CropLife
SOUTH AFRICA SUID-AFRIKA

WHAT IS INTEGRATED PEST MANAGEMENT (IPM)?

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Integrated pest management is when producers consider and incorporate a variety of pest control techniques and other appropriate measures in their pest management programme as opposed to relying on just one method for control.

This means using the most practical and appropriate combination of cultural, mechanical, biological and chemical methods to manage diseases, insects, weeds and other pests in the most cost-effective, environmentally sound and socially acceptable way. Today's IPM toolkit comprises of a wide range of useful technologies and products for pest management , including the cultivation of plant biotech crops with inherent traits for improved pest and weed control.

RESPONSIBLE USE AND RESISTANCE MANAGEMENT

The responsible use of any crop protection tool is based on the principles of IPM. The incorporation of herbicide tolerant (HT) and insect resistant (IR) crops into the crop protection toolkit is not a one-size-fits-all solution to managing pests. Instead, the goal with IPM is to encourage farmers to diversify the deployment of pest management practices that are economical and appropriate for their farming conditions, while simultaneously addressing the ongoing concern of insect and weed resistance issues.

Agricultural production has historically endured huge losses due to pests and diseases. With pests having the ability to develop resistance, the long-term utilisation of pest control methods has a limited lifespan. Resistance is, however, not unique to plant biotechnology, although biotech crops do bring some unique considerations. It is important that concerns regarding resistance should not deter the use of biotech crops; instead, these concerns should be addressed through the implementation of proper stewardship and pest management programmes that effectively delay resistance while enabling the benefits of the technology to the environment and agriculture to be realised.

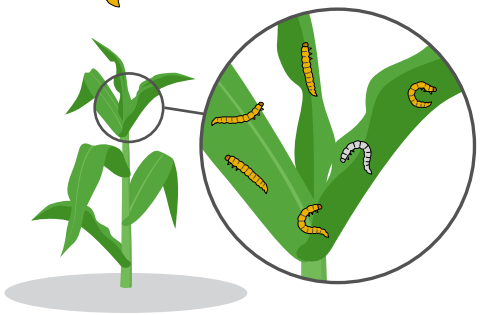
WHAT IS RESISTANCE AND HOW DOES IT DEVELOP?

In nature, there are a small number of weeds or insects in a population that are naturally resistant to certain forms of pest control. Suppose 90% of the population is susceptible, 5% naturally resistant and 5% naturally semi-resistant. If the pest comes into contact with the IR crop or a herbicide, it will control just about the entire population, except those that are already naturally resistant, and a small number of those that are semi-resistant. The survivors then lead to the next generation of weeds or insects, where there is now a hybridisation between resistant, semi-resistant and susceptible weeds or insects. After the first season, there is a slight shift to the more resistant insects or weeds in the population, and so it goes on and on until the resistant part of the species eventually becomes the dominant population. Although this is a natural process, it can be managed effectively to delay the onset of resistance.

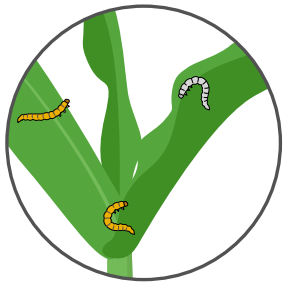
HOW DOES RESISTANCE EVOLVE?

Susceptible insect

Resistant insect

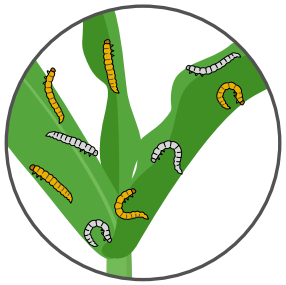


A small number of insects in the population are naturaly resistant to the Bt trait.



When maize with the Bt trait is initially used, it controls almost all of the insects in the population.

Survivors reproduce over time



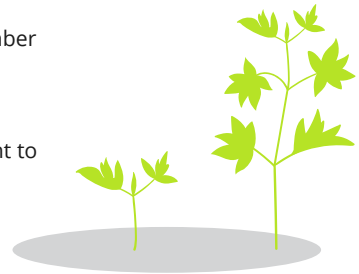
Survivors are resistant to the Bt trait and lead to the next generation of resistant insects when they mate with other resistant insects.

Herbicide applied

Susceptible weed

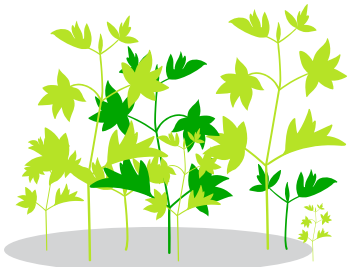
Resistant weed

A very small number of weeds in the population are naturally resistant to certain types of herbicides.



When the herbicide is used, it controls almost all of the weeds in the population.

Survivors reproduce over time



Survivors are resistant to the herbicide and lead to the next generation of resistant weeds.

Applying herbicides with the same mode of action repeatedly enables the resistant population to multiply.

MANAGING RESISTANCE IN IR CROPS

Similar to other crop protection products, insects can also adapt and develop resistance to biotech crops with inherent Bt insect resistant traits. The main factors contributing to these cases of targeted IR pest resistance has been the cultivation of IR crops for pest management, without the implementation of proper resistant management practices, including not adhering to the requirement for planting of a crop refuge.

KEY COMPONENTS OF RESISTANCE MANAGEMENT FOR IR CROPS

- **Scouting:** Growers must monitor their fields to know what pests are present and assess crop damage to help inform their decisions on pest management
- **Crop rotation:** Growers should refrain from planting one type of crop in the same field for consecutive years and rather grow a different crop entirely in alternating years. Alternatively, growers should avoid planting IR crops in the same field two years in a row and rather use non-IR varieties. This gives insects less exposure to Bt proteins, thereby slowing resistance developing.
- **Stacked traits with multiple modes of action:** Insects are less likely to develop resistance to IR crops with multiple modes of action compared to a single mode of action because it is much harder to develop resistance to two or more IR traits at the same time.
- **Mandatory planting of a crop refuge (detailed information below):** Insect resistant technology with the cultivation of IR crops is widely used in commercial maize and cotton production in South Africa and requires that farmers plant a structured crop refuge as part of their IPM programme.

WHAT IS A REFUGE?

A refuge is the mandatory planting of an area of the same crop without the IR trait adjacent to the IR crop field. 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 may emerge in the IR crop field, ensuring that susceptibility is passed on to the offspring and helping to prevent the emergence of resistant populations over time.

MANAGING RESISTANCE IN IR CROPS

HOW SHOULD A REFUGE BE PLANTED?

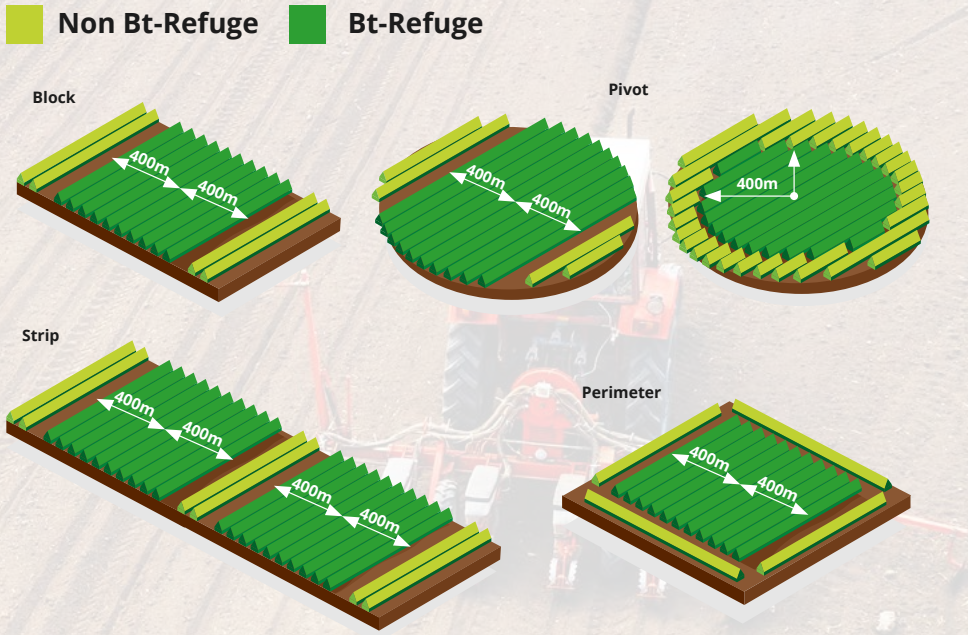
Refuge requirements vary depending on the country, crop and types of pests to be controlled.

The refuge management options available to growers of Bt insect resistant crops in South Africa is to plant either:

- 5% non-IR refuge of the same crop that is not treated with an insecticide or
- 20% non-IR refuge that may be treated with a registered non-IR containing insecticide/ bio-pesticide

In addition, growers must ensure that refugia is planted:

- Within 400 metres from the IR crop field.
- Within 7 days of planting of the IR crops.
- With hybrids having the same maturity as the IR crops and be managed in the same way.
- With a minimum of 6 rows, except for smallholders where this may exceed a 5% refuge area.
- Without mixing of IR and non-IR seed.



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MANAGING RESISTANCE IN HT CROPS

It is well understood that the challenges with herbicide resistance in key weed species is largely attributed to overreliance on a single weed control strategy e.g. herbicide applications with the same mode of action. As the cultivation of HT crops goes hand in hand with the application of specific herbicides, the use of diverse weed control strategies is key to sufficiently reduce selection pressure for the development of resistance.

KEY COMPONENTS OF RESISTANCE MANAGEMENT FOR HT CROPS

- **Scouting:** Growers must monitor their fields for resistance to ensure that effective weed control is being achieved.
- **Crop Rotation:** Growers should alternate different crops in the same field for consecutive years to destabilise weeds and prevent one weed species from dominating.
- **Sanitation:** Growers must practise proper sanitation, ensuring fields are free of weeds and clean farming equipment to limit the spread of weed seed
- **Herbicides with different modes of action:** Each herbicide active ingredient falls in a particular group with a particular mode of action or similar mode of action indicated by a HRAC (Herbicide Resistance Action Committee) group code. The HRAC group codes are indicated on the label and herbicides from different groups should be alternated within the spray programme.
- **Herbicide application frequency and dosage instructions:** Farmers must ensure to only apply the product according to the stipulated dosage, mixing and application instructions as specified on the label. Products should only be applied according to the specified application frequency as well as the minimum or maximum number of allowable applications per season.

It goes without saying that every farmer should commit to preventing resistance, as opposed to just reacting when it happens. By adhering to the resistance management practices for biotech crops and applying the principles of integrated pest management, farmers can help to ensure that the efficacy of these crop protection technologies remain sustainable and can be used well into the future.

For more information visit **www.croplife.co.za**

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