INSECTICIDE RESISTANCE MANAGEMENT GUIDELINES

IRAC GROUP 30 INSECTICIDES

Version 3.1

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Insecticide Resistance Action Committee

SECTION 1: Introduction

Insecticides which are considered GABA-gated chloride channel allosteric modulators and are classified into Group 30 of the IRAC Mode of Action Classification are a new class of insecticide chemistry, with first registrations in agriculture made during 2018. They represent a valuable resource for the control of insect and mite pests in many agricultural and horticultural markets and therefore it is considered essential to maintain their effectiveness through sustainable use.

The evolution and spread of insecticide resistance pose a significant challenge to the sustainable use of insecticides and acaricides in both agricultural and horticultural markets. Historic evidence of insecticide resistance development suggests that the performance of insecticides to which insects have developed resistance can be significantly reduced resulting in increased doses, increased frequency of application or necessitating a switch to another unaffected mode of action.

This document aims to provide basic guidelines for the prevention or delay in the onset of resistance to the IRAC Group 30 classified insecticides. The document serves as a technical document aimed at employees of the agrochemical companies developing, manufacturing, or distributing these insecticides, as well as a guide for those developing local pest management guidelines.

The management of insecticide resistance is only one of the key considerations that needs to be considered by the modern agriculturist and as such the economic, social, environmental, and human health impacts of any pest management program also must be considered.

At the time of writing there are no known cases of resistance to Group 30 insecticides, therefore the guidance and recommendations provided in this document are based on the current best practice and available knowledge. Should new information arise, then IRAC will endeavour to update this document with the new learnings.

The scope of this document is for crop protection uses including foliar, soil and seed treatments. The public health and animal health uses of group 30 insecticides are not covered in this document.

SECTION 2: Group 30 insecticides background & summary

IRAC Group 30 is a new mode of action group, acting on the insect nervous system, that allosterically inhibits the GABA-activated chloride channel, causing hyperexcitation and convulsions. GABA is the major inhibitory neurotransmitter in insects.

This group is represented by Meta-diamides and Isoxazolines. Three insecticidal compounds are currently classified within this group: Broflanilide (meta-diamide), Fluxametamide and Isocycloseram (isoxazolines). However, registration status differs between compounds and depending on region not all of them are available to all end users.

30 GABA-gated chloride channel allosteric modulators Nerve & muscle action	Broflanilide
	Fluxametamide
	Isocycloseram

Source: IRAC MoA Classification v.10.1, December 2021 www.irac-online.org

The guidelines presented here are designed by the Group 30 Task Team of the Insecticide Resistance Action Committee (IRAC). They are based on guidelines published in the IRAC Mode of Action Classification Scheme (2021, version 10.1) and on Guidelines on Prevention and Management of Pesticide Resistance (FAO, 2012).

As pest problems and control practices differ considerably between countries, crops and climatic conditions. These guidelines must cover a wide range of flexible options thus allowing regional experts to develop, implement and adapt these options to take local conditions into account.

The information provided is based on published information and to the best of IRAC International's knowledge at the time of writing (December 2021).

Status of Resistance to Group 30 (GABA-gated chloride channel allosteric modulators) Insecticides

There are currently no recorded cases of insect or mite resistance to IRAC Group 30 compounds. However, as of the time of writing, the number of granted registrations for these products is limited. As registrations and product use increases, so will the risk of resistance development.

Factors that may contribute to the development of resistance to Group 30 Insecticides:

- Multiple Group 30 products are commercially available or under development: At the time of writing there are four companies (BASF, Mitsui, Nissan and Syngenta), that have developed, and registered products containing a Group 30 Insecticide or have compounds in development phase in their pipelines. This increases the challenge of maintaining susceptible populations and requires discipline in implementing coordinated IRM (Insecticide Resistance Management) programs through inter-company cooperative efforts.
- Natural variation in susceptibility is expected within target pest populations. It highlights the need for end users to follow local recommended application guidelines and follow recommended resistance management programs to ensure long term effective control.

- Long residual activity: Group 30 insecticides are highly effective and can provide long residual activity depending on method of application and rate used. While these characteristics are desirable, if not properly managed, they can impose

significant selection pressure on a target pest population. This can decrease the susceptibility of selected pest populations in a relatively short period of time.

SECTION 3: Resistance management guidelines

Guidelines for use of Group 30 insecticides and resistance management

1. **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. Always make sure that all the spray equipment is in good condition and calibrated.

2. Rotation of insecticide Groups acts against rapid selection of resistant populations.
By diversifying the mode of action used in the crop cycle, the farmer is avoiding prolonged selection for one resistance mechanism. Carefully planned rotation of active ingredients from different mode of action groups provides the best option for minimizing resistance development. Sufficient intervals should be left between applications of active ingredients with the same modes of action. When spraying a product to control a multi-generation pest, the choice of insecticides in the rotation strategy needs to allow for follow-up applications with other active ingredients. This enables the farmer to prevent season long exposure of the target pest to a single chemical group or mode of action. Adopt a window strategy by limiting Group 30 treatments onto one generation of the target pest and switching to other modes of action in the subsequent generation. In many countries, the IRAC Group class number is now given on the label of the product. It can also be found in the MoA Classification published on www.irac-online.org

3. Use suitable rotation partners for Group 30 insecticides.
There is an extensive range of insecticides with different modes of action which can be used as rotation partners for Group 30 insecticides. Advice on suitable rotation partners can be obtained from IRAC's Mode of Action Classification available here. Local rotation strategies should be developed according to the insecticides registered for the particular use in question and commercially available to the farmer. Other factors which need to be considered include: the crops grown in the agrosystem, prevalent refuge crops, the insect pest complex, seasonal distribution, and resistance profiles of the target insects, together with occurrence and relevance of beneficial organisms.

4. Using insecticide mixtures
IRAC has issued a statement and a leaflet for the use of insecticide mixtures. In principle any two insecticides from the same mode of action group should not be tank-mixed or co-formulated to manage resistance.

5. The use of Group 30 insecticides against different pests in the same crop.
Multiple uses of different Group 30 insecticides against more than one pest species in the same crop is feasible but needs, at the local level, to take into account the pest populations dynamics, overlapping of the various species, their relative importance and each species'

potential risk for developing resistance. When two species appear simultaneously, always use the recommended rate for the more difficult to control species. When they appear independently at different crop stages, then always use the individual recommended rate for each species.

6. The use of non-specific mode of action products and IPM techniques help to prevent the development of resistance.

The use of integrated crop management (IPM) provides important tools in both managing crop pests and preventing resistance development. IPM techniques include monitoring and adhering to recommended pest and/or damage thresholds, respecting the usefulness of natural enemies, simple sanitation and removal of post-harvest residues in the fields. In addition, the use of resistant crop varieties and even by simply avoiding continuous year-round cultivation of a single crop can all help to slow down and even prevent resistance development. It is recommended that growers use a variety of practical IPM techniques to manage insect pests and minimize the number of insecticide applications as much as possible.

7. Plan the use of Group 30 insecticides in such a way that they complement the efficacy of the prevalent beneficial organisms.

The contribution of beneficial organisms to pest control can be significant in many cropping systems and can also play an important part in resistance management. They can effectively help control the target pests regardless of their degree or mechanism of resistance and can help slow down the resistance selection process. Proper timing of applications should target periods of lower beneficial organism activity or during their protected life stages when they are less prone to exposure to the insecticide treatment.

8. Monitor problematic pest populations to detect first shifts in sensitivity.

The generation of baseline sensitivity data for representative field populations of target pests is a useful tool for measuring changes in susceptibility over time. Ideally baseline susceptibility should be measured before the products containing the same or similar active ingredients are widely used. Re-assessing the insecticide sensitivity of these populations through a monitoring program conducted at regular intervals can detect possible changes in susceptibility. Monitoring methods for the major agricultural pests have been established and can be found on Test Methods | Insecticide Resistance Action Committee (IRAC) (irac-online.org). Following up reports of field failures are also a good way to detect early shifts in pest sensitivity.

SECTION 4: Label guidelines for Group 30 insecticides

4.1 IRAC Mode of Action icon

For insecticide applicators to be able to identify insecticidal product with the same mode of action and to choose between alternative MoAs for resistance management, the IRAC Mode of Action Classification Scheme was developed. Each insecticide mode of action is given a unique MoA number code.

Products containing a solo active ingredient.

It is requested that the MoA icon is displayed in a prominent position on the label. A clearly defined font should be used, (e.g., Arial or Calibri). A black and white colour scheme is recommended.

The icon uses the word GROUP in capital letters in black font on a white background; the mode of action letter or numeral should be in white font on a black background; the word INSECTICIDE in capital letters in black font on a white background. Both lines, and the whole indicator, are contained within black rectangles. See example below.

The words GROUP and INSECTICIDE in capital letters which should not be less than one-quarter of the height of the largest letter or numeral on the label and be between 2 mm and 12.5 mm high.

The letter(s) representing the mode of action should be written in capital letters which should not be less than one-half the height of the largest letter or numeral on the label and between 4 mm and 25 mm high. In any event, the words GROUP and INSECTICIDE must be no less than half, and no more than the actual size of the group number or letter.

Products containing two or more insecticide active ingredients

If more than one pesticide is included in a product then the icon should be written in plural e.g. INSECTICIDES not INSECTICIDE. The appropriate letter(s) or number(s) representing the Mode of Action (MoA) group(s) of each active constituent(s) are to be inserted between the words GROUP and INSECTICIDES (See example below).

The width of the white line that separates the groups for the pesticides in a product with more than one active ingredient should be defined. It should be wide enough so that when the icon is printed on small packets the line is clear.

Alternatively, the two or more insecticides can be stacked together.

Products containing one or more insecticide active ingredients and either a fungicide or herbicide.

Note that where a product has two or more active constituents, and these are represented by two or more modes of action, you must use two or more appropriate MoA identifier letters or numbers in a single statement. If in the product concerned (for example, an insecticide and a fungicide) these active constituents perform different types of functions,

you must show each function separately (that is, one indicator panel for the insecticide and another for the fungicide component). See example below.

GROUP	30	INSECTICIDE
GROUP	7	FUNGICIDE

Further information can be found at https://croplife.org/wp-content/uploads/2020/12/MoA-Labelling-Guidance-Revised-final-HRAC-transition-1.pdf

USE THESE GUIDELINES FOR LABEL DEVELOPMENT, PRODUCT POSITIONING, AND DEVELOPMENT OF LOCAL IRM PROGRAMS.

4.2 Maximum number of product applications

It is requested that all labels provide information on the maximum number of applications per product per crop cycle.

This information should be provided in the 'Directions for use' section of the label text. The Maximum number of applications should correlate with the resistance management recommendations, minimising repeated exposure of successive generations of the target pests to the single product.

4.3 Insecticide Resistance Management Recommendations

It is requested that each insecticide label contains a written insecticide resistance management guideline.

The insecticide resistance management guidelines should include three fundamental elements.

1. The IRAC mode of action group number and active ingredient name.
2. A recommendation that Group 30 insecticides are rotated with other modes of action using treatment windows.
3. A recommendation, that consecutive generations of the target pests are not treated with the same mode of action.

Example of three statements, which are compliant with the requested elements are presented below.

EXAMPLE 1: Short text version

PRODUCT NAME contains the active ingredient ACTIVE INGREDIENT NAME and is a Group 30 insecticide. The repeated use of PRODUCT NAME and other group 30 insecticides may result in the selection of insects which are resistant. To avoid or delay the selection of resistant insects, Group 30 insecticides should be used as part of an insecticide resistance management (IRM) strategy which avoids exposure of successive generations of the target pest to the same insecticides by rotating insecticides with

different modes of action within treatment windows and utilizing alternative methods of pest control in an integrated pest management (IPM) approach.

EXAMPLE 2: Longer text version

PRODUCT NAME contains the active ingredient ACTIVE INGREDIENT NAME and is a Group 30 insecticide. The repeated use of PRODUCT NAME and insecticides belonging to Group 30 may result in the selection of insects which are resistant and as a result product performance may be reduced. All Group 30 insecticides share the same biological site of action and it is assumed that evolved resistance will also affect other insecticides within group 30. In order to avoid or delay the selection of resistant insects, Group 30 insecticides should be used as part of an insecticide resistance management (IRM) strategy which incorporates the following: Insecticides from the same mode of action group should not be used to treat successive generations of the target pest. Multiple applications of the same insecticide may be applied but only when targeting a single generation of the target insect. If more than one application of an insect control agent is required to control successive generations of the target pest then alternative insecticides with different modes of action should be utilized in rotation with group 30 insecticides and between treatment windows. Where possible alternative methods of pest control should be utilized as part of an integrated pest management (IPM) approach.

EXAMPLE 3: Short text, insecticide mixture

PRODUCT NAME contains the active ingredients ACTIVE INGREDIENT NAME 1 which is a Group 30 insecticide and ACTIVE INGREDIENT NAME 2 which is a GROUP NUMBER insecticide. The repeated use of PRODUCT NAME and other group 30 and GROUP NUMBER insecticides may result in the selection of insects which are resistant. In order to avoid or delay the selection of resistant insects, Group 30 and GROUP NUMBER insecticides should be used as part of an insecticide resistance management (IRM) strategy which avoids exposure of successive generations of the target pest to the same insecticides by rotating insecticides with different modes of action between treatment windows and utilizing alternative methods of pest control in an integrated pest management (IPM) approach.

Where possible alignment of the insecticide resistance management recommendations should be aligned between companies manufacturing or distributing group 30 insecticides within an individual country.

SECTION 5: RECORDS OF RESISTANCE

This section contains references to publications on Group 30 products, and references to records of resistance in Group 30. It also provides guidelines on measuring pest sensitivity and resistance following IRAC recommended methods. This facilitates future comparisons and harmonises methods and strengthens our ability to manage resistance.

5.1 Recommended IRAC Methods and validation reports

Pest group	*Pest*	Name	Stage/ Method	IRAC Method	Validation	Comments
Lepidoptera	*Plutella xylostella*	Diamondback moth	Larvae/Dip	018		Proposed
Lepidoptera	*Spodoptera* sp. *Helicoverpa* sp.	Leafworm Fruitworm	Larvae/Diet	020		Proposed
Lepidoptera	*Tuta absoluta*	Tomato Leafminer	Larvae L2/Dip	022		Proposed
Thysanoptera	*Frankliniella* sp.	Western Flower thrips	Adults/Dip	010		
Acarida	*Tetranychus* sp.	Spidermites	Adult/Dip	004		Proposed
Coleoptera	*Phyllotreta* sp.	Flea beetle	Adult/Vial	031		Proposed
Diptera	*Liriomyza* sp.	Leafminer				tbd
Heteroptera	*Euschistus* sp.	Stinkbug	Adults/Vial	030		Proposed
Heteroptera	*Lygus* sp.	Mirid Bugs	Adults/Nymphs/Dip	033		Proposed
Hemiptera	*Psyllidae*	Pear & Potato Psyllid	All Stages/Dip	002		Proposed
Hemiptera	*Diaphorina citri*	Asian Citrus Psyllid	Nymph/Dip	032		Proposed
Hemiptera	*Nilaparvarta lugens*	Brown Planthopper	Adult/Dip	005		Proposed
Hemiptera	*Bemisia tabaci*	Whitefly	Adults/Dip	015 016		Proposed

The proposed methods above need to be validated with the Group 30 compounds before being approved by IRAC. It is generally recommended to establish baseline sensitivity in target pest populations in several countries before sales of each compound commence. Future sensitivity monitoring is conducted at each company's discretion. All data is under the ownership of the company generating the data, and publication is voluntary.

5.2 Literature and references

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