III Semester

Course 8: Plant Biotechnology

Credits -3

I. Learning Objectives: By the end of this course the learner has:

1. To acquire knowledge of sterilization techniques used in plant tissue culture.
2. To learn about various types of plant tissue culture practices.
3. To know the applications of plant biotechnology in production of novel plants.

II. Learning Outcomes: Students at the successful completion of the course will be able to:

1. Explain the scientific techniques and tools used in plant tissue culture laboratories.
2. Appraise the applications of plant tissue culture in agriculture and horticulture sectors.
3. Acquire skills related to various aspects in plant tissue culture.
4. Evaluate the role of transgenic plants in solving certain plant related beneficiary issues.
5. Justify the role of plant biotechnology in bioenergy and phytoremediation.
6. Judge the biosafety and bioethics related to plant biotechnology.

III. Syllabus of Theory:

UNIT-1: Basic techniques in plant tissue culture 10 Hrs.

1. Plant tissue culture: Definition, scope and significance; infrastructure and equipment required to establish a tissue culture laboratory.
2. Sterilization techniques; formulation of media for plant tissue culture.
3. Concept of totipotency, initiation and maintenance of callus cultures; induction of morphogenesis in vitro.
4. Somatic embryogenesis and organogenesis; factors affecting somatic embryogenesis and organogenesis synthetic seeds and their applications.

UNIT-2: Organ and haploid culture techniques 8 Hrs.

1. Importance and applications of meristem culture, zygotic embryo culture, endosperm culture.
2. Micropropagation and its uses, commercial exploitation of micropropagation.
3. Production of haploids using anther, pollen and unfertilized ovule cultures -

characterization and applications.

UNIT-3: Cell and protoplast cultures 12 Hrs.

1.Cell suspensions – continuous and batch cultures; mass cultivation of plant cells using bioreactors.

2. Production of secondary metabolites from cell cultures, strategies used for enhanced production of secondary metabolites. Biotransformation using plant cell cultures.

3. Isolation, purification and culture of protoplasts; methods used for protoplast fusion.

4. Somatic hybridization/cybridization –selection systems for somatic hybrids/cybrids, their characterization and applications.

UNIT-4: Transgenic plants 8 Hrs.

1. Transgenic plants – definition, biosafety and ethical issues associated with transgenic plants.

2. Herbicide resistance (glyphosphate), insect resistance (alpha amylase inhibitor).

3. Virus resistance (coat protein mediated, nucleocapsid gene), disease resistance (antifungal proteins, PR proteins).

4. Quality improvement (Golden rice), Shelf-life enhancement (Flavr savr tomato).

UNIT-5: Advances in plant biotechnology 7 Hrs.

1. Plant synthetic biology and its applications; plant-based vaccines and therapeutics.

2. Biofortification and genetically modified foods.

3. Biodegradable plastics, polyhydroxybutyrate.

4. Applications of plant biotechnology in bioenergy production and environmental remediation.

IV. Text Books:

1. Ignacimuthu , S., (2003) Plant Biotechnology. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
2. Kalyan Kumar De., (1997) Plant Tissue Culture – New Central Book Agency (P) Ltd., Calcutta.
3. Mascarenhas A.F., (1991) Hand book of Plant Tissue Culture. Indian Council of Agricultural Research. New Delhi.

4. Narayanaswamy, S (1994) Plant Cell and Tissue Culture, Tata –Mc Graw Hill Publishing Co., Ltd., New Delhi.

V. Reference Books:

1. C. Neal Stewart Jr. (2018) Plant Biotechnology and Genetics: Principles, Techniques, and Applications John Wiley & Sons, Inc. in Hoboken, New Jersey, USA.
2. Adrian Slater, Nigel W. Scott, and Mark R. Fowler (2008) Plant Biotechnology: The Genetic Manipulation of Plants Oxford University Press in Oxford, UK.
3. S. Mohan Jain and Pramod K. Gupta (2010) Plant Biotechnology: Methods and Applications CRC Press, Taylor & Francis Group in Boca Raton, Florida, USA.
4. Ram Lakhan Singh (2017) Plant Biotechnology: Recent Advances and Future Prospects Springer International Publishing AG in Cham, Switzerland.
5. Altman and P.M. Hasegawa (2013) Plant Biotechnology and Agriculture: Prospects for the 21st Century Elsevier Inc. in Amsterdam, Netherlands.

VI. Suggested activities and evaluation methods:

Unit-1: Activity: Preparation of media for tissue culture.

Evaluation method: Assessment of skill in preparation of media in an effective manner.

Unit-2: Activity: Group discussion on various tissue culture practices.

Evaluation method: Active participation, critical thinking, content presentaion, collaboration skills etc., based on a rubric.

Unit-3: Activity: Designing a bioreactor system for mass cultivation of plant cells.

Evaluation method: Awarding grade based on **s**kills performed in designing a prototype bioreactor.

Unit-4: Activity: Collection of scientific literature on various transgenic plants developed.

Evaluation method: Assess credibility and relevance of literature collected, analysis and conclusions made.

Unit-5: Activity: Case studies on applications of plant biotechnology.

Assessment method: Based on data and Information collected, analysis and interpretation made, presentation and organization of the report.

III Semester

Course 8: Plant Biotechnology

Credits -1

I. Course Outcomes: On successful completion of this practical course, student shall be able to:

1. Operate all the equipment and instruments in a plant tissue culture laboratory.
2. Establish callus and organ culture.
3. Obtain quality plants using micro-propagation techniques.

II. Laboratory/field exercises:

1. Equipment used in plant tissue culture.
2. Sterilization techniques in plant tissue culture laboratory.
3. Preparation of culture media
4. Callus induction and subculturing.
5. Organogenesis using PGRs'
6. Demonstration of cell and protoplast culture.
7. Demonstration of organ cultures.
8. Demonstration of anther and pollen cultures.