
DT-Bt stacked traits/Events in Maize

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Major Staples of Africa

(Million Ha – FAO 2011 Data)

- Maize: 33
- Sorghum: 19
- Millet: 18
- Cassava: 13
- Rice: 11
- Cowpea: 10
- Groundnut: 10
- Common bean: 6
- Yam: 5
- Where is wheat?
  Africa spends its limited resources to import wheat...
Challenges faced in Maize Production in ECA

- Yield potential
- Low soil fertility stress
- Drought stress
- Foliar and ear diseases (+ emerging)
- **Stemborers, weevils and grain borers**
- Non–optimal crop management practices
- Less than optimal seed systems to reach smallholder farmers
- Less than optimal nutritional content of current maize varieties

**Maize yield**

Africa average = 2.0 t/ha
Global average = 4.9 t/ha
The Stem Borer Problem in Kenya

- Loss of photosynthetic leaf area
- Dead hearts
- Lodging from damaged stems
- Increased ear rots & mycotoxins
- Reduced grain yields
- Causes loss of about 13% annually, valued **USD 90 million.**
Stem borer plant damage parameters

Leaf damage
Harvesting
Exit hole

Stem tunneling
Grain yield
Stem borer Management Options

1. Cultural control
2. Chemical control
3. Biological control
4. Host plant resistance (HPR)
   - Conventional
   - Biotechnology (MAS / GE)

Host plant resistance is the most economical method to control stem borers, as it is environment-friendly, practical, relatively inexpensive, safe, and easy to adopt and to use by poor farmers.
Historical Development of Plant Breeding

- **Selection**
  - 4000 B.C.

- **Crossing**
  - 1940

- **Hybrids**
  - 1995

- **Molecular breeding**

- **Gene transfer** (e.g. insect resistance => Bt)
Breeding by Crossing

Gene of interest („construction plan“ for a protein)

wild type

promising line

new variety

Other genes are transferred

several steps of backcrossing necessary to get rid of undesired genes
How to Make a GMO

identification and isolation

gene of interest

promising line

+ 

single gene

genetically enhanced variety
Creating Genetically Engineered Crops

1) Overview of the Process

2) DNA Isolation

3) Cloning Genes

4) Designing Genes

5) Transformation and Tissue Culture

6) Plant Breeding
Bt crystal proteins:

- from *Bacillus thuringiensis*
- easily bio-degradable
- specific insecticidal efficacy
- not harmful to humans, animals and the environment
- Bt-insecticides are registered in organic farming

*The gene encoding for some Bt-Proteins can be transferred to crops*
Maize with Bt gene

larvae feeds on Bt maize

the Bt protein damages the midgut of the larvae

larvae die within several hours
Why have GM crops been adopted rapidly?

A. Food safety
- Safety due to the use of genes with known characteristics
- Safety due to the intensive safety evaluation prior to commercialisation
- Its safety has been supported by many credible world health bodies.
- There has not been any issue of safety for nearly 20 years (1996-2015) it has been consumed by millions of people in over 25 countries.
- It can reduce health risks by reducing pesticide use.
- It has been shown to reduce cases of aflatoxins in maize.

B. Environment
- It has not shown any negative effects on the environment.
- It will lead to reduction in pesticides use thus reducing risks to the environment.
Genetic modifications are only used:

A. When all other techniques have been exhausted

B. When:

- The trait to be introduced is not present in the germplasm of the crop
- The trait is very difficult to improve by conventional breeding methods
- It will take a very long time to introduce and/or improve such trait in the crop by conventional breeding methods
Performance of Bt, non-Bt and commercial checks

Yield (t ha⁻¹)

- Bt: 9.7
- Non-Bt: 6.3
- Com Checks: 6.0

40% yield advantage

Leaf damage (0-9)

- Bt: a
- Non-Bt: b
- Com Checks: b

>60% leaf damage reduction

Bt-hybrid

Non-Bt isohybrid
Exit holes and tunnel length among Bt, Non-Bt and Checks

Holes/plant

- Bt
- Non-Bt
- Com Checks

%Stem tunneled

- Bt
- Non-Bt
- Com Checks

Holes

Stem tunnelling

Bt- Non-Bt Com Checks
DT-Bt Stacked Traits Events in Maize

WEMA Transgenic single events
Drought tolerant (DT) = MON87460
Insect protected (Bt) = MON810

WEMA Transgenic stacked events
DT-Bt stack = MON87460 x MON810

Process of making stacks
● Possible with transformation
● Practical with crossing inbred lines with the single events
Thank you for your interest!