PLANT TISSUE CULTURE

TO,
FIFTH SEMESTER STUDENTS

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- Plant tissue culture is a collection of techniques used to maintain or grow plant cells, tissues or organs under sterile conditions on a nutrient culture medium of known composition. Plant tissue culture is widely used to produce clones of a plant in a method known as **micropropagation** .

Tissue culture is **in vitro cultivation** of plant cell or tissue under aseptic and controlled environmental conditions, **in liquid** or on **semisolid** well defined nutrient medium for the production of primary and secondary metabolites or to regenerate plant.

HISTORY

Haberlandt

early 1900’S

- proposed concept of totipotency
- cells cultured under right conditions
- Callus cultured from tree cambium

HISTORY

1902	The idea of the totipotency of plant cell was given by Haberlandt
1937	White first time established successful root culture of tomato
1941	Vanoverbeek used coconut milk for growth and development of young Datura embryos
1957	Skoog and Miller demonstrated the role of auxin and cytokinin on root and shoot formation in tobacco – tissue
1962	Murashige and Skoog introduced the medium for tobacco culture
1987	Isolation of Bt. gene form bacterium *Bacillus thuringiensis*

❖ EXPLANT PREPARATION

EXPLANT : It is defined as a portion of plant body, which has been taken from the plant to establish a culture

•Explant may be taken from any part of the plant like root,stem,leaf,or meristematic tissue like cambium, floral parts like anthers, stamens etc..

•Age of the explant.

• Homozygous plants are preferred.

Basic aspects of tissue culture

- **Plasticity**
- **Totipotency**

Plasticity and Totipotency

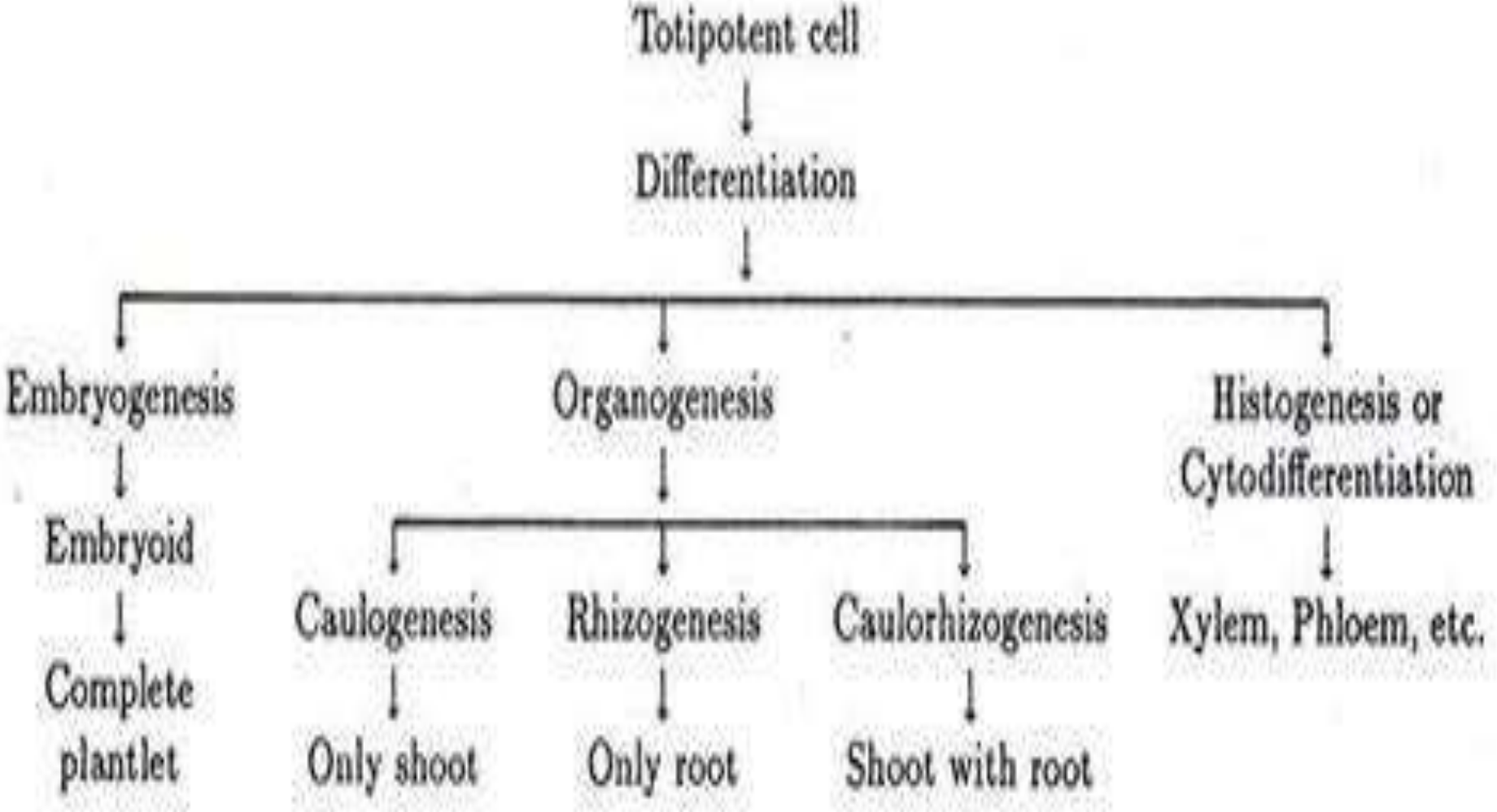
- Plasticity: ability of plants to survive varying conditions by altering their metabolism, growth and development
  - Ability to regenerate lost parts
  - Ability to begin cell division from tissue of the plant
  - Ability to generate any tissue or organ from any other type of cell
- Totipotency: maintenance of genetic potential of all cells (any cell can be stimulated to become any other type of cell)

Totipotency

- Ability of an isolated, fully differentiated and mature plant cell to revert or dedifferentiate to a meristematic state and then to divide, re-differentiate and develop to a whole plant.
- Totipotency is manifested through **dedifferentiation** and **re-differentiation.**

Cellular totipotency

- **Cytodifferentiation**
  - **Cell differentiation, mainly emphasis on vascular differentiation, tracheary element differentiation, etc.**
- **Dedifferentiation**
  - The phenomenon of mature cells reverting to a meristematic state and forming undifferentiated **callus** tissue.
- **Redifferentiation**
  - The ability of the component cells of the callus to differentiate into a whole plant or organ.


Totipotent cell
Differentiation
Embryogenesis
Embryoid
Complete plantlet
Organogenesis
Caulogenesis
Only shoot
Rhizogenesis
Only root
Caulorhizogenesis
Shoot with root
Histogenesis or Cytodifferentiation
Xylem, Phloem, etc.

- Every differentiated mature plant cell **contains the full complement of genes.**
- The entire characteristics of all the different cell types of an adult plant remain **crystallized within a mature cell.**
- A cell contain all the **genetic information** needed for their growth and development to an entire plant.
- **This inherent potentiality of a plant cell is called Totipotency.**
- Not all cells of plants are totipotent, because some cells, such as **tracheids, fibres, sclereids, vessel elements** etc lack cytoplasm and nucleus hence not totipotent.

- Under appropriate culture conditions, most plant tissues can be made to dedifferentiate and produce a mass of undifferentiated cells, called callus.
- Callus can regenerate entire plants by 2 routes,

  Somatic embryogenesis

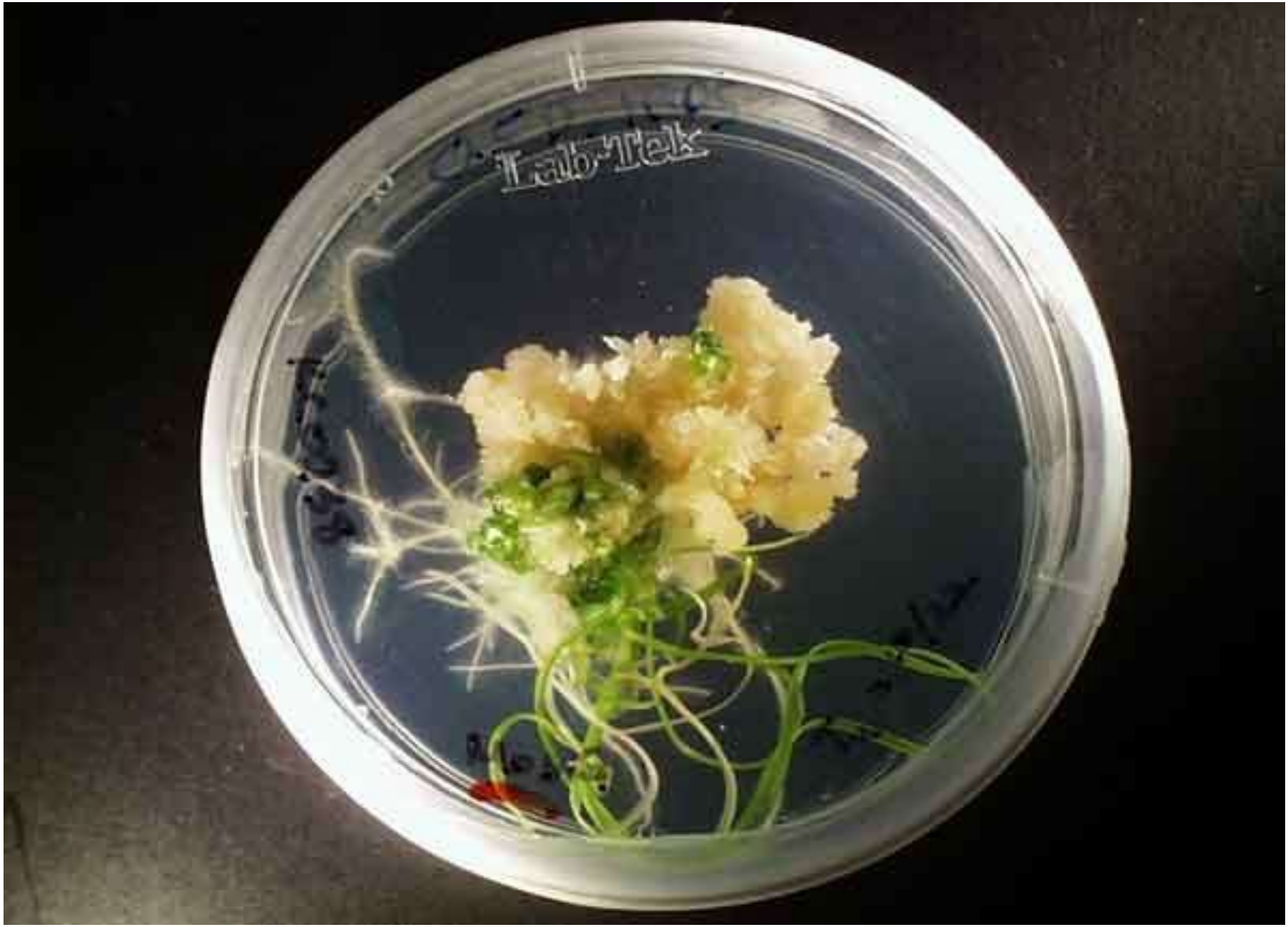
  Organogenesis

- **Organogenesis** is the direct development of shoots and roots.
- **Somatic embryogenesis** is the development of vegetative tissues to embryo.
- Hormones play a major role

- **Auxin , cytokinin, kinetin** involved in cellular differentiation.
- High kinetin to auxin ratio promotes shoot development also called **caulogenesis**.
- A low kinetin to auxin ratio promotes only root development also called **rhizogenesis**.

Significance of Totipotency

- Vegetative propagation
- Genetic modification of plants.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