

*Indian Technical Economic Cooperation (ITEC) Programme and  
Special Commonwealth African Assistance Plan (SCAAP) Programme of  
the Ministry of External Affairs*

*3<sup>rd</sup> Training Programme on  
Applications of Biotechnology and its Regulation  
4 August – 21 August 2009  
(Venue – Gual Pahari)*

*Organized by*

*The Energy and Resources Institute  
Habitat Place, Lodhi Road  
New Delhi – 110 003, India*

## Programme Schedule

<b>Tuesday, 4 August 2009, (Gual Pahari)</b>	
10.00 – 10:40	Welcome address and Opening remarks by Ms. Swati Ganeshan
10.40 – 10.50	TERI Multimedia Presentation
10.50 – 11.00	Round of introduction (Tea to be served inside)
11.00 – 11.20	Overview of the 3-week long program, Program Coordinator (Dr Vibha Dhawan)
11.20 – 1.00	Lecture 1 <b>General overview: What is Biotechnology?</b> (Dr. Neetika Walia)
1.00 – 2.00	Lunch break
2.00 – 3 .30	Lecture 2 <b>Achieving food and nutritional security</b> A brief presentation on the key challenges faced by humanity today in ensuring availability of food to large population, especially in Asian and African continents where the challenge of malnutrition is greater. Role of biotechnology in this scenario would be discussed. The lecture would entail problems associated with economic status, sanitation and health issues especially in relation to malnutrition. (Dr Nidhi P Chanana)
3.30 –4 .00	Tea break
4.00 – 5.30	Lecture 3 <b>Identification of superior germplasm: Trees</b> This session would highlight various parameters taken into consideration while marking a candidate plus tree (CPT). The path of further selection of CPT to elite would also be discussed. (Dr P P Bhojvaid)
<b>Wednesday, 5 August 2009, Plant Tissue culture (Gual Pahari)</b>	
10.00 – 11.30	Lecture 4 <b>Overview of plant tissue culture technology</b> The tissue culture technology evolved gradually. Who were the pioneer workers? How did the technology developed? What are the infrastructure and laboratory requirements for carrying out tissue culture work? The broad technology, its applications and limitations will also be discussed. (Dr. Sanjay Saxena)
11.30 – 12.00	Tea Break
<b>Shoot Multiplication</b>	
12.00 – 1.30	Lecture 5 <b>Shoot multiplication</b> Theoretically, each plant cell is capable of producing a complete plantlet. There are three methods by which plants can be regenerated/ multiplied, viz., somatic embryogenesis, organogenesis and axillary branching method. Each of the three procedures has different requirements for induction which shall be discussed in this session. (Dr. Sanjay Saxena)
1.30 –2.30	Lunch

2.30 – 4.00	Lecture 6 <b><i>Shoot elongation and in vitro rooting of the developed shoots</i></b> At shoot multiplication stage, the emphasis is on getting maximal clonal shoots. In certain cases, the shoots get stunted and need to be treated so that they attain certain height before they can be put for rooting. The elongated shoots can be treated as micro-cuttings and by changing the growth regulators, can be made to root through their basal cut ends. (Dr Vibha Dhawan)
4.00 – 4.30	Tea Break
4.30 – 5.30	Lecture 7 <b><i>In vivo rooting of micro-shoots and acclimatization of the tissue cultured plants</i></b> Tissue culture is a relatively expensive process and apart from media and manpower cost, energy cost for maintaining cultures is very high. Therefore, attempts are made to treat <i>in vitro</i> formed shoots as cuttings and root them under <i>in vivo</i> conditions. Since the plants developed inside a culture vessel are very different from the plants growing naturally in terms of anatomy, physiology, etc, they need to develop the desired characteristics and change their mode of nutrition from heterotrophic to autotrophic. Various aspects of hardening (gradual acclimatization of tissue cultured plants to field conditions) would be discussed in this session. (Dr. Vibha Dhawan)
<b>Thursday, 6 August 2009 Commercial Tissue Culture</b>	
10:00 – 11:30	Lecture 8 <b><i>Commercial tissue culture</i></b> Commercial production of tissue culture plants is influenced by several factors. This session will be dedicated to ponder over on all those factors. The current status of tissue culture at global level shall also be discussed. (Dr. Vibha Dhawan)
11.30 – 12.00	Tea Break
12.00 – 1.30	Lecture 9 <b><i>Other aspects of plant tissue culture</i></b> Besides, micropropagation, tissue culture has several other applications like protoplast culture, secondary metabolite production, anther culture, etc. Each of the applications shall be discussed in detail in this section. (Dr. Nidhi Chanana)
1.30 – 2.30	Lunch
2.30 – 5.30	Visit to Gual Pahari (MTP and Mycorrhizal Facilities)

<b>Friday, 7 August 2009,</b>	
10.00-11.30	<p>Lecture 10  <b><i>Molecular Markers and DNA Fingerprinting for Documentation of Plant Genetic Resources</i></b>            Until 1980's, the plant populations were largely characterised on the basis of their phenotypes. In order to differentiate individuals as being similar or dissimilar; isozymes and other biochemical markers were used as character states to quantify polymorphisms. However, the use of DNA based markers synchronising with the discovery of RFLP markers, completely revolutionised the way population genetic studies and molecular mapping were conducted. It was established that each individual has a unique DNA profile as unique as the fingerprints of human beings. DNA profiling/fingerprinting, hence, became the preferred method for analysing genomes. The current session will provide a historical perspective on the how several generations of molecular markers, viz. hybridisation based followed by PCR based markers were generated and utilized for scanning for mutations in the genome. RFLP, RAPD and AFLP among other marker techniques will be discussed. Use of SNPs genotyping platform, the third generation markers shall also be discussed. (Dr Anandita Singh)</p>
11.30-12.00	Tea Break
12.00-1.30	<p>Lecture 11  <b><i>Molecular Breeding</i></b>            Discovery of molecular markers has caused a major shift in breeding methodology based on molecular breeding techniques. Issues such as markers using candidate gene based approach, increased efficiency in application and DNA markers, new strategies for effective molecular breeding including assessment mapping to identify new molecular markers; an integrated gene and genomic system in bioinformatics etc. will be discussed. (Dr Shashi B Tripathi)</p>
1.30-2.30	Lunch
2.30 – 4.00	<p>Lecture 12  <b><i>Biofuels: from concept to reality</i></b>            The sky rocketing prices of the fossil fuels coupled with environmental and health concerns, have raised interest in the renewable sources of energy. The trees can be harvested every 10 years and used for producing ethanol, which can than be used as petroleum substitution. <i>Jatropha curcus</i> is being researched up on for their potential and large scale plantation specially in the developing part of the world such as India, Malaysia and Africa. In this session, discussion will be held potential of these crops to meet part of energy requirements. (Dr Alok Adholeya)</p>
4.00-4.30	Tea Break

4.30 – 5.30	<p>Lecture 13</p> <p><b><i>Treating pesticide contaminated sites</i></b></p> <p>"Increasingly, people in developed and developing countries have realized that the extensive use of chemical pesticides, which are used to keep crops healthy, has led to the contamination of the soil, crops and the resulting food products and drinks. Pesticide residues accumulate in agricultural land and can remain active for up to 30-50 years. With the advent of biotechnological intervention, there have been extensive research programme going on to degrade the pesticide contaminants in soil by microbes. Microbial consortia are in the process of development to remediate the pesticide residues in agricultural lands to regain them fit for organic farming whose produce will be free from any contaminants". (Dr Priyangshu Sharma)</p>
<b>Saturday, 8 August 2009</b>	
10.00 – 11.30	Lecture
11.30 – 12.00	Tea Break
12.00-1.30	Lecture
1.30 – 2.30	Lunch
2.30 – 4.00	<p>Lecture 14</p> <p><b><i>Biofertilizer production</i></b></p> <p>More than 150 years of over cultivation with synthetic fertilizers and pesticides has left our soils degraded, polluted and less productive. The judicious use of nature's own biofertilizers by their biotechnological applications appears to be a suitable answer to this problem. Biofertilizers include environment-friendly fertilizers with organisms such as: Rhizobium, Azotobacter, mycorrhizal fungi, phosphorus solubilizing bacteria (PSB) and blue-green algae. The lecture will address the methods and the issues related to their production. (Dr Reena Singh)</p>
4.00 – 4.30	<i>Tea Break</i>
4.30 – 5.30	<p>Lecture 15</p> <p><b><i>Biofertilizer application, limitations &amp; potential</i></b></p> <p>There are different ways of applying biofertilizer, which include seed treatment, seedling root dip, soil treatment etc. and will be dealt in the lecture. (Dr. Reena Singh)</p>
<b>Sunday 9 August 2009 : Local visit</b>	
<b>Monday, 10 August 2009</b>	
10.00 – 11.30	<p>Lecture 16</p> <p><b><i>Genetic engineering of crops</i></b></p> <p>Development in plant science has now made it possible to transfer a specific portion of DNA to the genome of higher plant. These foreign DNA integrates in the genome of other organism, expresses itself and replicates just as any other part of the genome. This has offered enormous</p>

	opportunities in terms of introducing traits, which did not exist in those species. This session will largely discuss on opportunities and concerns about technology. (Dr. Vibha Dhawan)
11.30 – 12.00	Tea Break
12.00 – 1.30	Lecture 17 <b><i>Different methods of producing transgenics crops</i></b> There are different methods of producing transgenic crops such as use of a soil-dwelling bacteria ( <i>Agrobacterium</i> ) which has the ability to integrate its DNA with the host plant DNA. These technologies and their applications and constraints will be discussed. (Dr Sanjay Saxena)
1.30 – 2.30	Lunch
2.30 – 4.00	Lecture 18 <b><i>Important traits for transgenic production</i></b> Research in transgenic production in the developed part of the world focused on traits such as herbicide tolerance, insect resistance, increased shelf life and virus resistance. In this session the transgenic traits and their resistance in developing world will be analysed. The need of developing countries including Africa and other traits which are more relevant to their countries will be brought out in this session. (Dr Nidhi P Chanana)
4.00 – 4.30	Tea Break
4.30 - 5.30	Lecture 19 <b><i>Crops presently being attempted for transgenic production</i></b> The important crops for which transgenes are produced are Soybean, Corn, Cotton, Canola, Squash, and papaya. Research is being attempted by many sectors in the developing part of the world especially on crops, which are relevant to them. Studies on commercial release of other crops especially in developing world will also be discussed in this session. (Dr Nidhi P Chanana)
<b>Tuesday 11 August 2009</b>	
10.00 – 11.30	Lecture 20 <b><i>Scenario in developing countries with special emphasis on commercialised crop</i></b> - Bt cotton – a case study - Bt corn In the Asia Pacific region, India and China have commercialised fibre crop i.e. Cotton. In so far as Food crops are concerned, transgenic corn in Philippines have been commercialised. The release of these two crops may serve as a future guide for commercialisation of other crops. These two will be presented as case studies. Discussions will center around importance of liasoning during the course of commercialisation. (Dr Vibha Dhawan)
11.30 – 12.00	Tea Break

12.00 – 1.30	Lecture 21 <b><i>Environmental and biosafety issues in modern biotechnology</i></b> Transgenic crops have enormous potential in terms of improving nutritional quality of crops and reducing use of insecticides/pesticides by introducing resistant genes. However the technology must be managed responsibly as irresponsible use of genes, especially for resistance to insecticides may lead to development of super varieties of insecticides which will be difficult to control by known pesticides. Capacity building at different stages and awareness about various regulations is a pre-requisite. Various issues related with the environment and biosafety will be discussed in this session. (Dr Vibha Dhawan)
1.30 – 2.30	Lunch Break
2.30 – 4.00	Lecture 22
4.00 – 4.30	Tea Break
4.30 – 5.30	Lecture 23 <b><i>Detailed regulatory guidelines and protocols for transgenic crops; food and feed scenario</i></b> India had initiated formulation of legislation and guidelines for regulation of GMOs and related products much before CBD (Convention on Biodiversity) and BSP (Biosafety Protocol) were put in place. The Environment Protection Act and 1989 Rules for GMOs framed by MoEF would be covered in this session. The existing mechanism pertaining to regulatory procedures leading to approvals will be critically examined. Additionally, the session will cover the existing scenario in India in the area of regulation of GM food and feed products. (Dr K K Tripathi)
<b>Wednesday, 12 August 2009</b>	
10.00 – 11.30	Lecture 24 <b>Recent Changes in patent laws in context of biotechnology</b> The core intellectual property protection in the biotechnology industry is the patent law. The session examines the basic tenets of patent law and provides an in-depth insight into special problems associated with biotechnology related patents. This session will cover international experiences in biotechnology patents, exemptions, biotechnology related patent prosecution and enforcement. The session will also cover the complex world of patents in India. The session starts with regulatory and policy issues in biotechnological innovations in India followed by a critical examination of the recently enacted Patents (Amendment) Act, 2005, and the parent Patents Act of 1970. The session will focus mainly on patent issues including the patentability of living organisms, human-beings, animals and plants. It will also address the implications of patenting such biological material as nucleic acids including genes, regulatory elements and ESTs (Expressed Sequence Tags). (Mr M V Shiju)
11.30-12.00	Tea Break

12.00 – 1.30	<p>Lecture 25</p> <p><b><i>Functional Genomics and Bioinformatics</i></b></p> <p>Biologists are witnessing a paradigm shift in the way they identify biological problems and resolve them. On one hand, a colossus of sequence data is being generated through various genome sequencing projects. On the other hand, wide range use of computational biological methods and statistics has become central to interpretive science. Simultaneously, tools and techniques have been developed that allow studying genome at a global scale and a high-throughput manner. All these advances have lead to the genesis of “Functional Genomics”, relates to application of genome wide, high throughput experimental approaches that allow assigning function to the DNA sequences. Bio-informatics is a very important functional genomics tool. The current session will provide an introduction to this frontier area of research. (Dr. Pankaj Khurana)</p>
1.30 – 2.30	Lunch Break
2.30 – 4.00	<p>Lecture No. 26</p> <p><b><i>Biopesticide production, application and limitation</i></b></p> <p>Biopesticides are emerging as alternative to synthetic pesticides for safer food production. However, the share of biopesticides in the market is slightly above 2%. In this session, issues related to the low share of biopesticides and to enhance their utilization will be discussed. This will be followed by field visit to the institute / industry dealing with biopesticides regulation / production. (Dr Nutan Kaushik)</p>
4.00 – 4.30	Tea Break
4.30 – 5.30	<p>Lecture No. 27</p> <p><b><i>Biopesticides and regulatory issues</i></b> (Dr Nutan Kaushik)</p>
<b>Thursday 13 August 2009</b>	
10.00 – 11.30	<p>Lecture No. 28</p> <p><b><i>Socio-economic and bio-ethical issues / public awareness and participation</i></b></p> <p>Modern biotechnological advances have wider implications on socio-economic issues. The impact of biotechnology on society constitutes the subject matter of the current session. Associated ethical issues in biotechnology relating to transparency and scientific validation of regulatory procedures and other areas concerning research priorities and ownership issues shall be discussed in detail. Furthermore, the importance of promoting public awareness through developing effective communication strategies and dissemination of scientific information in common language would be covered. (Dr S R Rao)</p>
11.30- 12.00	Tea Break
12.00 – 1.30	<p>Lecture No. 29</p> <p><b><i>Biosafety and trade related issues</i></b></p> <p>This session will bring out the inter-linkages of the trade practices in Agricultural products, both food and seed trade, the uniqueness of agro-biotech products in terms of environment and health risks and the</p>



	regulatory concerns. This will introduce the participants to the legal and administrative arrangements in regulating the trade practices in a given set of infrastructure. It involves issues like labelling of products, consumer choice, product segregation, monitoring and the compliance cost. The special focus will be on the market conditions in India as compared to those in developed countries and the consequent regulatory challenges. Discussions on market conditions in other countries and scenarios in the neighbouring states will be initiated to explore the strategy to be carried out towards regional harmonization. (Dr Sachin Chaturvedi)
1.30 – 2.30	Lunch
14-16 August 2009: <b>Visit to Mukteshwar</b> (Till 16 <sup>th</sup> Night)	
17 August 2009	<b>Visit to Pant Nagar University</b> (Staying at University for 17 <sup>th</sup> Night)
18 August 2009	<b>Morning – Departing for Delhi</b>
19 August 2009	<b>Visit to Agra</b>
20 August 2009	<b>Visit to IHC and Visit to IARI/NBPGR (Visit to National Phytotron Facilities)</b>
21 August 2009	<b>Visit to TERI University and Valedictory Session at TERI University</b>