

## IN VITRO TECHNOLOGIES AND INDUSTRIAL APPLICATIONS

Bot.Sp-13

Credit Hours: 3(2+1)

### THEORY:

#### Introduction of the Course:

The course is organized to provide students with an overview of plants tissue culture techniques, their potential in the production of propagative material and interaction with industries. It also introduces students to principles, practices and applications of plant tissue culture and transformation. Further, to give students hand-on experience and training in plant tissue culture and genetic engineering techniques. Additionally, it exposes students to issues and challenges encountered in the area of plant biotechnology.

#### Course Objectives:

The course is designed:

1. To enable the students to understand plant tissue culture and its industrial application.
2. To enable students in understanding the method of plant germplasm conservation, maintenance of cell suspension cultures, secondary metabolite production and utilization and its industrial application.
3. To enable the students how to develop academia industry linkage.

#### Course Contents:

1. Micropropagation (via organogenesis and embryogenesis) of floricultural, agricultural and pharmaceutical crops: Orchids, Chrysanthemum, Gerbera, Carnation, Anthurium, Bamboos, *Spilanthes*, *Stevia*, *Psoralea*, Chickpea and elite tree species of nation importance.
2. Production of virus free plants through meristem culture in orchids and fruit trees.
3. Germplasm conservation under *in vitro* conditions.
4. Variations: Somaclonal and gametoclonal variations, spontaneous, genetic and epigenetic variations.
5. Culture systems: Differentiated, undifferentiated, physiological, biochemical and molecular role of minerals and growth regulators in understanding differentiation of organs under *in vitro* conditions.
6. Problems in Plant Tissue Culture: contamination, phenolics, recalcitrance.
7. Problems in establishment of regenerated plants in nature: hardening, association of mycorrhiza and rhizobia.
8. Factors responsible for *in vitro* and *ex vitro* hardening.
9. Use of bioreactors in secondary metabolite production and scale up automation of plant tissue culture.
10. Recent applications of tissue culture techniques and biotechnology in the introduction of economically important traits in horticultural, agricultural and medicinal plants.
11. Interactions, training and workshops in Biotech industries and placements.

#### Practicals:

1. Development of regeneration protocols employing direct and indirect organogenesis / somatic embryogenesis in economically important horticultural and/or medical plants.
2. Control of phenolics in recalcitrant tissue under culture conditions.
3. Study of various physico-chemical factors (pH, light, hormones, etc.) on *in vitro* growth and development of tissue or organs, rooting of regenerants, *in vitro* and *ex-vitro* hardening, potting and acclimatization in natural conditions.
4. Shoot-tip meristem culture for raising virus-free plants in tomato / tobacco.

5. *Agrobacterium rhizogenes* mediated development of hairy root cultures.
6. Isolation of bioactive compounds from medicinal plants using column chromatography and TLC.
7. Preparation of synthetic seeds for germplasm conservation using somatic embryos or other propagules.

**Teaching-Learning Strategies**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome:**

1. The mentioned course fulfills all demands of plant propagation from basic to advance level.
2. They are expected to use this information for further advancement in Plant Tissue Culture.
3. The course is designed to educate students regarding various techniques of Tissue Culture and its application in various allied fields of sciences.
4. After completion of this course, students will be able to commercialize tissue culture products.
5. They can enhance the yield of several secondary metabolite by using tissue culture techniques.

**Assessment Strategies:**

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Recommended Readings:**

1. George, E.F., Hall, M.A and Geert-Jan De Klerk. (2008). *Plant Propagation by Tissue Culture* (3<sup>rd</sup> Edition), Springer, Netherlands.
2. Herman, E.B. (2008). *Media and Techniques for Growth, Regeneration and Storage 2005-2008*. Agritech Publications, New York, USA.
3. Neumann, K.H., Kumar, A. and Imani, J. (2020). *Plant Cell and Tissue Culture- A Tool in Biotechnology*. Springer Netherlands.
4. Pierik, R.L.M. (1999). *In vitro Culture of Higher Plants*. Kluwer Academic Publishers.
5. Prakash, J. and Pierik, R.L.M. (1991). *Horticulture – New technologies and Applications* (current Plant Science and Biotechnology in Agriculture). Kluwer Academic Publishers.

**Recommended Journals:**

In vitro Cellular and Developmental Biology-Plant, Plant Cell, Tissue and Organ Culture, Plant Growth Regulation, Plant Cell Reports.

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