

Plant Tissue Culture

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What is Plant Tissue Culture?

- Plant Tissue Culture (PTC) is the technique of growing plant cells, tissues, or organs in a sterile, nutrient-rich medium under controlled conditions.
- It is used for micropropagation, genetic modification, conservation, and medicinal compound production.



General Procedure of Plant Tissue Culture

1. Selection of Explant

- A small plant part (leaf, stem, root, meristem, embryo) is chosen for culture.

2. Sterilization (Aseptic Conditions)

- Explants are cleaned and sterilized using ethanol, mercuric chloride (HgCl_2), or sodium hypochlorite (NaOCl) to remove microbes.
- This process is performed in a laminar airflow chamber to prevent contamination.

3. Preparation of Culture Media

- Murashige and Skoog (MS) medium is commonly used, containing macronutrients, micronutrients, vitamins, sucrose, and agar.
- **Growth hormones:**
 - **Auxins** (IAA, NAA, 2,4-D) → Root and callus formation.
 - **Cytokinins** (BAP, Kinetin) → Shoot formation.

4. Inoculation

- Explants are placed onto the sterile medium in Petri dishes or test tubes.

5. Incubation

- Cultures are maintained at:
 - **Temperature:** 22-27°C
 - **Light cycle:** 16-hour light/8-hour dark
 - **Humidity:** 50-60%
- Cells grow into callus, shoots, or roots.

6. Subculturing

- Tissues are transferred to fresh media every 2-4 weeks to maintain growth.

7. Regeneration and Rooting

- Shoots and roots develop using **cytokinins** (for shoot formation) and **auxins** (for root formation).

8. Acclimatization (Hardening)

- Plantlets are moved to a greenhouse or soil for adaptation to external conditions.

9. Transfer to Field

- Fully grown plants are transplanted into the natural environment.

Historical Development of Plant Tissue Culture

- Plant tissue culture has evolved over more than a century, with key contributions from various scientists. Here's a concise historical timeline:

Period	Key Developments	Scientists Involved
19th Century	Cell Theory – Cells are the basic units of life.	Schleiden & Schwann (1838-1839)
	Totipotency Concept – Plant cells can regenerate into whole plants.	Gottlieb Haberlandt (1885)
Early 20th Century	First Tissue Culture Attempts – Unsuccessful due to lack of growth regulators.	Haberlandt (1902)
	Root Culture – Root tips successfully grown in sterile conditions.	Kotte & Robbins (1922)
	Tomato Root Culture – Proved indefinite tissue growth under controlled conditions.	Philip White (1934)
1930s-1940s	Discovery of Auxin (IAA) – Regulates cell elongation and differentiation.	F.W. Went (1937)
	Callus Culture – Established using auxins.	White & Nobécourt (1941)

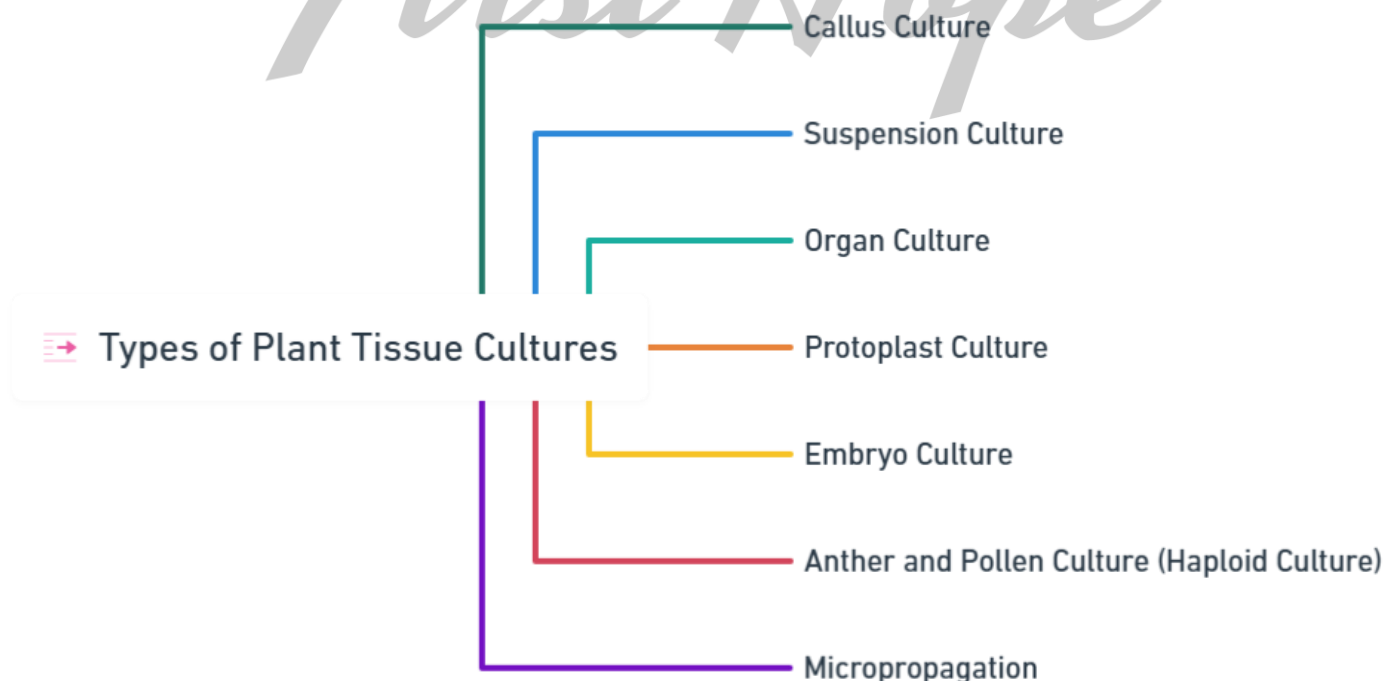
	Coconut Milk in Tissue Culture – Found to enhance cell division and shoot regeneration.	Overbeek (1947)
1950s-1980s	MS Medium – A widely used culture medium.	Murashige & Skoog (1954)
	Role of Cytokinins – Essential for shoot regeneration.	Skoog & Miller (1962)
	Somatic Hybridization – Protoplast fusion techniques for genetic modification.	Various scientists (1970s)
	Commercial Applications – Used in agriculture, horticulture, forestry, and pharmaceuticals.	1980s-Present

- This table provides a concise summary of the major milestones in plant tissue culture development.

Types of Plant Tissue Cultures

- Plant tissue culture techniques vary depending on the part of the plant being cultured and the objective of the study.

Below are the major types of plant tissue cultures, each with its unique methodology and applications.



1. Callus Culture

Definition:

- Callus culture involves the growth of an unorganized mass of plant cells (callus) derived from explants (leaf, stem, root, or other plant parts) under sterile conditions on a nutrient-rich medium containing plant growth regulators.



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