Insecticide Resistance Action Committee (IRAC) Mode of Action Classification: Bioinsecticides and Nematicides

Overview

- Insecticide resistance is a critical issue with important implications for agriculture and human health.
- The Insecticide Resistance Action Committee (IRAC) was established to prevent or delay the development of resistance in insect and mite pests by promoting the development and implementation of insecticide resistance management (IRM) strategies.
- IRAC developed and maintains the Mode of Action (MoA) Classification scheme as a key resource to enable the development of IRM strategies (Fig. 1).

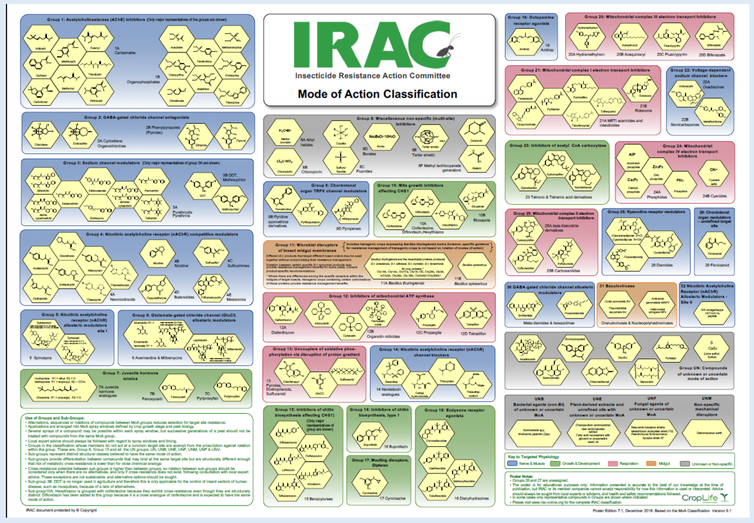

Fig. 1. IRAC MoA Classification scheme for developing IRM strategies

- **The objective of this poster is to communicate several recent changes to the IRAC MoA classification scheme, notably with respect to bioinsecticides and nematicides.**

Why Classify Bioinsecticides and Nematicides?

Biopesticides

- Bioinsecticides are currently used in IRM and integrated pest management (IPM) programs and the understanding of MoA of bioinsecticides is growing.
- Some bioinsecticides were already classified by IRAC (e.g. Bt proteins), but others were not.
- Many regulatory agencies are requiring or encouraging the classification of MoA on product labels to facilitate the implementation of sustainable practices (Fig. 2).

GROUP 1A INSECTICIDE

Fig. 2. Recommended pesticide MoA information box format for pesticide labels by CropLife International.

Nematicides

- The IRAC Nematode Working Group has also formally classified commercial nematicides, including bionematicides, in a separate classification scheme with unique MoA categories.
- Please visit www.irac-online.org for printable versions of the Nem classification scheme and further information.

Bioinsecticides

- For unknown (UN) groups, target protein responsible for activity is unknown, or uncharacterized.
  - A new MoA classification group is created if there insufficient evidence to demonstrate specificity of interaction for an understanding of MoA e.g. **Group 31 Baculoviruses**
  - If there is insufficient evidence to demonstrate specificity of interaction and lack of understanding of the MoA, it will be placed in an unknown category

Table 1. Classification of several bioinsecticides within the IRAC MoA unknown category.

Main Group and Primary Site of Action	Chemical Sub-group or Exemplifying AI	Active Ingredients
UN* Compounds of unknown or uncertain MoA	Azadirachtin	Azadirachtin
	Benzoximate	Benzoximate
	Bromopropylate	Bromopropylate
	Chinomethionat	Chinomethionat
	Dicofol	Dicofol
	Lime sulfur	Lime sulfur
	Mancozeb	Mancozeb
	Pyridalyl	Pyridalyl
	Sulfur	Sulfur
UNB* Bacterial agents (non-Bt) of unknown or uncertain MoA		*Burkholderia* spp, *Wolbachie pipientis* (Zap),
UNE* Plant-derived extracts and crude oils of unknown or uncertain MoA		*Chenopodium ambrosioides near ambrosioides* extract Neem oil Fatty acid monoesters with glycerol or propanediol
UNF* Fungal agents of unknown or uncertain MoA		*Beauveria bassiana* strains *Metarhizium anisopliae* strain F52, *Paecilomyces fumosoroseus* Apopka strain 97
UNM* Non-specific mechanical disruptors		Diatomaceous earth
UNP* Peptides of unknown or uncertain MoA		
UNV* Viral agents (non-baculovirus) of unknown or uncertain MoA		

*Actives in groups marked with an asterisk are thought not to share a common target site and therefore may be freely rotated with each other unless there is reason to expect cross-resistance. These groups are 8, 13, and UN.

Summary

- The IRAC MoA scheme remains a living document.
  - As our understanding on the specificity of target site and MoA of chemistry and bioinsecticides improves, IRAC will review the data for (re)classification.
- Classification of new technologies (e.g. dsRNA) will be undertaken when a request is made to IRAC.
- New technologies will be appended to the classification until they are commercially available.
- Classification and group assignment is the responsibility of the IRAC MoA team. Request for classification/inclusion should be made via the IRAC website.