms have been adopted globally during the past five to seven years. Up to now, many characteristics have been modified by transgenic technology in crop plants. These include resistance to insects, pests and diseases, enhanced nutritional qualities, resistance to abiotic stress and development of new varieties. However, the scientific community is still divided over the issue of transgenic technology. Debates and discussions are held at various fora over the uses and risks involved in transgenic technology. There is less scientific consensus on the free release of transgenic varieties. Many people are still disillusioned over the environmental hazards associated with transgenic crops. To educate students, researchers, college and university teachers, and to address certain concerns regarding genetically modified organisms (GMOs), Delhi University Botanical Society (DUBS) organized a National Seminar on Genetically Modified Organisms – Biosafety Aspects.

The two-day deliberations consisted of five scientific technical sessions and a panel discussion. The main topics covered were: Status and priorities for biotech crops; Technology options for development of genetically modified crops; Biosafety aspects of genetically modified organisms; Development of transgenic crops in India; Risk assessment and regulatory procedures and Conventions and IPR issues.

The seminar was inaugurated by Deepak Pental (Director, University of Delhi, South Campus). He stressed on the importance and application of transgenic technology for betterment of mankind and emphasized on proactive research in this area. Pental emphasized that GMOs are needed to improve food security and national economy of the country, and India has to open the gates to this technology. K. R. Koundal (Director, National Research Centre (NRC), Plant Biotechnology) in his presidential address, highlighted the status and priorities of agricultural biotechnology in India. He stressed on the need for collaborative research in transgenics and focused on confidence-building measures, which should be adopted to make GMOs people-friendly. Koundal stressed that better scientific evaluation methods have to be designed to study the risks associated with GMOs and combat the myths associated with them.

Since *Bt*-crops are one of the commonly grown transgenic crops and have been permitted by GEAC (Genetic Engineering Approval Committee), the discussion was centred on *Bt*-crop technology. P. Ananda Kumar (NRC Biotechnology, Indian Agricultural Research Institute (IARI)) spoke about '*Bt*-transgenic crops'. His presentation gave a detailed overview of *Bt*-technology, right from its inception to its present status. 'The biosafety of *Bt*-insecticidal proteins to biodiversity and environment has been intensively investigated and documented. Abundant scientific evidences indicate that cultivation of *Bt*-crops is safe to the environment. The assessment of risk and biosafety will have to be carried out on a case-by-case basis taking various factors into consideration, which include geographical location where the crop is intended to be grown', according to Kumar. Concluding his talk, Kumar cautioned the audience that transgenic crop cultivation has to be integrated with practices that nurture crop diversity, crop rotation, soil fertility and wild life diversity. Raj K. Bhatnagar (International Centre for Genetic Engineering and Biotechnology (ICGEB), New Delhi) gave a lecture on 'Insecticidal proteins of *Bacillus thuringiensis* and their application'. Critical evaluation of performance of transgenic crops over the years has demonstrated economic, environmental and social benefits of *Bt*-crops and the major reason for acceptance of *Bt*-proteins is their lack of interaction and activity in mammals, including man. He elucidated how the onset of resistance in insects against *Bt*-insecticidal proteins is delayed and what strategies are being practised to avoid resistance and improved expression of insecticidal proteins in transgenes to prevent escape from cultivated crop systems to wild relatives.

The safety and regulatory concerns associated with transgenic crops constitute a major hurdle for developing countries, because many lack the regulatory frameworks and technical capacity necessary to evaluate these crops and the conflicting claims surrounding them. Gurinder Jit Randhawa (NRC on DNA fingerprinting, National Bureau of Plant Genetic Resources (NBPGR)), New Delhi, in her presentation gave information on steps taken by NBPGR to issue permits for transgenic planting material for research purposes. According to her, 'Since 1997, transgenic lines are being imported on regular basis through NBPGR and till date 32 imports of different crops

*A report on the seminar organized at Indian National Science Academy, New Delhi during 10–11 March 2005, in the memory of late P. Maheshwari, doyen of plant embryology in India and founder of Delhi University Botanical Society, as a part of his birth centenary celebrations. The seminar was sponsored by the Ministry of Environment and Forests, Government of India.

namely *Brassica oleracea*, *B. juncea*, *B. napus*, *Oryza sativa*, *Gossypium* sp., *Zea mays*, *Cicer arietinum*, *Glycine max* and *Nicotiana tabacum* have been imported for research purposes in the country and all major precautions have been taken before their import so that there is no chance of gene contamination'.

Sudhir K. Sopory (ICGEB), gave a presentation on 'Genetically modified plants for salinity stress tolerance'. He emphasized that novel stress responsive genes and transgenic research offer an important strategy to develop salt-tolerant plants. Citing the example of *Pennisetum* as a model system to study stress tolerance, he said that by manipulating the expression of genes of the glyoxalase pathway, glyoxalase I and glyoxalase II together, the ability of double transgenic plants to salinity stress is greatly enhanced compared to the single transgenic plants harbouring either glyoxalase I or glyoxalase II. Akhilesh K. Tyagi and Jitender Khurana (Department of Plant Molecular Biology, University of Delhi, South Campus), dealt with new technologies and work that is being carried out in their laboratories. Tyagi shared his views on the rice genome. He said that release of the genome sequence from two subspecies of *Oryza sativa* has brought rice to the forefront of genomic studies. Development of plants for traits like enhanced yield or resistance to various stresses (biotic or abiotic) requires a thorough understanding of the cellular and functional aspects of plant, which is dictated by its genetic make-up. In conclusion, Tyagi noted that trangenics in rice would revolutionize Indian agriculture in near future. Khurana elaborated on the role of light signalling pigments in plants. According to him, 'manipulating light signalling components for controlling agronomically important traits like flowering time and plant height will help in producing novel crop species. Understanding light perception and signalling mechanisms is not only important from the fundamental point of view, it offers the potential to alter these pathways through breeding and transgenic manipulation towards creation of crop varieties to meet the demands of modern cultivation'. Some of the traits like early flowering, altered plant height, and better performance under stress conditions have already been manipulated by genetic engineering. V. Siva Reddy (ICGEB), focused on the potential that chloroplast genetic engineering offers in the area of crop biotechnology. Chloroplast genetic engineering helps in containment of foreign gene spread to untransformed wild relatives, because in majority of plants the plastome is maternally inherited and foreign gene integrated into plastid genome has less chance to migrate through pollen, thus ruling out the possibility of gene flow. He added that since chloroplasts are the seat of several metabolic pathways in plants, genetic modifications in these offer great potential in further improvement of traits in crop plants.

Addressing the possible risk of allergenicity posed by transgenic crops and genetically modified foods, A. B. Singh (Institute of Genomics and Integrative Biology, Delhi) talked on 'Transgenic plants and allergenicity: Health risk assessment'. The potential allergenicity of the introduced proteins can be evaluated by focusing on the source of the gene, sequence homology of the introduced protein to known allergens and the reactivity of the novel proteins with immunoglobulin (IgE). Application of such criteria provides reasonable assurance that the crop will not be allergenic. Singh stressed on the setting up of state-of-the-art laboratories to test the allergenicity caused by GMOs and their products on either animals or human health.

'The credibility of the regulatory process and acceptance of products of biotechnology depend heavily on the public's ability to understand the process and the key scientific principles on which it is based', was the opening statement made by P. K. Gupta (Department of Genetics and Plant Breeding, CCS University, Meerut) in his talk on 'Biosafety and IPR issues in GM crops'. Gupta elaborated on the techniques that are available for evaluating and combating the risks posed by GM crops. He added that two international instruments have recently changed the situation with respect to trading of GMOs; Cartagena Protocol for Biosafety (effective from 11 September 2004; ratified by 111 countries on 3 December 2004) and a set of guidelines, 'Risk Analysis Principles for Food Derived from Biotechnology' established by a little known body called 'Codex Alimentarius Commission' (established by FAO and WHO in 1963). GMOs are either marker-free or utilize markers that are consumer-friendly.

Manoranjan Hota (Ministry of Environment and Forests, Government of India) discussed the role of his Ministry in strengthening the capacity to implement the Cartegena Protocol in India, the first international regulatory framework for safe transfer, handling and use of living modified organisms. In his presentation on, 'Cartagena Protocol on biosafety and capacity building in India', Hota said that the protocol seeks to protect biological diversity from the potential risks posed by living modified organisms resulting from modern biotechnology and stressed on the need to educate more people and make farmers aware of transgenic technology and its uses.

In the concluding session, A. K. Bhatnagar (Department of Botany, University of Delhi, member GEAC and Convenor) said that there is wide consensus that transgenic crops should be evaluated on a case-by-case basis, as is the case with pharmaceuticals, taking into consideration the specific crop, trait and agro-ecological system. Since few transgenic crops have been evaluated for their ecological impacts in tropical regions, a major research effort is required in this area. Concerted efforts are needed to educate and make people aware of the technology, which has already gained access.

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DRDO research grants

A website has been created by DRDO for applying for research grant under DRDO's Extramural Research Program (ER). The details are given below:

The principal investigators (PI) can go to the site http://www.drdo.org.in/ and search for the icon named 'sponsored research in academic institutions'. After clicking the icon, one will see the icon by name 'Extramural Research' through which the forms and conditions can be downloaded. The form can be filled online with aided instructions and converted into a PDF file which can be transmitted to the Directorate of Extramural Research & Intellectual Property Rights.