

What is Biotechnology and the Development Pathway to GM Crops

Yona Baguma

**National Crop Resources Research Institute
P. O. Box 7084, Kampala, Uganda**

Outline

- ✓ **Plant domestication and breeding**
- ✓ **Genesis of genetics**
- ✓ **Introduction to biotechnology**
- ✓ **Overview of agricultural biotechnology**
 - traditional agricultural biotechnology
 - modern agricultural biotechnology
- ✓ **The development pathway of GM crops**

Plant domestication and breeding



**Cassava
originated in
Latin America
and has been
grown by the
native Indian
population for
at least 4000
years**

Inter-specific breeding programme in cassava

Manihot species

M. tristis

M. peruviana .

M. flabellifolia .

M. pseudoglaziovii

M. epruinosa

M. dichotoma

Objectives

- CMD resistance
- Tuber quality
- CBSD resistance

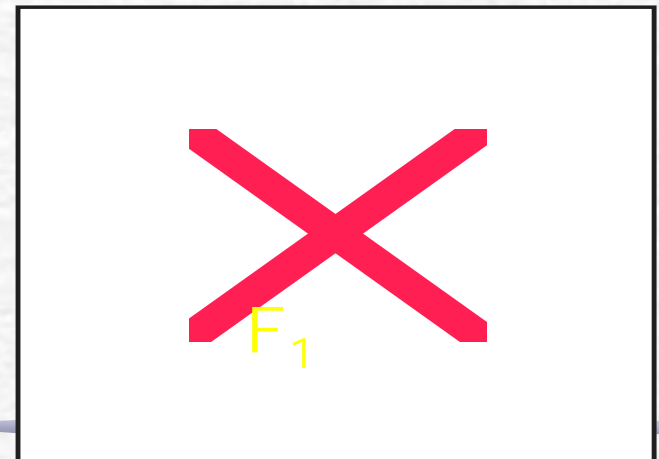
Wild *Manihot* Species with the Waxy Phenotype



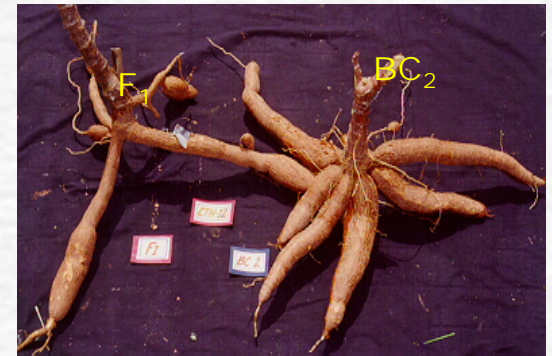
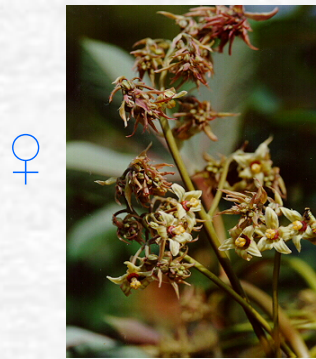
M. chlorosticta CW14-11
4% Amylose



M. crassisejala CRA13
3% Amylose



Breeding for disease resistance or enhanced tuber quality through interspecific breeding programme



Wedge grafting

Control

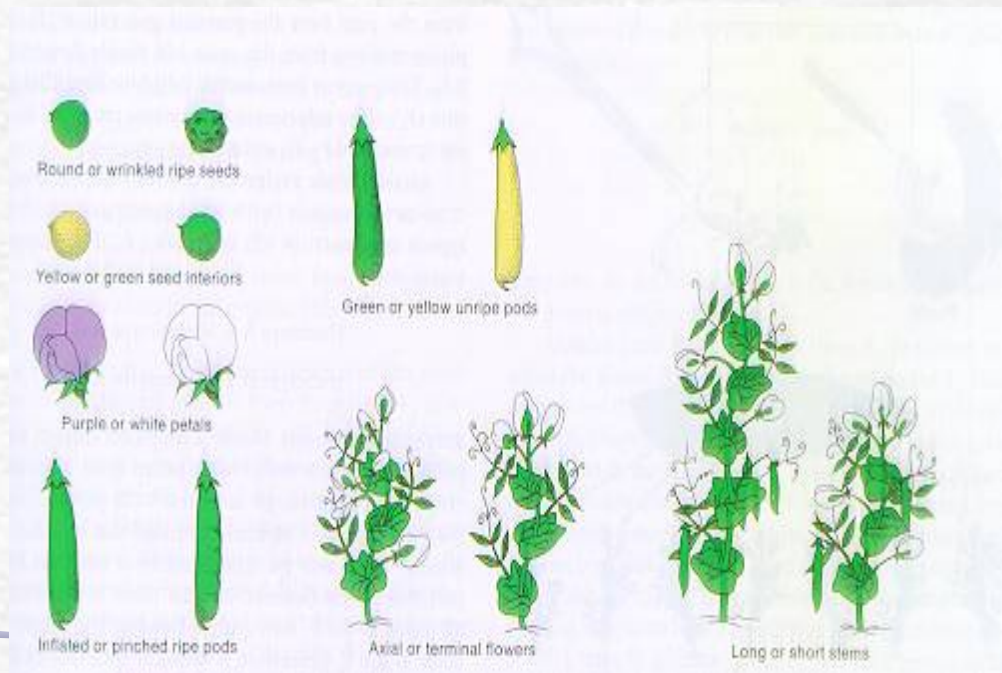


Genesis of genetics



Gregor Mendel

In >30,000 crosses, Mendel studied the inheritance of 7 traits in peas (*Pisum sativum*). Conclude that some **FACTORS** were responsible?



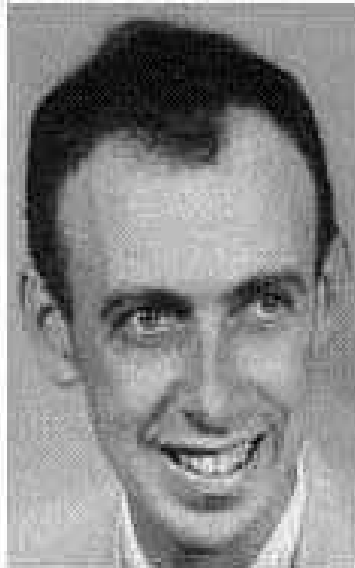
A decorative horizontal band at the top of the slide, featuring a light purple background with several overlapping, wavy, darker purple lines that create a sense of movement or liquid flow.

Introduction to biotechnology

A single, thin, wavy purple line that spans the width of the slide, mirroring the style of the top decorative band.



Francis Crick



James Watson



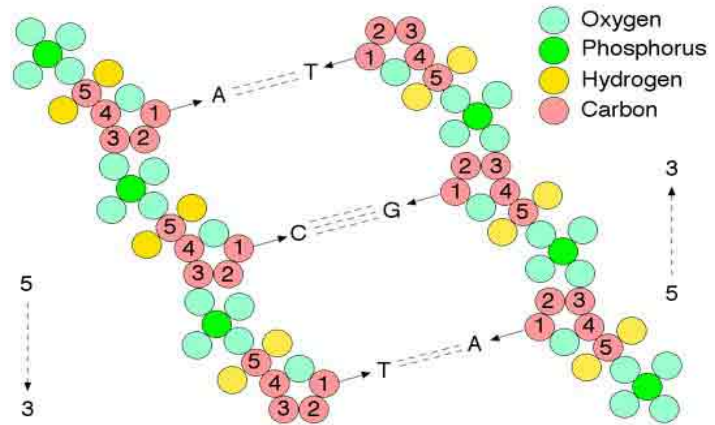
Maurice Wilkins



Rosalind Franklin



Francis Crick shows James Watson the model of DNA

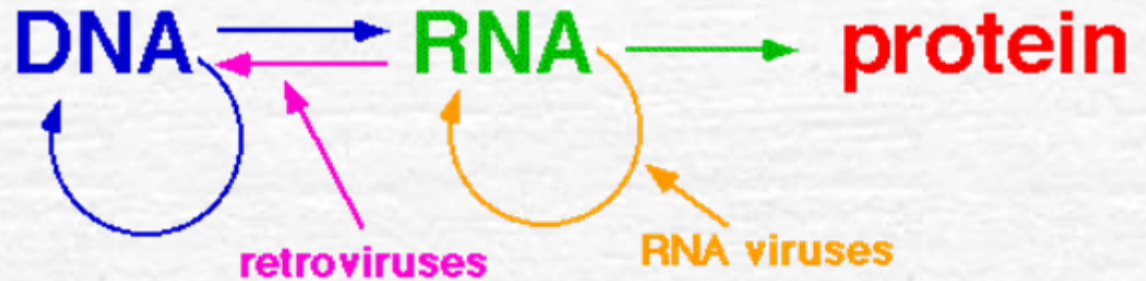
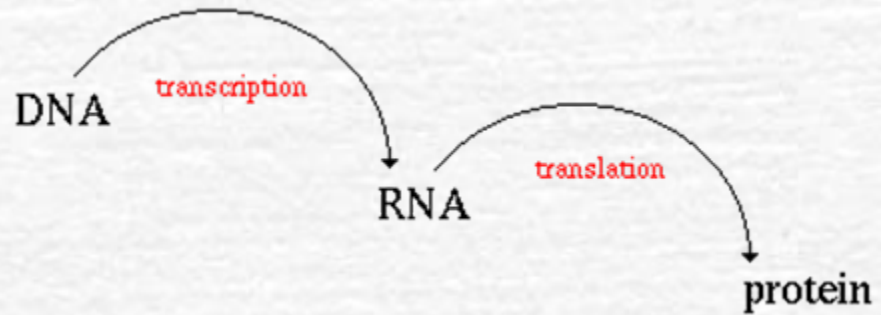
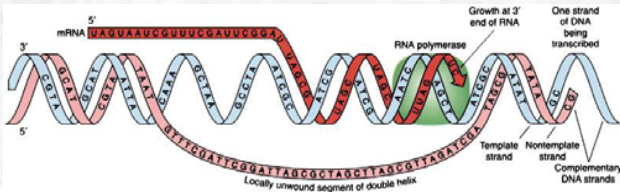


1951 - 17th of March, 1953

Some definitions

- Biotechnology “the integration of natural sciences and engineering in order to achieve the application of organisms, cells, parts of thereof and molecular analogues for products and services” (European Federation of Biotechnology General Assembly, 1989).
- Gene “the functional unity of heredity”
- Genetically engineered “a cell, strain, or organism whose phenotype has been altered by manipulation of its genetic material.
- Choice biotechnologies - agricultural biotechnology, medical biotechnology, environmental biotechnology, industrial biotechnology, biosafety and biopolicy

The Central Dogma of Molecular Biology

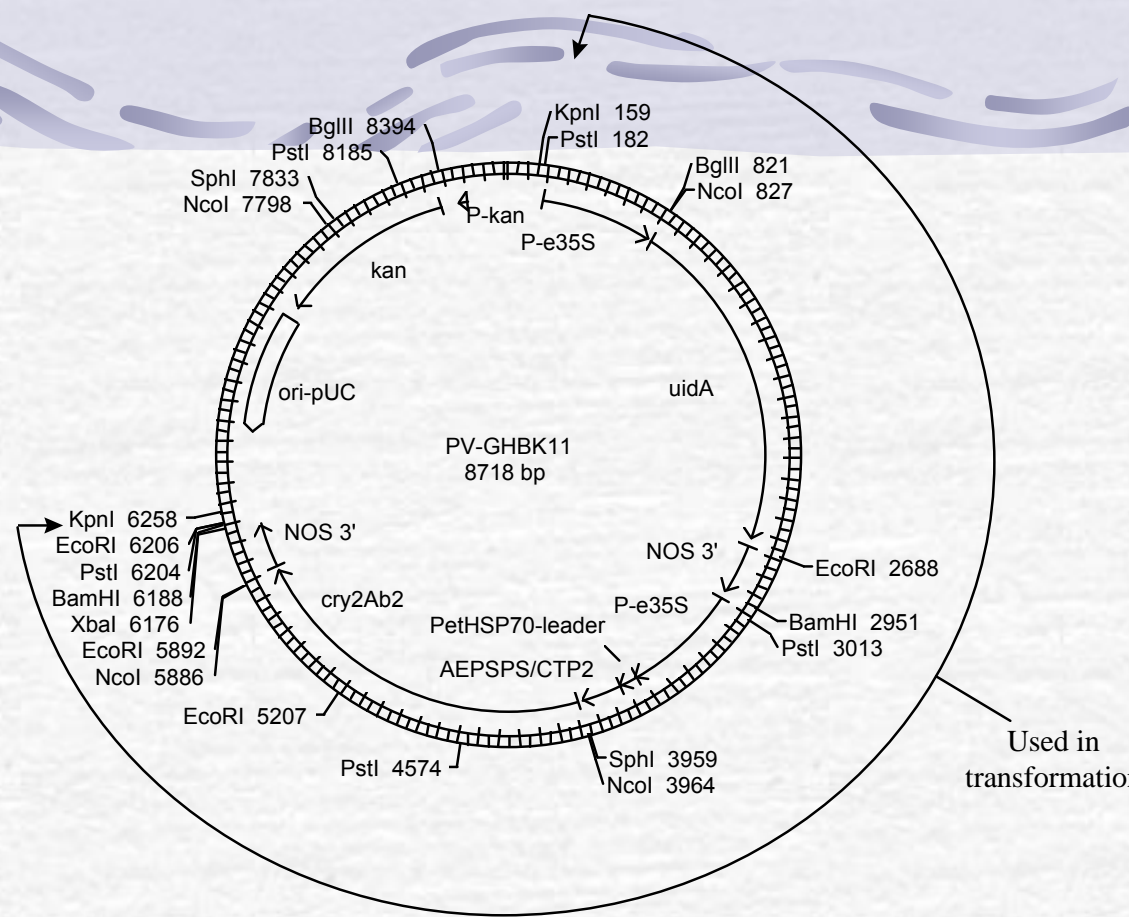


Genetic manipulation

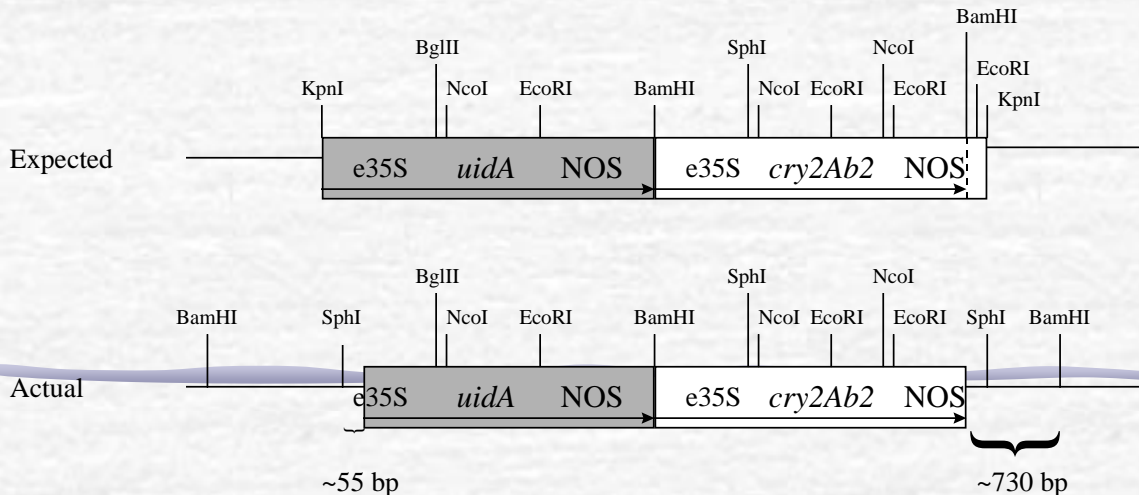
- Genetic manipulation: a technology in which a gene or genes are taken from one organism (donor), possibly modified and then re-inserted into another organism (recipient) in an attempt to transfer the desired trait or character
- Also called genetic engineering, gene manipulation, gene modification, recombinant DNA technology or bioengineering



The Gene and the Construct used in Transformation



Used in transformation

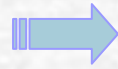


IP issues

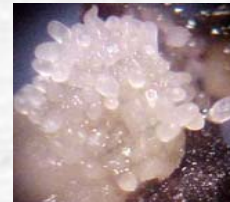
Banana transformation



Male bud



Immature flower

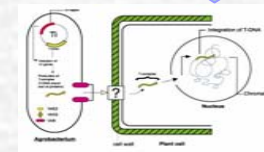


Embryogenic callus



ECSs

ECS initiation and transformation



ECS transformation using agro bacterium



Selection

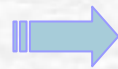


Shoots from EC clones

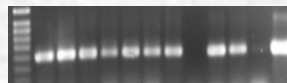


Future activities

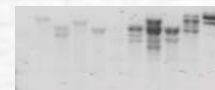
Morphological analyses



PCR analyses



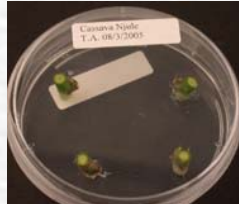
Southern blot analyses



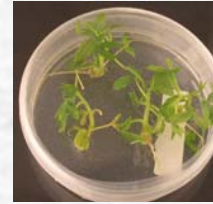
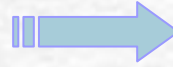
Cassava transformation



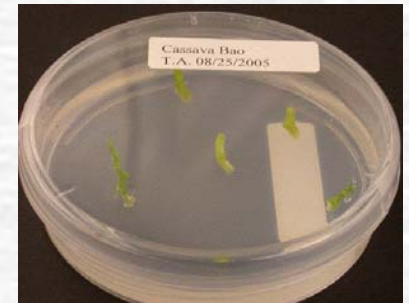
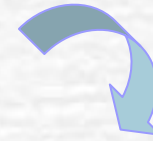
Potted, maintained in growth chamber



Shoot nodal cuttings



Shoots from nodal cuttings



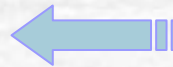
Cultured shoots on MS Agar



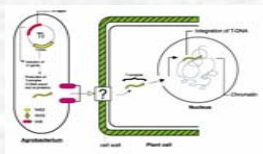
FEC initiation and transformation



FEC



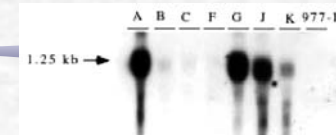
OESs



FEC transformation using agro bacterium



Gene expression analyses



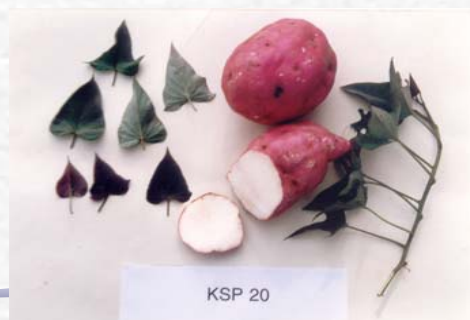
Tissue culture and regeneration



Status

- TC protocol developed and technology disseminated to farmers
- Associated with increased yields and reduced cost of production

Some farmer-preferred varieties



Trait evaluation

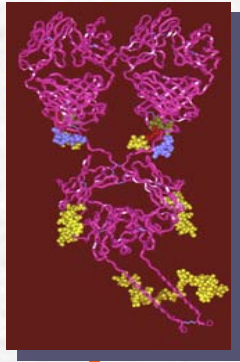


In maize, it controls: maize borer

In cotton, it controls:
cotton bollworm,
pink bollworm



A Novel Approach to Pharmaceutical Production



Identify gene for virus neutralizing monoclonal antibody gene

Transform plant cell with antigen gene



Product Formulation

Conclusions

- **Biotechnology is not new**
- **GM is no synonymous to biotechnology**
- **Biotechnology is a tool of breeding**
- **Biotechnology is an inevitable tool for development (Bioeconomy)**
- **Need for constant information updating**



THANK YOU FOR YOUR ATTENTION