Insecticide Resistance Action Committee

Text Version

Insecticide Resistance Management Guidelines for sucking pests

IRAC Sucking Pest Working Group

Including: aphids, whiteflies, psyllids, scales, mites, thrips, planthoppers, leafhoppers, plantbugs and other insects that feed on the plant vascular systems.

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The guidelines presented here are developed and modified by the Sucking Pest Working Group of the Insecticide Resistance Action Committee (IRAC). Our objective as industry technical experts and IRAC members is to provide a reference document for designing IRM strategies for sucking pests. The information provided is based on published information and to the best knowledge of IRAC International at the time of writing (November 2019).

As pest problems and control practices differ considerably between countries, crops and climatic conditions, these guidelines are meant to be flexible and allow experts to develop, adapt and implement these options to take local conditions into account. However, exceptions will need to be addressed by experts on a case by case basis.

Introduction

Resistance to insecticides is a 'heritable change in the sensitivity of a pest population' that is reflected in the failure of a product to achieve the expected level of control when used according to label recommendations for that pest species. The aim of this guideline is to summarize strategies that companies, influencers and growers can use to slow the development of resistance and provide more effective and sustainable pest control.

IRAC Mode of Action (MoA) Classification

Sucking insects can be controlled by insecticidal compounds with different modes of action (MoA). Repeated use of any insecticide can lead to resistance to that specific insecticide. In addition, if insects become resistant because of a change in the target site of the insecticide, there is a high risk that insects become resistant to all insecticides with the same mode of action.

The IRAC MoA classification is intended to identify insecticides acting at specific target sites where mutations could confer cross-resistance to all compounds in the same group. It provides a guide to the selection of insecticides for use in an effective and sustainable insecticide resistance management (IRM) strategy.

A list of insecticide MoA and corresponding chemical groups with more details on insecticide Modes of Action can be found on the IRAC web site irac-online.org and the IRAC MoA App, that can be downloaded on to your cell phone (see also references at the end of this document)[1].

The IRAC Mode of Action group numbers are now included on product labels in many countries. Additionally, statements providing insecticide resistance management guidance are also often given on the labels.

Status of resistance to sucking pest insecticides

There are many published instances of species where resistance to insecticides has developed and others which have the potential to develop resistance. For the latest information please refer to the IRAC web site irac-online.org.

Guidelines:

1. IRAC member companies are responsible for including IRM information in product labels.
The principle is to provide clear IRM information using language in a format understandable to farmers. Moreover, IRAC member companies recommend stating on product labels the maximum number of applications. Implementation in countries depends on the local regulatory label guidelines.

2. Always use products at the recommended label rates and spray intervals with the appropriate application equipment.
Insecticides used at rates higher or lower than recommended on the label can result in resistance and/or unwanted effects on non-target organisms and the environment. Ensure that all the spray equipment is well maintained and there are no blocked nozzles or filters since this results in incorrect rates. Target the most susceptible insect life stages whenever possible.

3. Rotation of insecticide Mode of Action groups prevents rapid selection of resistant populations.
Farmers can avoid prolonged selection for insecticide resistance by rotating and diversifying the insecticide modes of action used in a crop cycle. **The recommended approach is to use products of the same MoA within a discrete period of time commonly called a "window". A window is defined by the approximate duration of an insect generation. For sucking pests this is generally simplified by using 15- or 30-day windows depending on the target species.**

a) Avoid use of the same mode of action in consecutive windows.
b) If insecticides from several mode of action groups are available, then the use of multiple modes of action within a window is recommended provided that different modes of action are used in the following window.
c) Following a window of any mode of action group, rotate to a window of applications of effective insecticides with a different mode of action.
d) Multiple applications (generally less than 3) of the same MoA insecticide are acceptable if they are used to treat a single insect generation or are used within a window. Make sure that the residual activity of the multiple applications fits within the window.
e) For short cycle crops (e.g. lettuce), it may be necessary to consider the duration of the crop cycle as a window. In this case, it is recommended to alternate to different modes of action in the next crop cycle.
g) Avoid rotating products in different sub-groups of the same MoA except if there are no registered and effective alternatives.

4. Transplanted seedlings.
It can be common for seedlings grown in plant nurseries to be treated with insecticides prior to transplant to the field. It is recommended that growers purchasing seedlings for transplant enquire about insecticide use programs during the period of time the seedlings were held in the nursery, so that where possible they can avoid using sequential treatments of the same insecticide mode of action, upon transfer to the field. In addition, growers should be aware of the resistance status of pests in transplant production areas and to ensure those resistant insects are not re-distributed to local production fields.

5. Use Integrated Pest management (IPM) practices to protect crops from pest damage and reduce the risk of insecticide resistance.

IPM discourages the development of pest populations by using diverse techniques that are economic, safe and environmentally sound. It does not exclusively rely on insecticides, hence in IPM systems selection pressure by specific modes of action is reduced and the risk of resistance minimized.

IPM strategies consist of basic components:

a) Apply at established pest threshold levels for insecticide applications. Monitor pest populations in the field to identify species, pest stages, population densities, and presence of natural enemies so rational pest control decisions can be made.

b) Integrate effective control techniques including cultural, chemical, biological and plant biotechnology pest control measures, which minimize effects on non-target organisms:
   - Use pest resistant or damage tolerant crop varieties.
   - Practice sanitation and removal of infested post-harvest crop residue and other pest insect host plants, including the consideration of weed management.
   - Avoid year-round cultivation of susceptible crops to limit survival of treated pest populations.
   - Consider deploying alarm or disruption pheromones where appropriate.

c) Conserve beneficial organisms, such a pollinators, insect predators and parasitoids.

6. Correct identification of the target pests can improve the effectiveness of the insecticide application

Although some sucking insect species can appear very similar at a quick glance, their susceptibility to different insecticide modes of action can be very different. It is therefore recommended to spend time to accurately identify the species of pests that require control and check the product label for guidance on the recommended product rate and timing. Insect species with similar appearance may also have a different insecticide resistance profile, which may affect product performance. For example the green peach aphid (*Myzus persicae*) has developed resistance to many insecticide modes of action, whilst the pea aphid (*Acyrthosiphon pisum*) remains largely susceptible to most aphicides. As both aphids can be found in pea and bean crops a misidentification can lead to unexpectedly reduced control. If identification of the pest species is unclear, consult with local advisors for guidance on identification and insecticide susceptibility.

7. Consider the systemic properties of some soil and seed-applied products.

The systemic properties of some active ingredients allow these products to be applied either directly to the soil, as a seed treatment or as foliar spray. Systemic activity may extend the residual efficacy and the length of the MoA spray window and needs to be considered when planning a program to minimize resistance development. If further insecticide treatment is required after either a seed treatment or a soil application (e.g . via drench, drip irrigation or granular in-furrow applications), it is recommended to use an effective foliar product with a different mode of action.

8. Ensure good coverage and retention of insecticide spray applications to optimize pest control.
Sucking pest insects are often located in non-exposed parts of the plant, either on the underside of leaves, at the base of the plant or hidden in flowers. In order to achieve the optimal level of control of these difficult to reach pests, ensure that good spray coverage of the affected plant parts and optimal retention of the insecticide product are achieved by following label instructions on spray equipment, application volumes and the addition of adjuvants or additives.

9. Ensure that insecticide applications target the most appropriate target insect life stage.
Some insecticide modes of action are active against specific life stages of the target insect pest (e.g. insect growth regulators such as inhibitors of chitin biosynthesis target juvenile insect stages such as nymphs/larvae) and therefore may either be ineffective or only provide partial control of other life stages if present in the target environment. Read the product label carefully and follow instructions to ensure products are applied optimally to control the target pest. If in doubt about the timing of application of any product for best effects consult with the product manufacturer or local approved advisor. Also note that some forms of insecticide resistance are also life stage specific. For example neonicotinoid resistance in tobacco whitefly (Bemisia tabaci) only affects pupae and adults. This can mean that although some populations of insects may develop resistance, the affected product may still provide some level of control against susceptible life stages.

10. Selection of the appropriate insecticide in order to maintain pest control and the preservation of non-target organisms.
Different insecticide products have different selectivity profiles depending on their active ingredient and use pattern (e.g. foliar, soil, seed applied). The preservation of non-target organisms is beneficial in maintaining both a healthy environment and in maintaining control of pests through the preservation of predators and parasitoids. Where possible it is recommended to utilise target pest specific insecticides to minimise the impact on non-target organisms and limit the use of broader spectrum insecticides to incidences where multiple pest species may be present within the crop.

11. Using insecticide mixtures.
IRAC has issued advice about the use of insecticide mixtures. For guidance refer to the IRAC-mixture-statement and IRAC leaflet-on-use-of-mixtures. As with applying single active ingredient products, insecticide mixture products should be used with careful consideration of the characteristics of the individual active substances, use pattern and pest complex targeted.

12. The use of insecticides of the same Mode of Action against different pests in the same crop.
Multiple uses of different insecticides against more than one pest species in the same crop are feasible but should be considered within the framework of insecticide resistance management programs and developed at local level, taking into account changes in pest populations, overlapping of different species, the relative importance and the risk of resistance development. Good resistance management practices such as avoiding repeated applications of the same mode of action across multiple treatment windows due to application against multiple pest species are key to successful IRM implementation. Where two species appear simultaneously always use the higher recommended rate for the more difficult to control species.

13. Avoid using insecticides from the same Mode of Action where resistance is known.

Continuous use of the same mode of action on a resistant population may escalate resistance levels and should be avoided, particularly if the product is used at higher than recommended rates. This recommendation is valid for solo and mixture products that contain the affected MoA.

14. Monitor problematic pest populations in order to detect first shifts in sensitivity.

Baseline sensitivity data for representative field populations of pests should be established by industry experts before the products became widely used. Re-examining the insecticide sensitivity of pest populations at regular intervals can be used to detect changes in susceptibility.

Monitoring methods for many of the major agricultural pests have been established by IRAC and can be found on the IRAC website www.irac-online.org/teams/methods/. Reporting of field failures to IRAC company representatives is also a good way to detect early shifts in pest sensitivity.

15. Where local information is known about cross-resistance between different MoA groups.

Although in most situations rotation between different mode of action (MoA) insecticides will be useful, there have been some cases of metabolic cross resistance between molecules belonging to different groups. Therefore, it is recommended to consult local experts to find out the known status of resistance in your area. Avoidance of cross-resistance may help to build up a more effective rotation strategy.

16. Never use a product of questionable origin or composition.

Products from unknown or non-approved sources may not have the advertised composition, in which case efficacy may be affected and IRM becomes impossible. Moreover, illegal products may pose risks for users and the environment.

References

1.) Sparks, T. and Nauen, R. (2015) IRAC : Mode of action classification and insecticide resistance management. Pesticide Biochemistry and Physiology 121: 122 - 128