Course title: Plant Biotechnology and Crop Improvement			
Course code: BBP 121	**No. of credits:** 3	**L-T-P:** 42-0-0	**Learning hours:** 42
Pre-requisite course code and title (if any): None			
Department: Department of Biotechnology			
Course coordinator: Dr. Shashi Bhushan Tripathi	**Course instructor** Dr. Shashi Bhushan Tripathi		
Contact details: shashi.tripathi@teriuniversity.ac.in			
Course type: Core	**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	Topic	L	T	P
1	**Introduction to cropping systems in India**	2	0	0
2	**Principles of Plant Tissue Culture** • History/background of plant tissue culture • Set up of a tissue culture laboratory • Medium constituents (macro- and microelements, hormones, other growth regulators) and preparation • Micropropagation - Culture Initiation - Shoot multiplication - Rooting - Hardening (acclimatization) - Common problems • Somatic Embryogenesis • Organogenesis • Clonal fidelity of tissue cultured plants • Effect of physical environment • Applications of plant tissue culture - 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	16	0	0

	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** • Conventional breeding versus Transgenesis • Introduction to Agrobacterium tumefaciens and A. rhizogene • 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) • Detection, characterization and expression of transformants (Genetic markers, reporter genes, transgene stability and gene silencing)	12	0	0
4	**Transgenic Technology for Crop Improvement** • **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	12	0	0
	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