

BT CROPS – is your resistance management plan in place?

Over the past 20 years, South African maize growers have rapidly embraced biotech crops with a built-in insecticidal protein that provides protection against targeted maize pests such as maize stalk borer (*Busseolla fusca*).

Biotech maize varieties, expressing a range of different insecticidal proteins from the naturally occurring soil bacterium, *Bacillus thuringiensis* (Bt), have been commercially approved by South African regulators as single or stacked Bt traits. By 2018, an estimated total of 2 million ha of biotech maize was grown in South Africa. These comprised of:

- 207 000 ha of insect-resistant (IR) maize;
- 460 000 ha of herbicide-tolerant (HT) maize; and
- 1,3 million ha of stacked IR/HT maize (ISAAA, 2019).

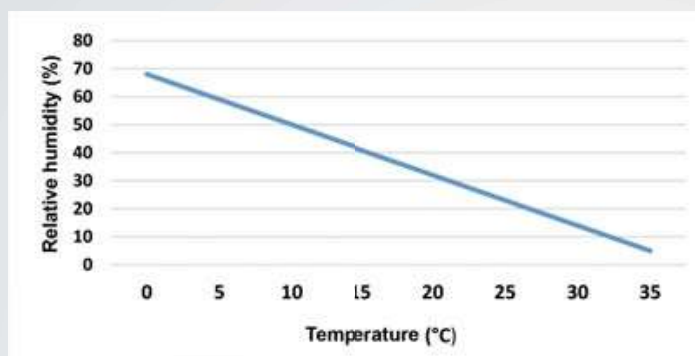
Despite the successful adoption of biotech maize by growers, continued accrual of benefits is largely dependent on proper stewardship of available Bt crops to sustain its effectiveness as a pest manage-



Figure 1: Plant biotechnology product life cycle.

Source: Excellence through stewardship (ETF), 2009.

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Graph 1: Maximum permissible relative humidity at different temperatures to prevent the rapid deterioration of seed.

Source: SA Graan/Grain, March 2018, Craven et al.

Table 1: Moisture content and storage period of grain seed at temperatures below 32 °C.

SEED MOISTURE CONTENT	STORAGE PERIOD
11% - 13%	½ year
10% - 12%	1 year
9% - 11%	2 years
8% - 10%	4 years

CONSTRUCTION CHARACTERISTICS OF A GOOD SEED STORE

- The store should not have any windows, with only one door that seals and locks properly.
- The foundation should be of rock or cement and be 90 cm above the ground level. Material for the walls can be stone, cement, wood or metal.
- The floor should be tiled and any cracks that form should be sealed.
- The floor, wall and roof construction should be such that no cracks can form where insects can hide. All gaps around power points, wiring, ventilation and doors should be sealed.
- Ventilation openings should not be accessible to insects and birds.

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ment tool. With Bt insect resistance having already been documented in South Africa, the deployment of insect resistance management (IRM) strategies is a crucial component of an integrated pest management (IPM) system under the stewardship life cycle approach.

IRM – OLD PROBLEM, NEW TECHNOLOGY

The purpose of IRM is to maintain the effectiveness of Bt crops as an insect pest management tool by preventing or delaying the development of insect resistance to inherent Bt traits. It is important to note that resistance is not a unique concern for biotech-derived crops and remains an ongoing challenge for other types of pest management applications.

Implementation of resistance management is generally mandated wherever Bt crops have been commercialised, including South Africa. In terms of the Genetically Modified Organisms Act (No. 15 of 1997), technology permit holders are required to do the following:

- Monitor resistance management strategies.
- Develop a surveillance plan for detecting resistance development.
- Undertake grower educational programmes.
- Develop a compliance management plan to counteract resistance development.

A key component of a resistance management programme is the adoption of a refuge strategy, where the concept of a 'refuge' is defined as a non-Bt planting area that supports the production of Bt-susceptible insects.

GOOD IPM IS GOOD RESISTANCE MANAGEMENT

A robust resistance management plan needs to match the best available insect resistant technology to combat the targeted pest with due consideration to the local environment and agricultural practices in an integrated manner. Apart from the refuge strategy, other important considerations in IPM and resistance management strategies for Bt crops include the following:

- Knowledge of major pest biology and ecology.
- Understanding the efficacy of available insecticidal traits.
- Selection of locally adapted crop varieties.
- Understanding local cropping systems.
- Scouting and monitoring for target pest damage.
- Application of alternative pest management options when needed.
- Grower education and training on responsible use.

REFUGE STRATEGY – HOW IT WORKS

1

Growers using Bt maize are required to plant a refuge area of non-Bt maize. The refuge maintains a population of susceptible insect pests not exposed to selection pressure from the Bt protein. These susceptible insects would be available in high enough numbers to breed with resistant insects that emerge in the Bt crop field, ensuring that susceptibility is passed on to offspring, helping to prevent the emergence of resistant populations over time.

2

One of the refugia management options available to maize growers locally, is to plant a refuge adjacent to their Bt-cultivated maize fields. It can either be a minimum of 5% non-Bt maize refuge that is not treated with an insecticide or a 20% non-Bt maize refuge that may be treated with a registered non-Bt-containing insecticide/biopesticide within 400 m of the Bt maize field.

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