Biotechnology In Uganda:

Plant Tissue Culture Development and Applications

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What is Biotechnology?

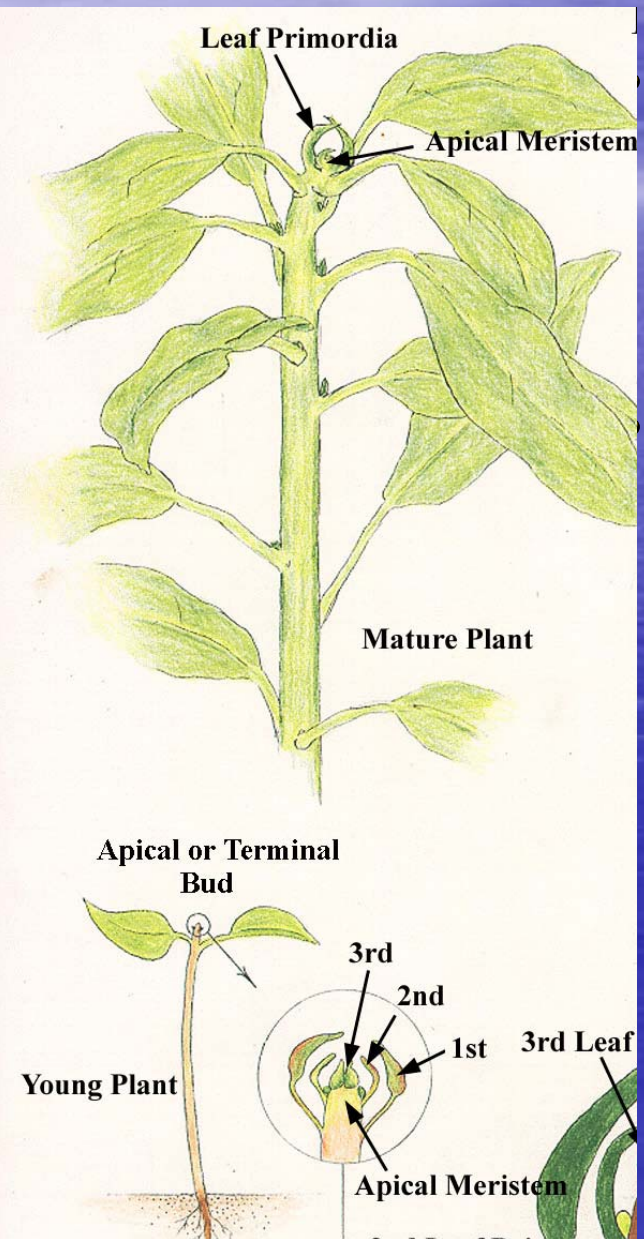
Biotechnology is technology based on biology, especially when used in agriculture, food science, and medicine.

Biotechnology studies and applications of biological techniques for the betterment of human life.

Branches of Biotechnology:

- Environmental Biotechnology
- Medical Biotechnology
- Industrial Biotechnology
- Agricultural Biotechnology
  - Plant Breeding
  - Biological Nitrogen Fixation
  - Protein Technologies (Vaccines, Enzyme linked assays)
  - Molecular Diagnostics (PCR, Microarrays)
  - Plant cell and tissue culture

Plant Tissue Culture

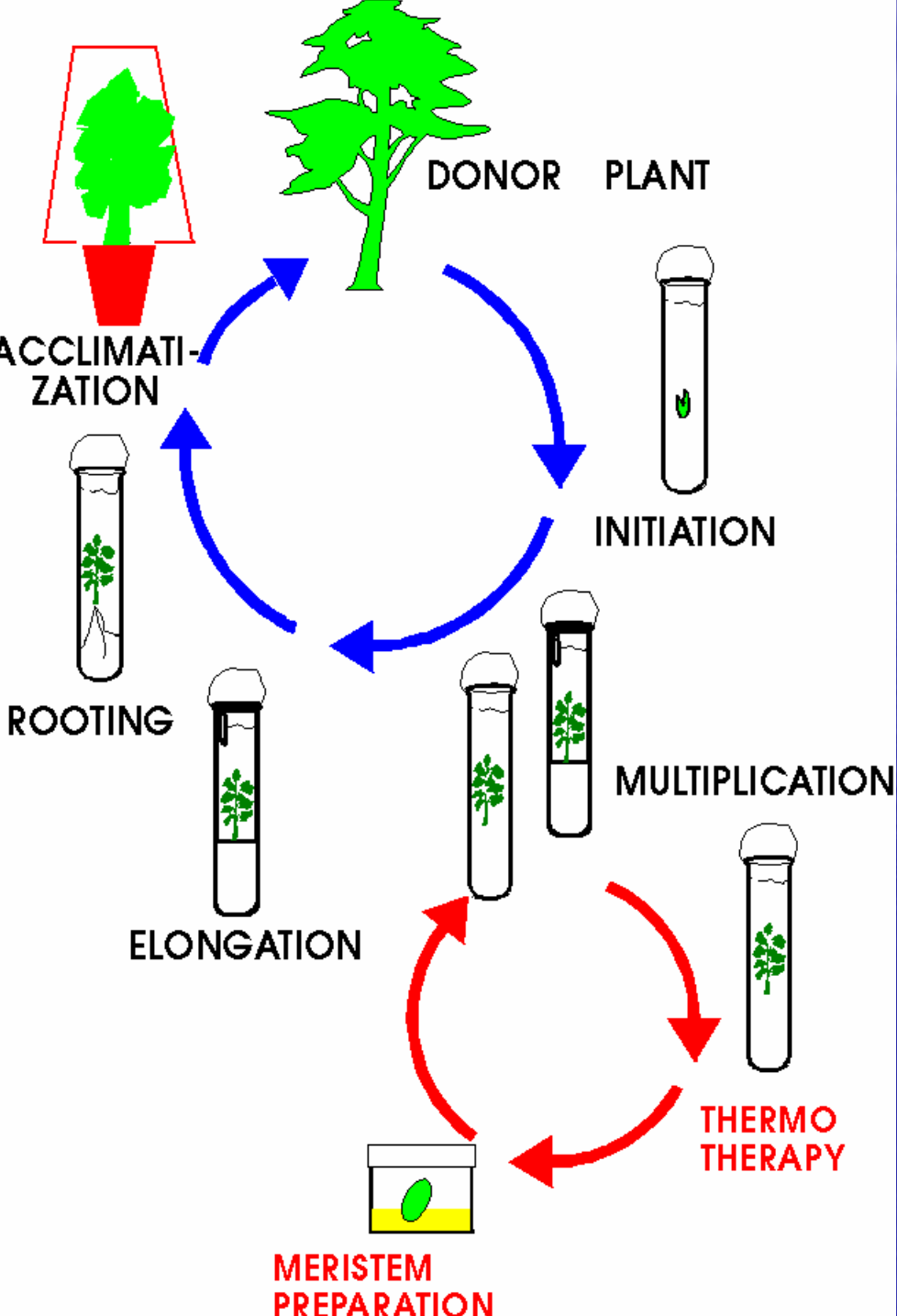


Tissue culture is the technique through which any plant part (other than storage organs) is cultured under a conducive sterile environment with the purpose of obtaining growth.

This idea originated from the cell theory, a phenomenon referred to as totipotency, which suggests that each plant cell is an independent unit, capable of forming a complete organism. Any plant part e.g. a leaf tissue, nodal section, root-tip, floral parts or pollen grains can be utilized to regenerate new plants.

TC Applications

- Plant Breeding
- Industrial (Secondary Metabolites)
- Germplasm Conservation
- Horticulture and Forestry
  - Production of disease free plants
  - Rapid clonal propagation



Production of Disease free TC Plants

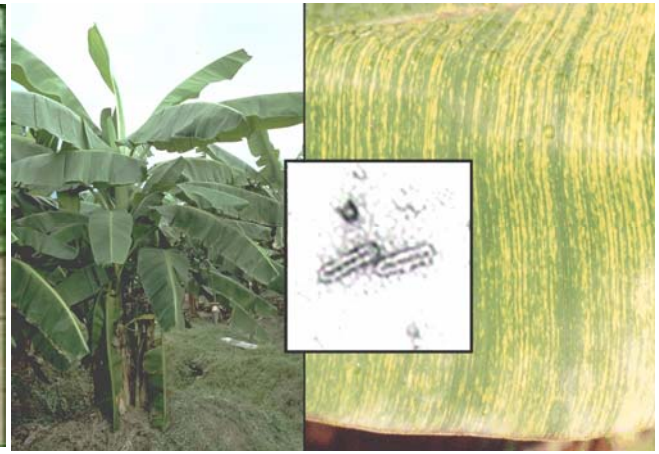
- Tissue culture laboratory
- Seed certification facilities and system
- Trained personale
- Available virus elimination techniques
  - Meristem culture
  - Thermotherapy
  - Cryotherapy

The Need for Disease-Free Planting Material: A case for Bananas

- There is declining banana production and increasing demand for good quality and healthy planting material in Uganda.
- The decline is associated with the prevalent banana weevil and nematode pests, and diseases including Fusarium wilt, Black sigatoka, *Banana streak virus* and Banana bacterial wilt.
- The common farmer practice of using suckers from gardens infected with the various pests and diseases has also played a big role in their spread from one plantation to another and from one crop to the next.
- The situation threatens food security, employment and income in the banana producing areas.

Banana nematodes: Paring a sucker

Hot water treatment of pared suckers to remove nematodes



Banana Streak Virus (BSV)

The devastating BBW

Drying and withering of infected male bud

yellowing of leaves caused by Xcm

Bacterial ooze from pseudostem

Symptom of infected banana finger

Justification For Investment in TC: Private laboratories and Nurseries

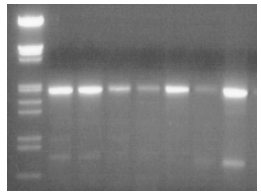
- The application of tissue culture (TC) technology offers the possibility of rapidly multiplying selected banana clones and in combination with molecular disease diagnostics, it is possible to produce pathogen free banana plantlets.
- This can halt the further spread of banana pests and diseases, and with other agronomic interventions lead to enhanced banana production through ensuring ready availability of clean planting material.
- The TC has no parallel in any traditional propagation methods regarding the rate of multiplication: Millions of quality plants can be produced at any given time.
- TC technology is very appropriate to other vegetatively propagated crops e.g. sugarcane, flowers, and coffee.

Rapid clonal propagation

- Probably the most important and application of TC technology

- Plant Tissue Culture =? In vitro/ mass/ rapid/ micropropagation/ multiplication

Molecular (PCR) indexing for viruses,
and Quality control



1 sucker

The Plant Tissue Culture Process

400,000 plantlets after 1 year


FHIA-25
FHIA-17
9/9/05
FHIA-25
26/8/05
FHIA-17
9/9/05

TC bananas with the farmers

What to we need for TC development?

i) To optimize protocols for rapid *in vitro* multiplication of farmers' preferred cultivars,

ii) To optimize molecular techniques for indexing plants for viruses,

iii) Good policies that allow and support investment in biotechnology

iv) To scale up the sustainable production and distribution system of clean tissue culture plantlets through public-private partnerships.

Research Hypotheses

This project is based on the hypotheses that:

- Optimized *in vitro* micropropagation protocols for various banana cultivars and the ability to index banana plants for pathogens can help unlock their yield potential

- Somaclonal variants raise possibilities of selecting clones with good food quality and agronomic attributes including resistance to diseases.

- Given a capacity for large scale prodn. of pathogen free TC banana plantlets and a sustainable distribution system, it is possible to boost banana prodn. in Uganda.

TC Research, Development & Applications:
Who are the players in Uganda?




MAK PLANT TISSUE CULTURE LABORATORY
Quality banana plantlets that can cause a change



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