Course title: Plant Biotechnology and Crop Improvement							
Course code: BBP 121	No. of credits: 3	<b>L-T-P:</b> 42-0-0	Learning hours:				
			42				
Pre-requisite course code and title (if any): None							
<b>Department:</b> Department of Biotechnology							
Course coordinator: Dr. Shashi Bhushan Trip	oathi Course ins	Course instructor Dr. Shashi Bhushan Tripathi					
Contact details: shashi.tripathi@teriuniversity.ac.in							
Course type: Core	Course offe	Course offered in: Semester1					

### **Course description:**

The broad objective of the present core course is to define the purview of plant biotechnology with respect to crop improvement. In this respect, students will be acquainted with application of principles and techniques of plant tissue culture and transgenic technology. While in tissue culture, the focus shall be on media composition and preparation, methods of in vitro regeneration, applications and limitations, with respect to genetic transformation, aspects of cloning, DNA delivery, detection, characterization and expression of transformants and gene silencing etc would be covered. Global status of GMOs, various case studies illustrating the application of biotechnology in developing crop varieties that are resistant to various biotic and abiotic stresses, enhancing nutritional quality, improved post-harvest qualities, and aspects related to commercial release of transgenic crops would also be dealt in detail.

### **Course objectives:**

- 1. Introduction to plant tissue culture as a tool for crop improvement and generation of clonal populations of elite plant genotypes.
- 2. Development of plant transformation vectors specifically designed to facilitate transfer of improved/unique genetic traits to plants, and to provide knowledge on diverse genetic transformation technologies available for the production of transgenic plants in crop improvement programs.
- 3. Familiarization with regulations related to the development, field testing and commercial release of transgenic crops.

Course contents				
Module			T	P
1	Introduction to cropping systems in India	2	0	0
2	Principles of Plant Tissue Culture	16	0	0
	<ul> <li>History/background of plant tissue culture</li> </ul>			
	Set up of a tissue culture laboratory			
	<ul> <li>Medium constituents (macro- and microelements, hormones, other growth</li> </ul>			
	regulators) and preparation			
	Micropropagation			
	- Culture Initiation			
	- Shoot multiplication			
	- Rooting			
	- Hardening (acclimatization)			
	- Common problems			
	Somatic Embryogenesis			
	<ul> <li>Organogenesis</li> </ul>			
	<ul> <li>Clonal fidelity of tissue cultured plants</li> </ul>			
	Effect of physical environment			
	<ul> <li>Applications of plant tissue culture</li> </ul>			
	- Anther, pollen and ovary culture for production of haploid plants and			
	homozygous lines			
	- Production of Triploids			
	- Embryo culture and embryo rescue			
	- Protoplast isolation, culture and fusion; selection of			

	hybrid cells and regeneration of hybrid plants			
	- Production of secondary metabolites			
	- in situ conservation and cryopreservation			
	- Production of virus-free plants (virus indexing and elimination)			
	- Synthetic seeds			
3	Introduction to transgenic technology	12	0	0
	Conventional breeding versus Transgenesis	12	O	
	<ul> <li>Introduction to Agrobacterium tumefaciens and A. rhizogene</li> </ul>			
	Features of Ti and Ri Plasmids and their use as vectors, Binary and co-			
	integrate vectors,			
	Cloning strategies			
	Methods of DNA delivery			
	- Agrobacterium mediated transformation			
	- Direct DNA transfer to plants (particle gun, electroporation, Silicon carbide			
	fibres, PEG mediated, in-planta)			
	Chloroplast Transformation			
	DNA viruses as Expression vectors (Cauliflower mosaic virus, Gemini			
	virus, Tobacco mosaic virus, Potato X virus)			
	<ul> <li>Detection, characterization and expression of transformants (Genetic</li> </ul>			
	markers, reporter genes, transgene stability and gene silencing)			
4	Transgenic Technology for Crop Improvement	12	0	0
	• GM technology for :			
	- Conferring resistance to biotic stresses (pests, viruses, fungi)			
	- Abiotic stresses (tolerance to salt, cold, drought)			
	- Herbicide resistance			
	- Increasing shelf life of fruits and flowers			
	- Enhancing the nutritional quality (pro-vitamin A)			
	- Metabolic engineering and industrial products (plant secondary			
	metabolities, alkaloids, industrial enzymes, therapeutic proteins, antibodies, edible			
	vaccines)			
	Aspects related to commercial release of transgenic crops			
	Total	42	0	0

#### **Evaluation criteria:**

1.	Minor tests - 1	25%
2.	Minor tests - 2	25%
3.	Major test (end semester)	50%

# **Learning outcomes:**

- 1. An understanding of plant tissue culture techniques that can be employed for the production of superior quality plants.
- 2. Ability to rationalize and develop strategies for incorporating novel traits in plants through genetic engineering.
- 3. Appreciation of health and environmental concerns and understanding of regulations related to commercial release of transgenic crops.

### **Materials:**

### **Essential Readings**

- 1. George E. F., Hall A H, and De Klerk G J (2008) Plant propagation by tissue culture. Springer. 501 p.
- 2. Bhojwani SS and Razdan M K (1996) Plant Tissue Culture: Theory and Practice. Elsevier. 767 p

### **Suggested Readings:**

1. Herman, Edwin B., (Ed.) (2009) Genetic modification of plants: methods and applications 2005-2009, USA: Agritech Consultants. 153p.

- 2. Herman, Edwin B., (Ed.) (2007) Microbial contaminants in plant tissue culture, Vol. III: 2003 2007. Agritech Consultants, Inc. Shrub Oak. 110p
- 3. Neumann, K H, Kumar, A, Imani, J (2009) Plant Cell and Tissue Culture A tool in biotechnology: Basics and applications. 333p
- 4. Halford,Nigel G. (Ed.) (2006) Plant Biotechnology: Current and Future Applications of genetically modified crops. John Wiley and Sons Ltd. 303 p
- 5. Chrispeels MJ; Sadava DE (2003) Plant, Genes and Crop Biotechnology. Jones and Bartlett Publishers, Inc

## Additional information (if any):

### **Student responsibilities:**

- 1. Class attendance.
- 2. Study of course materials as specified by the instructor.

### **Course reviewers:**

- 1. Dr. A K Singh, Head, Department of Horticulture, IARI, New Delhi
- 2. Dr. Sabhyata Bhatia, Staff Scientist IV, National Institute of Plant Genome Research (NIPGR), New Delhi4
- 3. Dr Praveen Verma, Scientist, NIPGR, New Delhi