

UNIVERSITY OF NAIROBI
Seed Enterprises Management Institute

**GENETICALLY MODIFIED ORGANISM (GMO) SEED and
IMPLICATION IN FARMING:
SEED CERTIFICATION (FIELD INSPECTION, TRANSPORT,
PROCESSING, TESTING AND LABELLING**

Presentation to SEMIs Trainees

8.00-9.00 am

Lawrence M'Ragwa (Ph.D.)
Kenya Agricultural and Livestock Res. Organization
(KALRO)

GENETICALLY MODIFIED SEED AND IMPLICATION IN FARMING

- Biotechnology tools to improve varieties is a common practice today.
- If well used can contribute to improved value in varieties within short period.
- Our interest is on application of Biotechnology Methods to prevent plant diseases; herbicide resistance; enhance nutrition; taste; fruit appearance-color .
- Some methods:-
- Tissue culture (TC) (not a GMO but usually mistaken to be by Farmers). This protocol allows cleaning of plants by generating plants from selected clean plant parts including meristems or even single cells under sterile lab conditions. Entire plant can be produced from single cell
- To produce disease free plants; Cut apical or axillary meristems which are free from disease infections
- Culture meristems in various media (to form roots and shoots) to generate many TC plants

Genetic Engineering of Plants

- How to get a gene into a plant (Transformation)
 1. *Agrobacterium tumefaciens* (Bt) with wild type and desired Ti plasmid in which there is T DNA site
 2. Microprojectile Bombardment (biolistics)
 3. Electroporation burs in which is Tt of electricity
- Gene Transfer in Plants: through
- Marker Assisted Selection (MAS).. Acceptable
- Genetic modified organisms (GMO) of various crops

Gene Transfer in Plants (using Bt) or TRANSFORMATION

- Vector used: Ti Plasmid of *Agrobacterium tumefaciens* (Bt) occurring in soil...
- Ti Plasmid.. Tumor inducing plasmid (affect dicots) with transfer DNA (T-DNA)
- Strategy:- collect infected target plant with wound sites; inoculate with Bt carrying recombinant Ti Plasmids; grown gall form where plant chromosomes will have desired T-DNA (Transformed plant cell)
- Infected tissue is then raised in shoot generation medium for 2 days so that transfer of T-DNA along with gene of interest takes place.
- Then transformed tissues are transferred onto selection cum plant regeneration medium supplemented with lethal antibiotic (Kanamycin)
- The medium has bacteriostatic agent to suppresses Bt present in transformed tissues
- After 5 weeks, the regenerated shoots are transferred to root inducing medium
- After another 3 weeks complete plants are obtained, which are transferred to soil, following the hardening of regenerated plants
- Genetic engineering using foreign genes that are introduced in domesticated crops is what some refer to as unacceptable GMOs.
- Marker Assisted Selection (MAS).. Using gene markers called Restriction fragment length polymorphism (RFLP markers) .. Acceptable plants...
- Genetic modified organisms (GMO) of various crops

GENETICALLY MODIFIED SEED AND IMPLICATION IN FARMING cont'd

- Marker assisted breeding
- This is a process where a marker (morphological, biochemical, or one based on DNA/RNA variation) is used for indirect selection of genetic determinant/s of a desired trait e.g. yield, drought, disease resistance
- Breeders identify gene or group of genes which are used to identify desired trait
- This is not controversial process as identified varieties are usually used in breeding programs.

GENETICALLY MODIFIED SEED AND IMPLICATION IN FARMING Cont'D

- We now know GMOs) are living (plants, animals, microorganisms) in which genetic material (DNA) has been artificially altered in a way that it doesn't occur naturally by mating and /or natural recombination.
- Desired gene/s is moved from one organism through bacteria to improve another in labs. Genes are inserted to crops. Changed organism is GMO or transgenic
- IMPACTS OF GMO ON FARMERS
 - Reaction of farmers is mixed: some adopted; others listen hesitated
 - Benefits: increased yield, less use of pesticide and herbicides, higher profits: use of Bt cotton, Bt maize and herbicide tolerant soya

CONCERNS ABOUT GMO

- Are GMOs safe? This depends from which country you come:
- Arguments are as varied as the countries and lobby groups
- USA has approved many plant GMOs in 80% of conventional processed foods; some are resistant to herbicide (roundup ready products or resistance to pests (Bt cotton, maize)
- However these must be labelled
- Farmers fear domestic markets are not stable due to perceived health risks
- Farmers have limited rights to retain and reuse seed
- Companies in US have made it difficult for farmers to file lawsuits if wronged but are required to go for binding arbitrations
- Contracts have limited liability: farmer cannot claim damages if GMO causes harm to farmer.

GENETICALLY MODIFIED SEED AND IMPLICATION IN FARMING...CONT

- In Australia, Japan, and all EU there are restrictions or outright bans on production and sale in GMOs. GMO challenge with international markets
- Impact of GMOs during seed production and environment
 - Isolation is a problem and processing capacity to process and present to farmers will be not easy
 - 80% of GMOs are grown in the world are engineered for herbicide tolerance
 - Environmental Concerns
 - EU argue long time effect is unknown: May develop resistant weeds & insects!
 - Once released in environment the GMOs cannot be recalled
 - Governments must decide for their farmers and environments
- Effects of GMOs to Farmers: GMO cross pollinate: Who is liable?
 - Companies have patents and have power to sue farmers like it happened in canola case in Canada: more debate on this.....

Has your country accepted production and sale of GMOs?

INTRODUCTION INTO SEED CERTIFICATION

Seed system include production, certification, marketing and USE.

- Seed production is done by breeders, seed companies and other private entities under both internal and regulator quality assurance
- The regulator enforces seed laws through certification which include
 - Field inspection to ensure seed crop retains genetic purity
 - Seed transport control to ensure the harvested is what is in store
 - Lab services which include, sampling and testing according to seed laws, OECD and ISTA rules to allow international trade
 - Labelling and sealing/packaging ensuring what was in the field is what is sold to farmers
 - Monitoring marketing and distributors(stockists), exporters, importers) and end user (farmers) packages

CERTIFICATION

- Includes field inspection (first step in certification)
- Done by both producer and regulator
- Regulator requires that
 - Seed crop is registered with regulator
 - Producer provides proof of origin showing the Breeder
 - Inspectors determine crop is grown per agreed standards- isolation, intended class, inspected timely to ensure purity
 - Seed crop is pure, no genetic contamination and free from pests and diseases (especially seed borne)
 - Transport of harvest is monitored upto the store (in Kenya)
 - **Is transport monitored in your country?**

Certification Includes Seed Conditioning/Processing

- Seed Crops of approved fields are harvested and taken for processing to remove impurities like:-
 - Weeds
 - Inert materials
 - Immature, broken and diseased seed
- Systematic grading and sorting out colored seed
- Sampling of seed for testing by regulator before treatment
- Treating or dressing with standard chemicals

CERTIFICATION INCLUDES SEED TESTING

- After sampling the regulator tests the seed for various quality parameters including
 - Purity
 - Germination capacity
 - Moisture content
 - Seed health especially seed borne diseases
 - Then assigning lot numbers for the tested seed
 - If seed fails they recommend how to dispose off the lot
 1. Not for sale
 2. Burning/destroying
- How is testing done in your country?

CERTIFICATION INCLUDES LABELLING AND SEALING

- The regulator ensures the approved lots is labelled and given weight demonization
- The approved seed is packed in approved container and sealed in presence of regulator
- It is then sealed for sale through various channels registered by Regulator
- This ensures seed pack cannot be tempered with without being noticed and the farmer can get right seed as sealed.
- Is seed law strictly enforced in your country? ¹³

POST CONTROL TESTS AND SURVEYS

- Regulator and seed providers conduct tests to:-
 - Check whether or not the preceding control measures have been effective.
 - The tests ensure that traits of varieties have remained unchanged during multiplication
 - The team undertake surveys at planting to sample from what farmers are planting
 - The samples are sown alongside the post control plots for comparison
 - This assists to verify seed being sold is of high quality or not.



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