

HISTORY OF PLANT TISSUE CULTURE

Programme: B.Sc (H) Botany

Course Title: Plant Biotechnology

Course code: BOTY 3014

Prof. Shahana Majumder

Department of Botany

Mahatma Gandhi Central University, Motihari

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- Plant tissue culture is the aseptic culture of cells, tissues, organs and their components under defined physical and chemical conditions in vitro.
- The theoretical basis for plant tissue culture was proposed by **Gottlieb Haberlandt** in his address to the German Academy of Science in 1902 on his experiments on the culture of single cells

- Historically, **Henri-Louis Duhamel du Monceau** (1756) pioneered the experiments on wound healing in plants through spontaneous callus (unorganised mass of cells) formation on decorticated region of elm plants.

Elm tree



- Vochting (1878) suggested the presence of polarity as a key feature that guide the development of plant fragments.
- He observed that the upper portion of a piece of a stem always produced buds and the basal region produced callus or roots.

- In 1902, a German Botanist Gottlieb Haberlandt developed the concept of culture of isolated cells of *Tradescantia* in artificial condition. Though his experiment failed to induce the cells to divide.

Tradescantia sp



- He did not succeed because by that time even auxin was not discovered. But he lent a foundation to plant physiology.
- He described the cultivation of mesophyll cells of *Lamium purpureum* and *Eichhornia crassipes*, epidermal cells of *Ornithogalum* and hair cells of *Pumonaria*

Eichhornia crassipes,



Ornithogalum



- Cell survived for 3-4 weeks. Due to this endeavour, **Haberlandt is regarded as the father of tissue culture.** Most importantly he suggested the concept of **totipotency.**

- From 1902 to 1930 attempts were made for organ culture. Hannig (1904) isolated embryos of some crucifers and successfully grew on mineral salts and sugar solutions.
- Simon (1908) successfully regenerated a bulky callus, buds, roots from a poplar tress on the surface of medium containing IAA which proliferated cell division.

- The two important discoveries made in the mid-1930s which gave a big push to the development of plant tissue culture technique were: (a) identification of **auxin** as a natural growth regulator, and (b) recognition of the importance of **B-vitamins** in plant growth.
- In 1934, Gautheret had cultured cambium cells of some tree species (*Salix capraea*, *Populus nigra*) on Knop's solution containing glucose and cysteine hydrochloride and recorded that they proliferated for a few months.

- The first true plant tissue cultures were obtained by Gautheret from cambial tissue of *Acer pseudoplatanus*.
- He also obtained success with similar explants of *Ulmus campestre*, *Robinia pseudoacacia*, and *Salix capraea* using agar-solidified medium of Knop's solution, glucose and cysteine hydrochloride.

- The first continuously growing tissue cultures from carrot root cambium were established by Gautheret in 1939.
- White (1939a) reported the establishment of similar cultures from tumour tissue of the hybrid *Nicotiana glauca* x *N. langsdorffii*.
- Then the possibility for cultivation of plant tissues for unlimited period was announced simultaneously by P.R. White (1939) and R.J. Gautheret (1939).
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- Gautheret and White during 1930-40 were responsible for establishing the media composition we use today
- Subsequent detailed work by Raghavan and Torrey (1963), Norstog (1965) and others led to the development of **synthetic media** for the culture of younger embryos

- During 1940 to 1970, suitable nutrient media were developed for culture of plant cells, tissue, protoplasts, anthers, roots tips and embryos. I
- *in vitro* morphogenesis (i.e. regeneration of complete plant from cultured tissue) of plants was always successfully done.

- In 1957, Skoog and Miller put forth the concept of hormonal control of organ formation
- **Murashige** was instrumental in giving the techniques of in vitro culture a status of a viable practical approach to propagation of horticultural species. He worked extensively for the popularization of the technique by developing standard methods for in vitro propagation of several species ranging from ferns, to foliage, flower and fruit plants.

- In 1959, discovery of kinetin promoted by F. Skoog along with C.O. Miller and co-workers and demonstration of induction of regeneration of shoots in tobacco callus paved the way for multiplication of plant by tissue culture.
- In 1960s, E. Cocking for the first time developed a method for isolation of protoplasts in large quantities using the fungal enzyme obtained from *Myrothecium* sp.

- In 1960 Jones et al. designed a microculture method for growing single cells in hanging drops in a conditioned medium
- The first plant from a matured plant cell was regenerated by Braun in 1959.

Indian Story

- In India, work on tissue culture was started during mid 1950s at the Department of Botany (University of Delhi) by Panchanan Maheshwari who is regarded as father of embryology in India.

- During 1960s the Botany School at the University of Delhi, led by P. Maheshwari, became actively engaged with in vitro culture of reproductive organs of flowering plants.
- Kanta, 1960 developed the technique 'intra-ovarian pollination' and 'test-tube fertilization'

- Different tissue culture methodologies were involved for morphogenic studies involving ovary, embryo, endosperm, ovules, etc.
- At the University of Delhi, **Sipra Guha Mukherjee and S.C. Maheshwari** (1964-67) for the first time developed the haploid through anther and pollen cultures.

- Haploid plants from pollen grains were first produced by Maheswari and Guha in 1964 by culturing anthers of *Datura*.



Resources

- Free web resources
- Bhojwani, S. S., & Razdan, M. K. (1996). Plant tissue culture, theory and practices. A revised edition. *Studies in plant science*, 5.
- Thorpe, T. A. (2007). History of plant tissue culture. *Molecular biotechnology*, 37(2), 169-180.

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