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CHIPS

VOL 35 NO 05 • NOVEMBER / DECEMBER 2021

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Resistance management in the control of potato tuber moth in potato production

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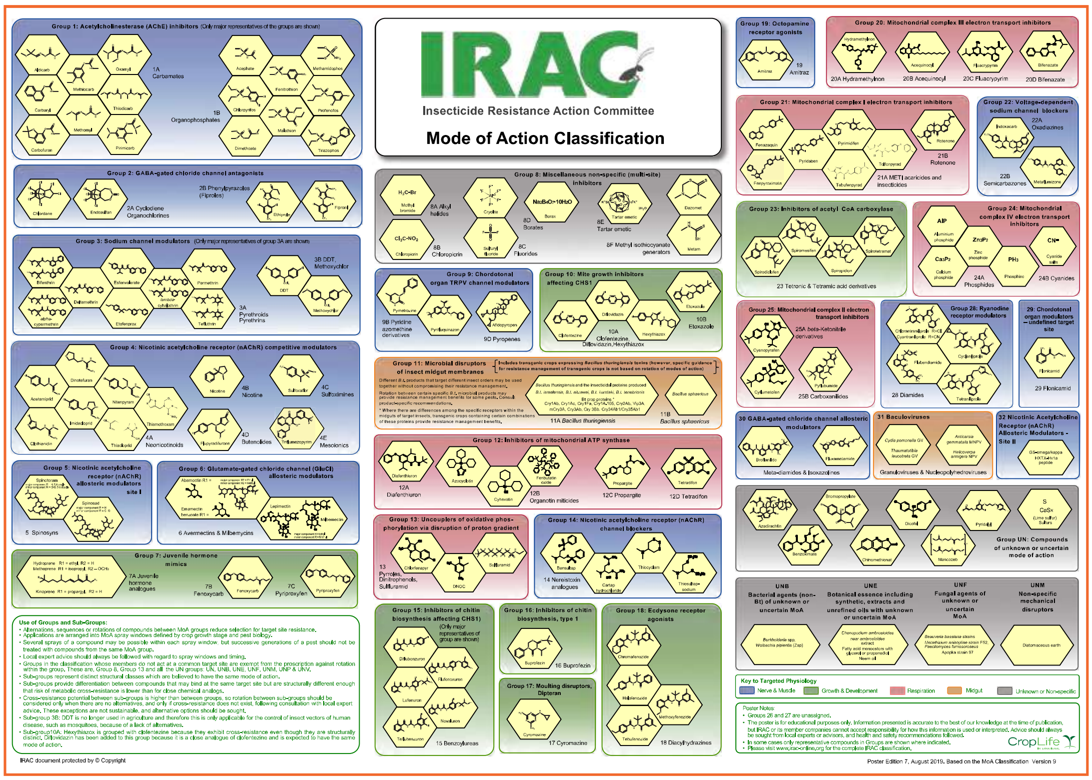
Insecticide resistance is the phenomenon whereby insect populations evolve to become less responsive to insecticides (also called sensitivity shift), and can no longer be controlled by the dosage of insecticide normally used to provide effective control.

A sensitivity shift that leads to resistance, develops through mutations in the genetic coding of the insect. Mutations usually occur randomly, with most of the mutations having no impact on the insect's physiology or biochemistry. However, on occasion, a mutation confers resistance to an insecticide, resulting in a competitive advantage for the insect and its offspring if the same insecticide is used repeatedly.

When insecticides with different modes of action (MoAs) are not rotated or used interchangeably, insects that carry the resistance mutation will survive and become more representative within the population, increasing the pace of sensitivity shifts and ultimately resulting in an entire population developing resistance within a few generations.

Figure 1: The IRAC MoA classification. A high-resolution version of the figure is available at *www.irac.com*.



Pest management and MoAs

To stop insects with resistance mutations from becoming dominant in the population, insecticides with different MoAs should be alternated in sequence or rotated to ensure that consecutive pest generations are not exposed to insecticides with the same MoA. This will decrease selection pressure on these insecticides and slow the pace of sensitivity shifts significantly.

However, cross-resistance may occur when resistance to one insecticide confers resistance to another, even when the insect has not been exposed to the latter product.

The Insecticide Resistance Action Committee (IRAC) categorises insecticides into groups according to their MoA (*Figure 1*). These groups are easy to find on the IRAC website (*www.irac.com*) or the IRAC application for smart devices. This is a valuable tool for producers and crop advisors to understand the different groups and their respective MoAs.

The pest management practices required to delay the pace of sensitivity shifts and resistance development, are as follows:

- Identify the MoA of the insecticide used and alternate with insecticides that have a different MoA. In South Africa, the MoA of the insecticide is displayed on the front panel of the label, for example: Group 1A. In this example, the compound falls within MoA Group 1 (acetylcholinesterase inhibitors) and in sub-group A (carbamates). Sub-groups represent distinct classes of insecticides that have the same MoA but are

different in structure or mode of interaction with the target protein. This sub-categorisation differentiates between closely related insecticides and reduces selection for either the metabolic or target site cross resistance. The cross-resistance potential between sub-groups is much higher than between groups, thus rotation between sub-groups should be avoided.
- Apply insecticides during the correct application windows to avoid consecutive pest generations being exposed to the same MoA. An application window refers to a period of residual activity provided by a single application, or several applications of the same MoA applied in sequence, generally coinciding with the timeframe of one pest generation (approximately 30 days, depending on local conditions).

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- Multiple successive applications of the same MoA are acceptable when treating a single insect generation.
- Following a treatment window, rotate to a different window of application with a different MoA.
- Never apply insecticides at reduced or higher dosage rates or reduced water volumes. Apply insecticides only at the label-instructed timing and dosage.
- When making use of insecticide mixtures according to label instructions, always apply active ingredients at their individually registered dosage rates.

Practical guidelines

To reduce the number of insecticidal treatments required and optimise application timing, pest populations should be monitored throughout the season by means of regular scouting, which includes using pheromone traps.

If weather conditions are conducive to high pest populations, the shortest spray interval and the highest recommended rates on the label should be used. Systemic and translaminar pesticides (such as cyantraniliprole or acetamiprid) should only be used at the beginning of the season, when plants are actively growing, to allow the chemicals to sufficiently translocate within the potato plants.

When developing a spray programme for the control of potato tuber moth specifically, ensure that chemicals with the same MoA are not repeated in the programme for the control of a different pest on potato crops, especially if the presence of these species overlap (e.g., potato leafminer).

Where two pests are present simultaneously, the higher recommended rate for the pest that is more difficult to control, should be used. Similarly, if other crops in the vicinity are also hosts of potato tuber moth (e.g., tomatoes), ensure that the spray programmes are aligned in terms of the MoA applied against a specific generation of the pest.

In South Africa, approximately 26 different active ingredients representing twelve different MoAs are registered for the control of potato tuber moth on potatoes, providing adequate variety for insecticidal rotation during and between seasons.

When making use of agrochemicals, good agricultural practices should always be followed. This includes using spray equipment that is properly calibrated and in good working order, only using spray equipment and application methods as stipulated on the product label, ensuring good penetration into the crop canopy and sufficient wetting of the leaf surface by using a registered surfactant for optimal coverage (if recommended as such on the label), and not spraying during unfavourable conditions (e.g. during the hottest time of the day or in windy conditions).

Integrated pest management

Minimising selection pressures and delaying the onset of resistance for insecticides can also be achieved by making use of integrated pest management, which considers all available techniques to reduce pest populations. These methods include crop rotation, cultivar selection, planting of genetically modified crops (which are not currently available in potatoes), monitoring pest populations, biological control, releasing sterile insects, and mating disruption.

When chemicals are used, they should always be used selectively and as part of an integrated resistance management programme.

This article is Monograph 4 of the Potato Production Stewardship Programme – a collaborative initiative of Potatoes South Africa, CropLife South Africa, and the Insecticide Resistance Action Committee. For more information, contact Dr Gerhard Verdoorn at gerhard@CropLife.co.za.

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