

UNIT - III

PLANT TISSUE CULTURE :-

Historical development of plant Tissue culture :-

A German botanist, Gottlieb Haberlandt, cultured fully differentiated plant cells isolated from different plants in the year 1902.

* This was the very first step or concept for the beginning of plant cell & tissue culture.

* Cell doctrine further admitted that a cell is capable of showing totipotency.

* Totipotency is the regeneration capacity of the parenchyma cells.

* Thereafter scientist Hanning cultured embryos from several cruciferous species in 1904.

* Scientist Kotte & Robbins cultured root & stem tips respectively in 1922. Scientist Went discovered first plant hormone Indole Acetic Acid (IAA) in 1926.

* In 1932, Prof. White developed plant tissue culture medium for in-vitro culture of meristematic cells of Tomato. The composition of medium was Salt, yeast extract, sucrose & three vitamins namely ascorbic acid, thiamine and nicotinic acid.

thereafter prof. white introduced vitamin B₁₂ as growth supplement in tissue culture media for tissue culture of tomato root tip in 1934.

* The first true plant tissue cultures were obtained by Gautheret from cambial tissue of *Acer pseudo-platanus*, which the identification of a variety of plant growth regulators such as cytokinin, auxin, other hormones, vitamins etc. & their role in affecting cell division & differentiation.

* Embryo culture also had its beginning early in the first decade of the last century with barley embryos. Scientist Ball discovered whole plant from shoot tip & organ regenerated on callus in 1950.

Terms Used In Tissue Culture :-

* Explant :- An excised piece of differentiated tissue or organ is regarded as an explant. The explant may be taken from any part of the plant body eg:- leaf, stem, root.

* Callus :- The unorganized, autonomous, uncontrolled and undifferentiated mass of plant cell is known as callus. Generally, when plant cells are cultured in a suitable medium they divide to form callus i.e. a mass of parenchymatous cells.

* **Differentiation** :- It is the process by which meristematic cells are converted into two or more types of cells or tissues that are diff from each other.

* **Dedifferentiation** :- The phenomenon of mature cells reverting to meristematic state to produce callus, means the process of formation of unorganized tissues from the highly organized tissues. dedifferentiation is possible since the non-dividing quiescent cells of the explant, when grown in a suitable culture medium revert to meristematic state.

* **Re-differentiation** :- The ability of the callus cells to differentiate into a plant organ or a whole plant is regarded as re-differentiation. that means the dedifferentiated cells lose the capacity of division, becomes mature to form specific functions.

* **Totipotency** :- The ability of an individual cell to develop into a whole plant is referred to as cellular totipotency. The inherent characteristic features of plant cells namely dedifferentiation & re-differentiation is responsible for the phenomenon of totipotency.

* **plasticity** :- It is the condition of the adaptability of a plant species to change in its environment or differences b/w its various habitats.

* Organogenesis :- The development of adventitious organs or primordia from undifferentiated cell mass in tissue culture by process of differentiation.

* Synthetic Seed :- It is the condition where artificial encapsulation of somatic embryos shoot bud or aggregates of cell of any tissues done by a hypodermis which have the ability to form a plant in in-vitro or ex-vivo condition.

* Somaclonal variation :- The genetic variations found in the in-vitro cultured cells are known as somaclonal variations. It occurs due to change in chromosome number & / or structure in plant tissue cultures.

* Micropropagation :- The production of a large number of individual plants from a small piece of plant tissue cultured without formation of callus in an aseptic nutrient medium.

TYPES OF CULTURES

The plant growth and development occur in two different ways namely determinate growth where plant growth occurs with certain shape & size like leaves, fruits, flowers etc. & indeterminate growth where plant growth occurs in the roots & stem part which is proliferate continuously. Types of cultures depends on the type of explant used.

Hence plant tissue culture broadly classified in to eight types viz.

1. Seed culture.
2. Embryo culture.
3. meristem culture.
4. Bud culture.
5. callus culture.
6. cell suspension culture.
7. Anther culture.
8. protoplast culture.
9. Hairy root culture.
10. Immobilized cell culture.

1. Seed culture :-

Seeds are cultured in-vitro to generate seedlings or plants in aseptic condition for raising the sterile seedling. The seed culture is done to get the different kinds of explants from aseptically grown plants that help in better maintenance of aseptic tissue.

Importance.

- * Increasing efficiency of germination of seeds.
- * It is possible to independent on asymbiotic germination.
- * It is important in production of orchids.

2. Embryo culture :-

Embryo culture is the sterile isolation & growth of an immature or mature embryo in-vitro for procurement of a viable plant. Embryo developed (initially white in colour) from wide hybridization

blw two diff species may not mature fully due to embryo endosperm incompatibility. The whole process is known as Embryogenesis.

Importance :-

- * It is useful in production of haploids.
- * It helps in prevention of seed dormancy.
- * It helps in shortening of breeding cycle.
- * It helps in prevention of embryo abortion with early ripening stone fruits.

3. Meristem Culture :-

It is the culture technique by which the apical meristem of shoots of angiosperms and gymnosperms are cultured to get the disease free plants. Generally meristem-tips blw 0.2 - 0.5 mm, most frequently produce virus-free plants & this method is referred to as meristem-tip culture. These explants are cultured on a medium containing cytokinin (plant hormone).

Importance :-

- * It helps in production of virus free plants.
- * It helps in Germplasm conservation.
- * It helps in production of transgenic plants.
- * It helps in rapid clonal multiplication.
- * The method is successful in case of herbaceous plants than woody plants.
- * It helps in culture of potato, banana, cardamom

► Bud culture :-
Buds contain active meristems in the leaf axils, which are capable of growing into a shoot. Each node of the stem is cut & allowed to grow on a nutrient media to develop the shoot tip from the axil which ultimately develops into new plantlet. In axillary bud method where the axillary buds are isolated from the leaf axils & develop into shoot tip under little high cytokinin concentration.

Importance :-

- * Easy step for micropropagation.
- * Easy method for production of disease free plants.
- * Isolation of phytoconstituents is easy.

► Callus culture :-

It is culture of undifferentiated mass of parenchyma cell produced from an explant of a seedling or other plant part in agar medium under aseptic condition is known as "callus homogeneous parenchymatous mass".

Importance :-

- * It is the source of tissue for plant regeneration. The whole plant can be regenerated in large number from callus tissue through manipulation of the nutrient & plant hormones in the culture medium. This phenomenon is known as plant regeneration or organogenesis or morphogenesis.

- * Chromosomal variation occurs genetically or epigenetically in the cells of callus tissue.
- * Increased amount of secondary metabolites are obtained by extraction of the particular callus tissue.
- * This method is the source of Tissue for cell suspension culture.
- * Several biochemical assays are performed from callus culture.