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FACULTY OF ENGINEERING &
TECHNOLOGY

Course: B. Tech Biotechnology
Sub Code: BBT-515

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Sub Name: Plant Biotechnology

LECTURE 3

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STEPS OF PLANT TISSUE CULTURE PROCESS

There are three main steps to the tissue culture process:

STAGE I: initiation phase.

A piece of plant tissue is cut from the plant, disinfested, and placed on a medium. A medium typically contains mineral salts, sucrose, and a solidifying agent such as agar. The objective is to achieve an aseptic culture (one without contaminating bacteria or fungi).

STAGE II: multiplication phase.

The plant material is re-divided and placed in a medium with plant growth regulators that induce the growth of multiple shoots. This process is repeated many times until the number of plants desired is reached.

STAGE III is: root formation phase.

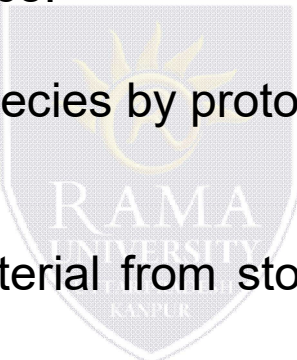
Hormones are used to induce rooting and the formation of complete plantlets.



Importance of Plant Tissue Culture

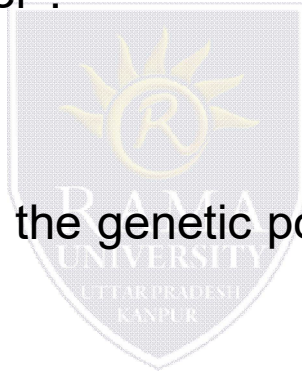
- ✓ The production of clones of plants that produce particularly good flowers, fruits, or have other desirable traits.
 - ✓ To quickly produce mature plants.
 - ✓ The production of multiples of plants in the absence of seeds or necessary pollinators to produce seeds.
 - ✓ The regeneration of whole plants from plant cells that have been genetically modified.
 - ✓ The production of plants in sterile containers reduces disease transmission.
 - ✓ Allows production of plants from seeds that otherwise have very low chances of germinating and growing, i.e.: orchids and Nepenthes.
 - ✓ To clean particular plants of viral and other infections and to quickly multiply these plants as 'cleaned stock' for horticulture and agriculture.
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APPLICATIONS

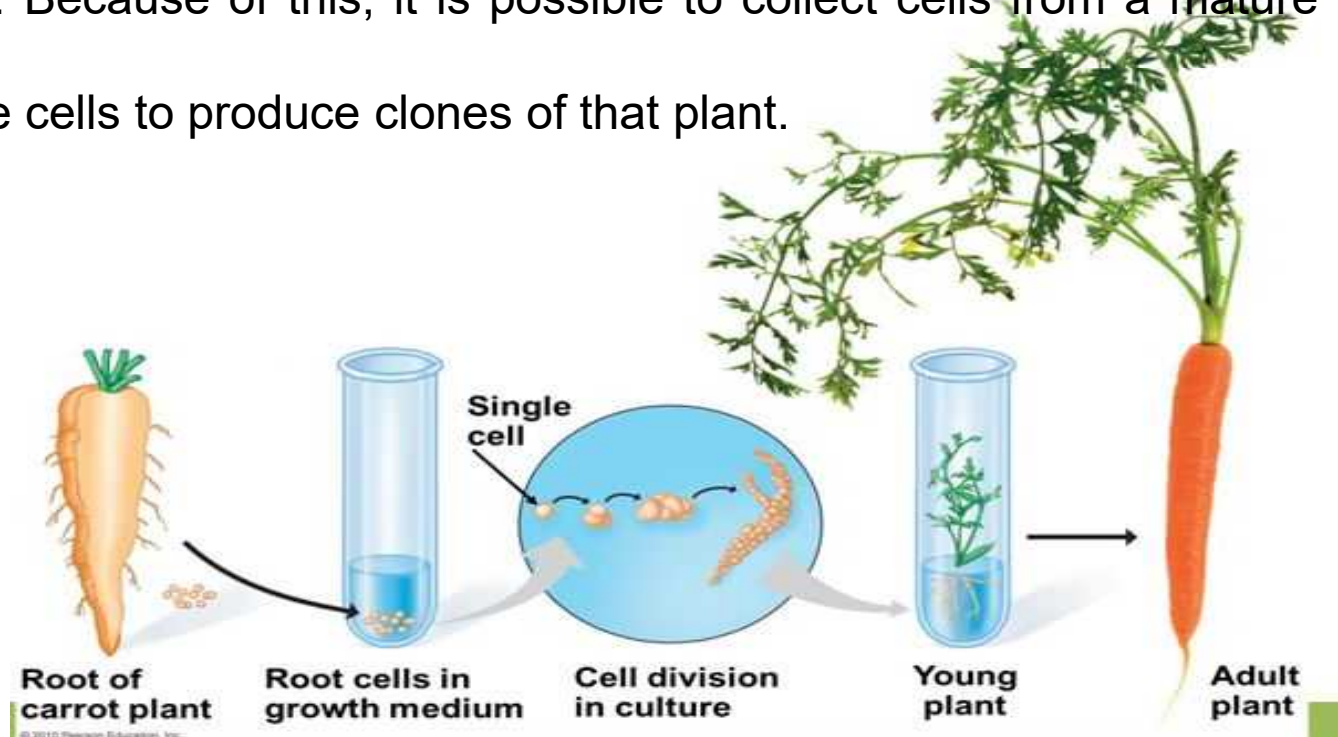
- ✓ To conserve rare or endangered plant species.
 - ✓ To screen cells rather than plants for advantageous characters, e.g. herbicide resistance/tolerance.
 - ✓ To cross distantly related species by protoplast fusion and regeneration of the novel hybrid.
 - ✓ To produce clean plant material from stock infected by viruses or other pathogens.
 - ✓ Production of identical sterile hybrid species can be obtained.
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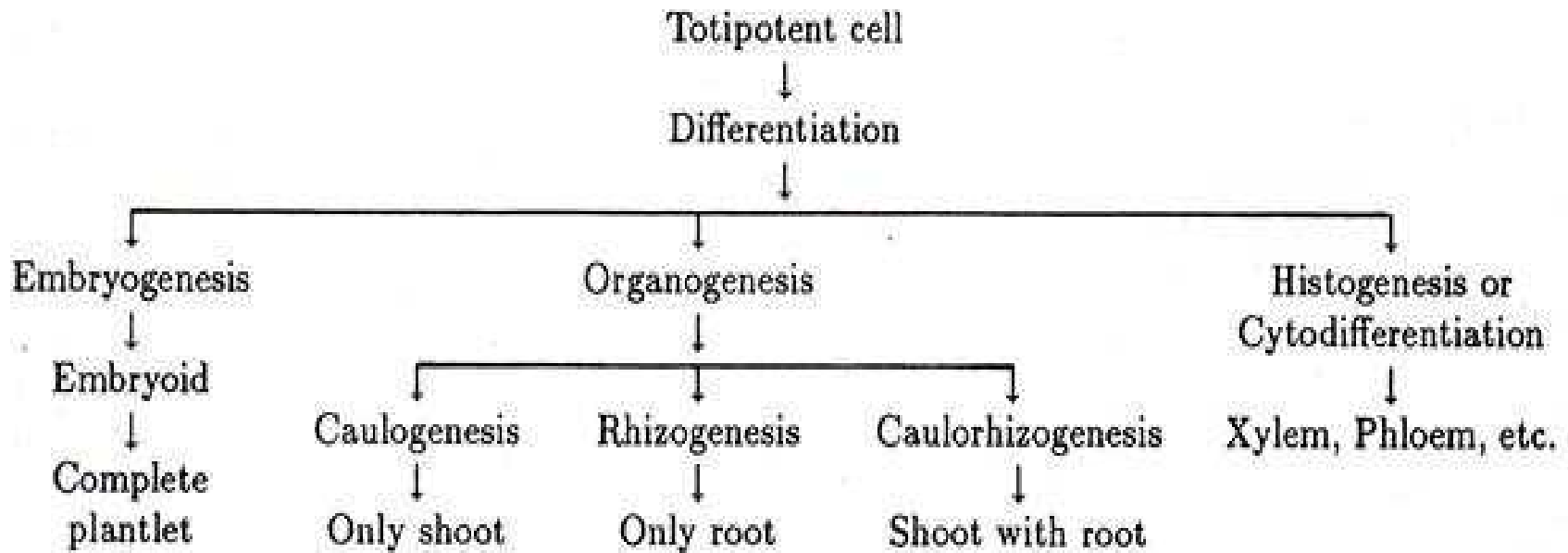
CONCEPT OF TOTIPOTENCY

- Totipotency is the ability of a single cell to divide and produce all of the differentiated cells in an organism. In Latin, totus means "entirely" and "potens" means "having power".
- In other words, totipotency is the genetic potential of a plant cell to produce the entire plant.
- Isolated cells from differentiated tissue are generally non dividing and quiescent; to express totipotency they undergo dedifferentiation and then redifferentiation.



- In 1950s, Steward and his co-workers succeeded in growing carrot plants from isolated phloem cells.
- Adult plant cells are totipotent, meaning they have the ability to give rise to a fully differentiated plant. Because of this, it is possible to collect cells from a mature plant and use those cells to produce clones of that plant.





Differentiation of totipotent cells

- In plant tissue culture, more often an explant (an excised piece of differentiated tissue or organ) is used to initiate their growth in culture. The non-dividing differentiated quiescent cells of the explant, when grown on a medium, first undergo changes to achieve the meristematic state.
- The phenomenon of mature cells reverting to a meristematic state and forming undifferentiated callus tissue is termed as dedifferentiation. The ability of the component cells of the callus to differentiate into a whole plant or a plant organ is termed as re-differentiation.
- These two phenomena of dedifferentiation and re-differentiation are the inherent property of plant cell i.e., the potential lies within the genes which remain inactive in differentiated tissues or organs and are able to express only under adequate cultural conditions

Importance of Totipotency



QUIZ

