Insecticide Resistance Action Committee

Insecticide Resistance Management Guidelines for Sucking Pests

IRAC Sucking Pest Working Group

Introduction

- The guidelines have been developed by industry experts representing the **Sucking Pest Working Group** of the Insecticide Resistance Action Committee (**IRAC**), based on published information at the time of writing (June 2020).
- The aim of this guideline is to summarize strategies that growers can use to slow the development of resistance and provide more effective and sustainable pest control.
- The guidelines are meant to be flexible and allow experts to develop these options taking local conditions into account.

Insecticide Resistance

Resistance to insecticides is a *'heritable change in the sensitivity of a pest population against a certain insecticide mode of action (MoA)'* that leads to control failure of a product when used according to label recommendations.

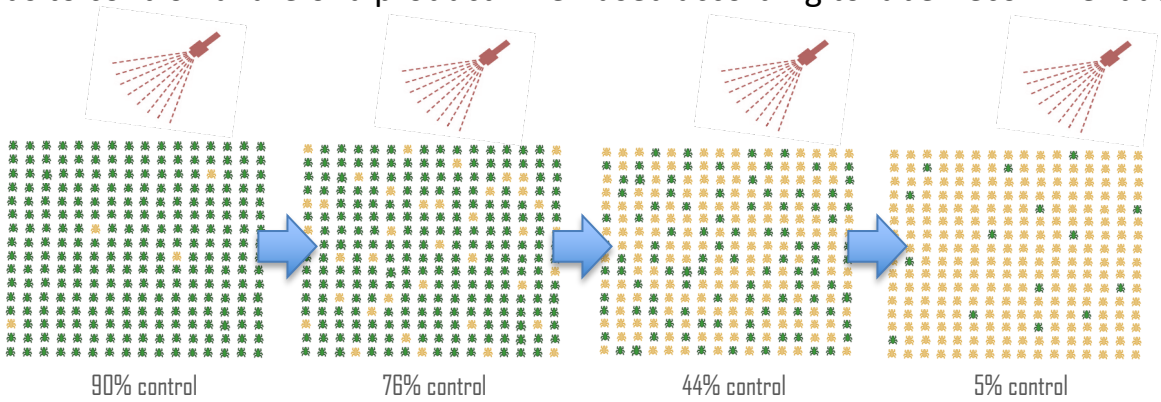


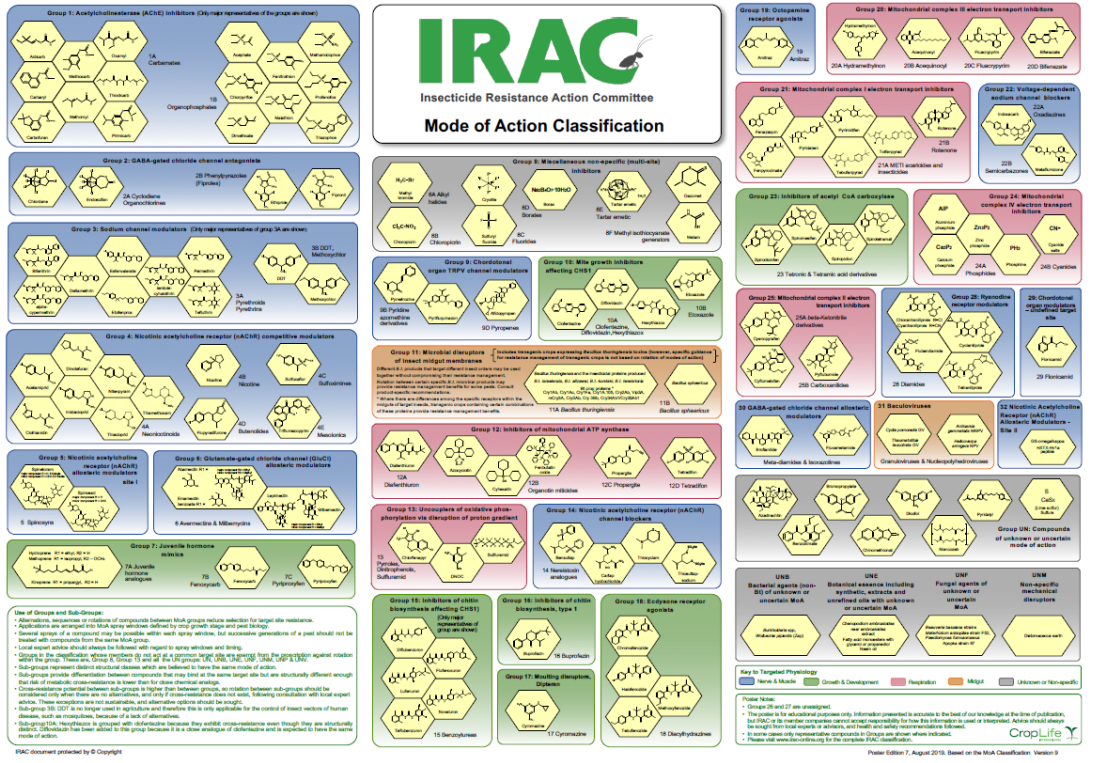
Fig. 1 Insects which are less sensitive to a certain MoA (yellow) have a better chance to survive repeated applications of products with the same MoA than sensitive insects (green). Over time the pest population consisting mainly of less sensitive (resistant) insects becomes very difficult to control using the same MoA.

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

IRAC Mode of Action (MoA) Classification

- Sucking insects can be controlled by insecticidal compounds with different MoA.
- Repeated use of any insecticide can lead to resistance to that specific insecticide.
- If insects become resistant because of a change in the target site of the insecticide, there is a high risk that insects develop resistance resistant to all insecticides within the same MoA group.
- The IRAC MoA classification is intended to identify groups of insecticides acting at the same specific target site, 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.

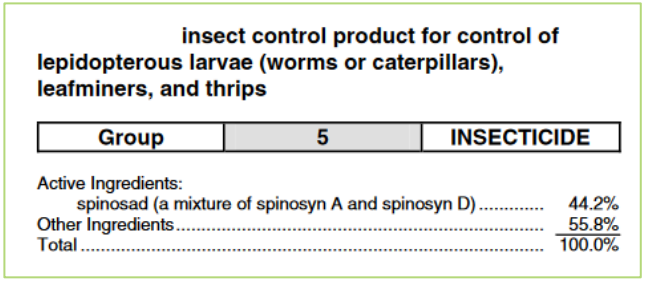


Link to The Mode of Action Classification poster on the IRAC Website: [MoA Poster]

IRAC IRM Guidelines for Sucking Pests

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 https://irac-online.org/ and the IRAC MoA App, that can be downloaded on to your cell phone using Google Play or Apple App store

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.

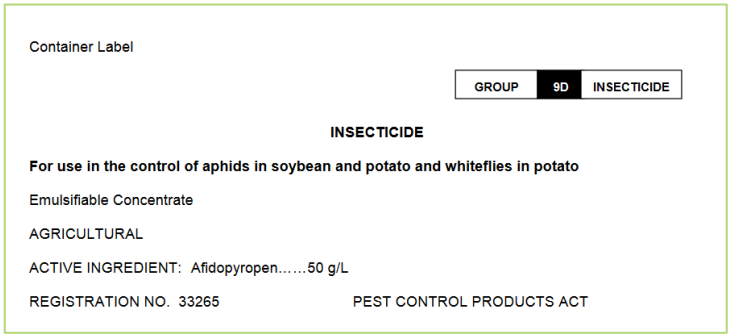


insect control product for control of lepidopterous larvae (worms or caterpillars), leafminers, and thrips

Group	5	INSECTICIDE

Active Ingredients:
spinosad (a mixture of spinosyn A and spinosyn D) 44.2%
Other Ingredients 55.8%
Total 100.0%

MoA classification group



Container Label

GROUP 9D INSECTICIDE

INSECTICIDE

For use in the control of aphids in soybean and potato and whiteflies in potato

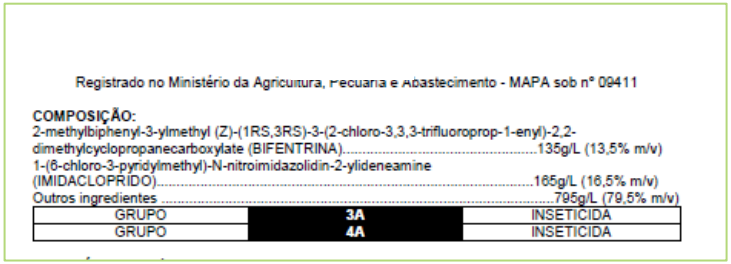
Emulsifiable Concentrate

AGRICULTURAL

ACTIVE INGREDIENT: Afidopyropen.....50 g/L

REGISTRATION NO. 33265 PEST CONTROL PRODUCTS ACT

MoA classification, group and subgroup



Registrado no Ministério da Agricultura, Pecuária e Abastecimento - MAPA sob nº 09411

COMPOSIÇÃO:
2-methylbiphenyl-3-ylmethyl (Z)-(1RS,3RS)-3-(2-chloro-3,3,3-trifluoroprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate (BIFENTRINA).....135g/L (13,5% m/v)
1-(6-chloro-3-pyridylmethyl)-N-nitroimidazolidin-2-ylideneamine (IMIDACLOPRIDO).....165g/L (16,5% m/v)
Outros ingredientes .....795g/L (79,5% m/v)

GRUPO	3A	INSETICIDA
GRUPO	4A	INSETICIDA

Mixture label: MoA classification, groups and subgroups

Guidelines:

1. IRAC member companies are responsible for including IRM information in product labels.

The principle is to provide clear IRM information. Moreover, IRAC member companies recommend stating on product labels the maximum number of applications. Implementation in countries depends on the local regulatory label guidelines.

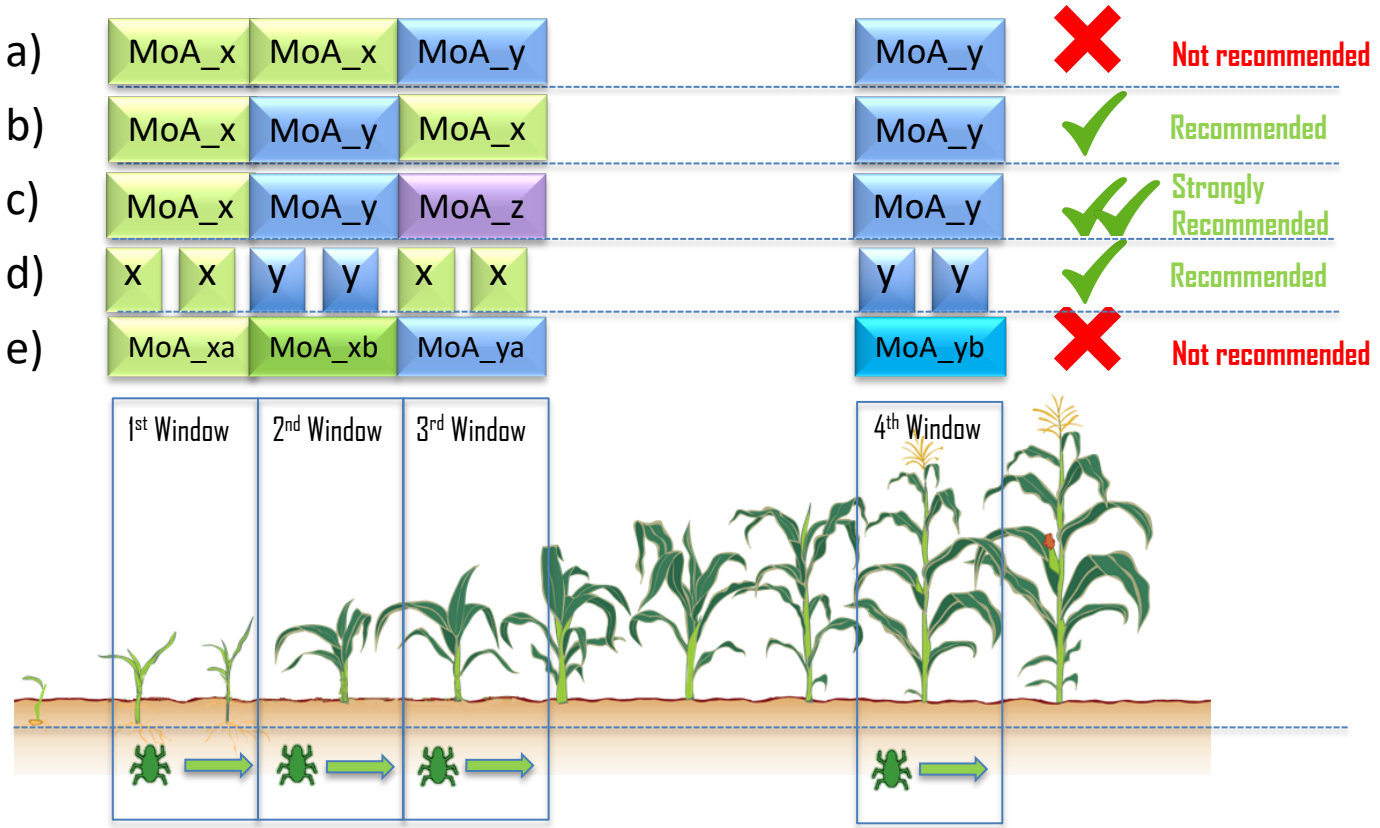
2. Always use products at the recommended label rates and spray intervals with the appropriate application equipment.

- 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.

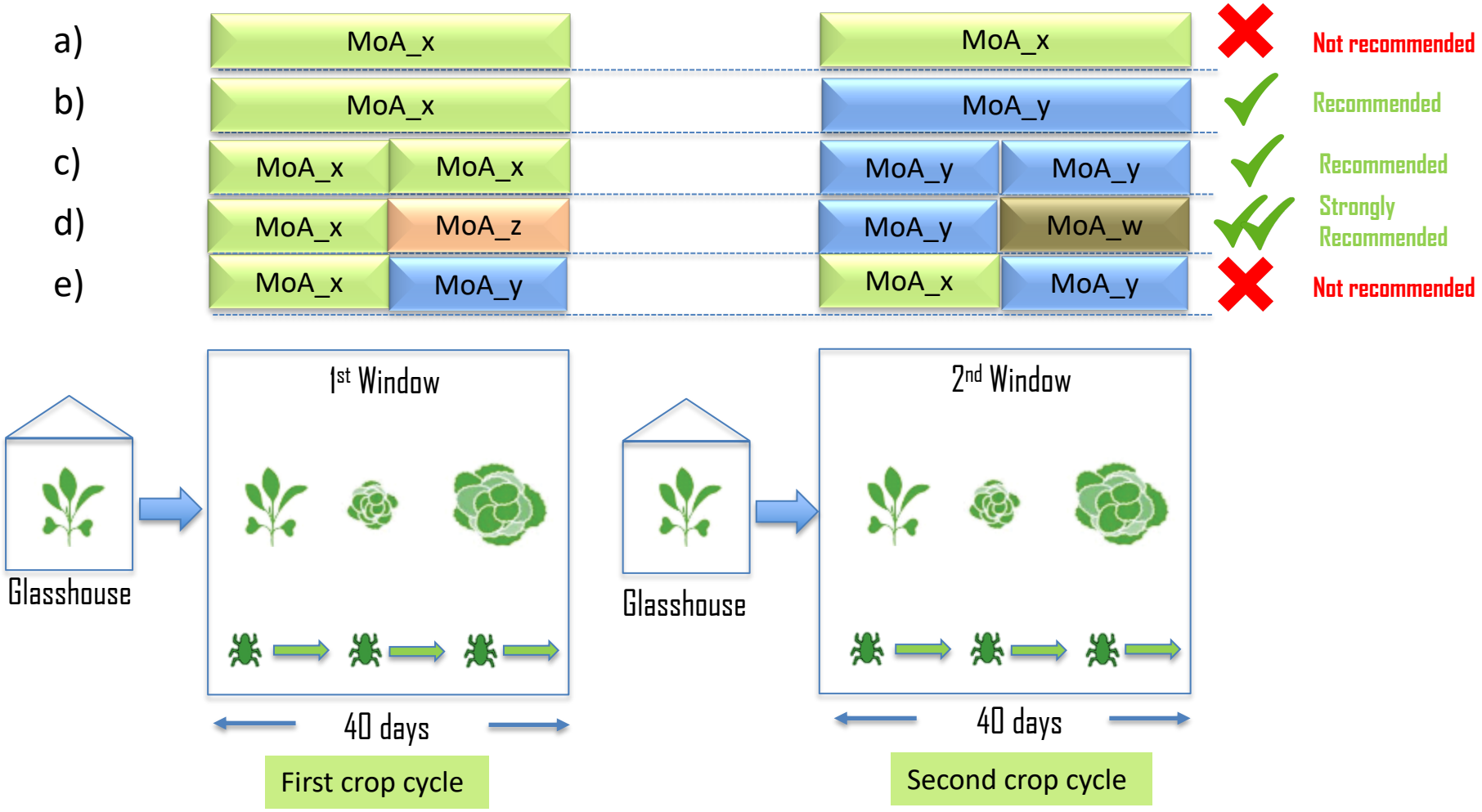
3. Rotation of insecticide MoA groups prevents rapid selection of resistant populations.

- Insecticide resistance can be avoided by rotating modes of action used in a crop cycle.
- Apply products of the same MoA only within a defined “window” in time. A window is defined by the duration of an insect generation. (15- or 30-days depending on species).

a) Do not apply insecticides with the same MoA in successive windows
b) Following a window of any MoA group, rotate to a window with a different MoA.
c) If possible rotate even more than two MoAs between application windows
d) Multiple applications (generally less than 3) of the same MoA insecticide are acceptable within a window. Make sure that the residual activity of the multiple applications fits within the window.
e) Avoid rotating products in different sub-groups of the same MoA except if there are no registered and effective alternatives.

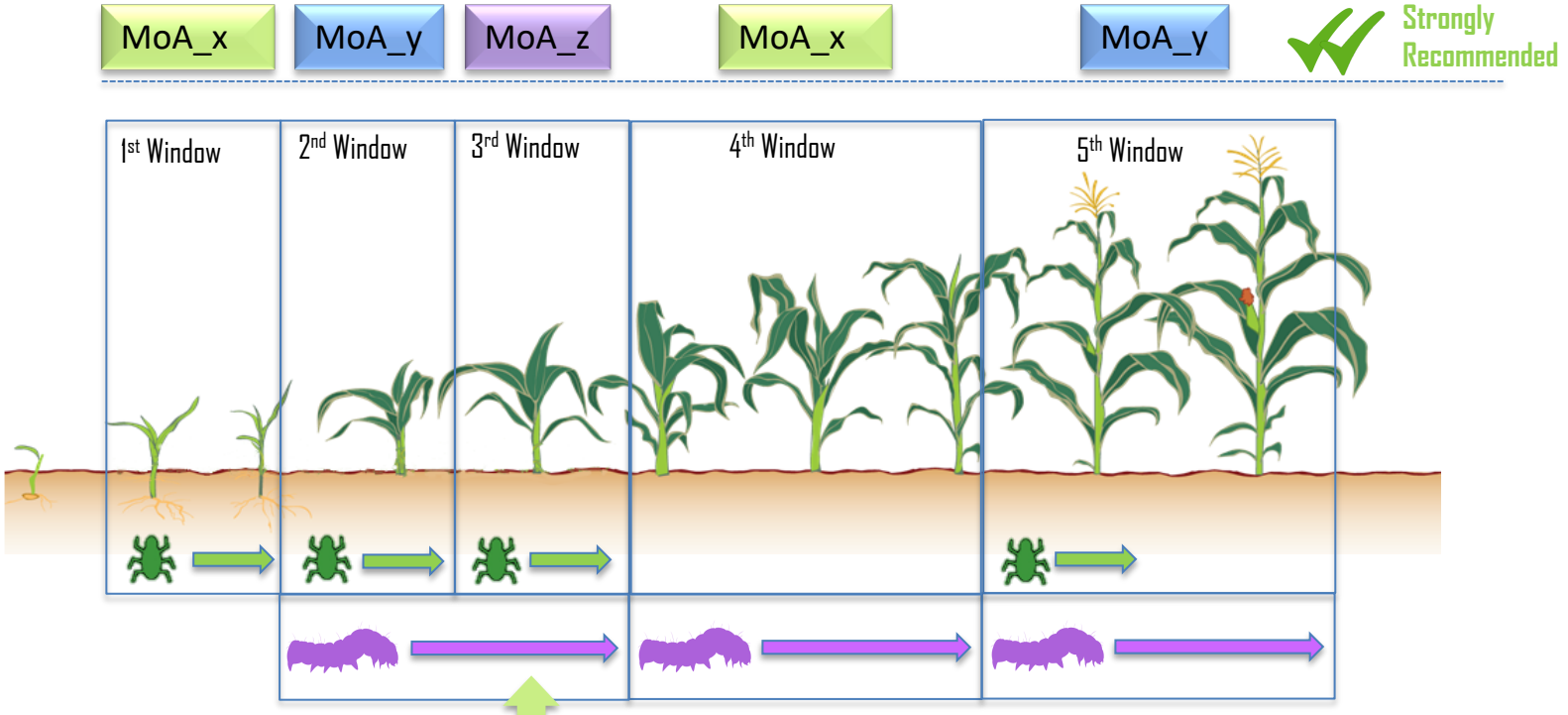


For short cycle crops with multiple plantings (e.g. lettuce), it may be necessary to consider the duration of the crop cycle as a window.



4. The use of insecticides of the same MoA against different pests in the same crop.

- Multiple uses of insecticides against more than one pest species in the same crop are feasible but should follow insecticide resistance management programs developed according to local needs, changes in pest populations and overlapping of different species.
- Good resistance management practices such as rotating MoA between treatment windows 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.

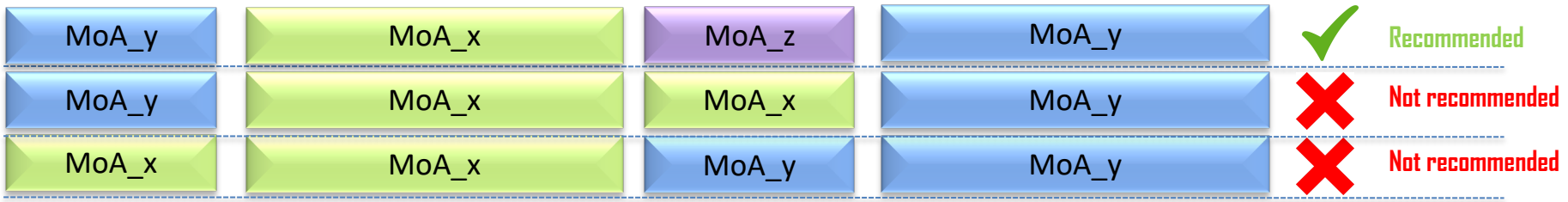


5. Transplanted seedlings

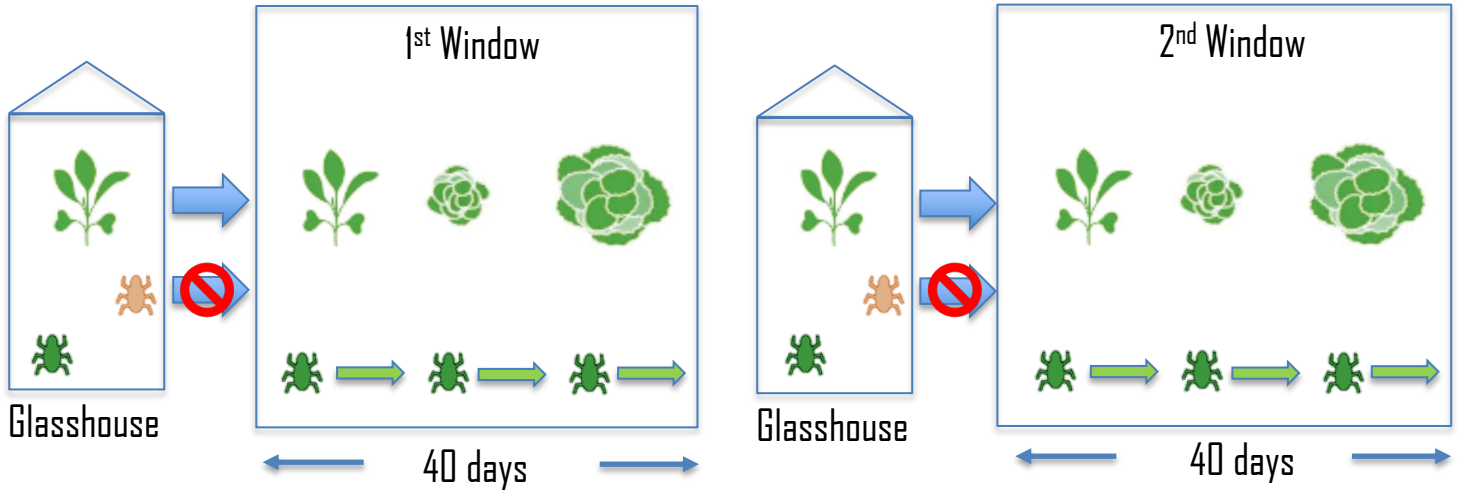
a) Growers purchasing seedlings from a nursery should enquire about insecticide use in the nursery, so that they can avoid using sequential treatments of the same insecticide MoA, upon transfer to the field.

b) In addition, growers should be aware of the resistance status of pests in transplant production areas and to ensure those resistant insects are not redistributed to local production fields.

a)

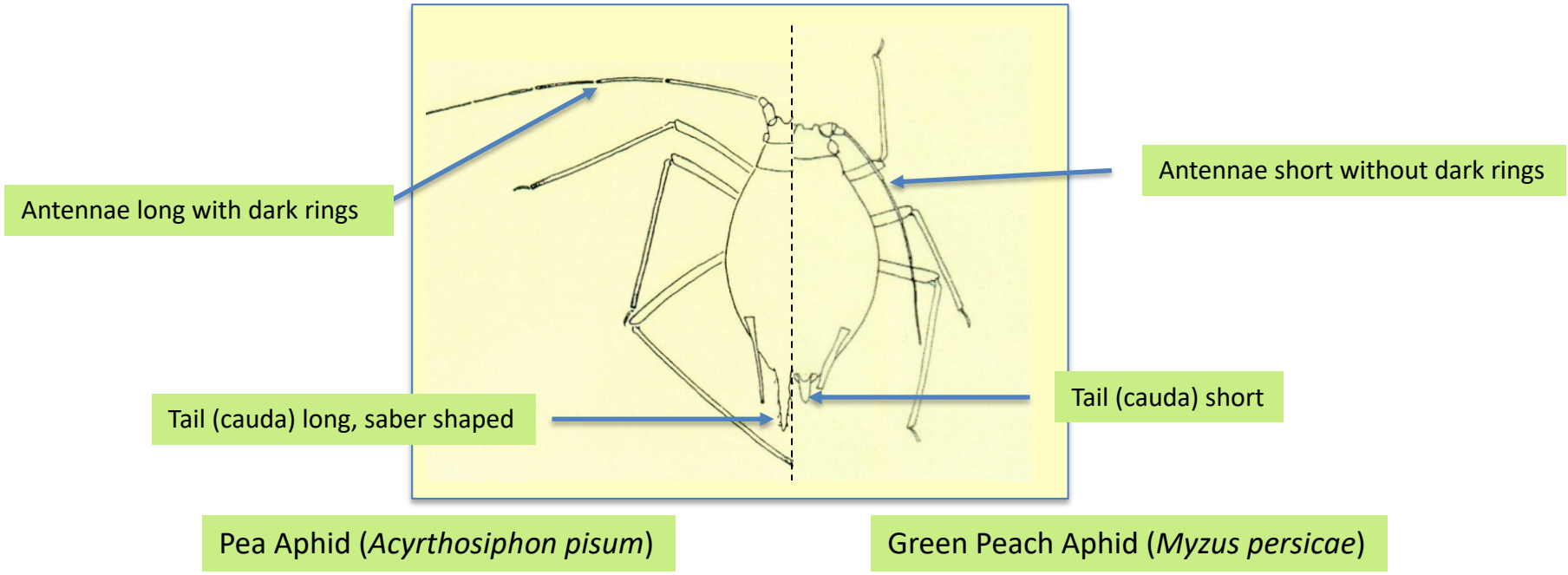


b)



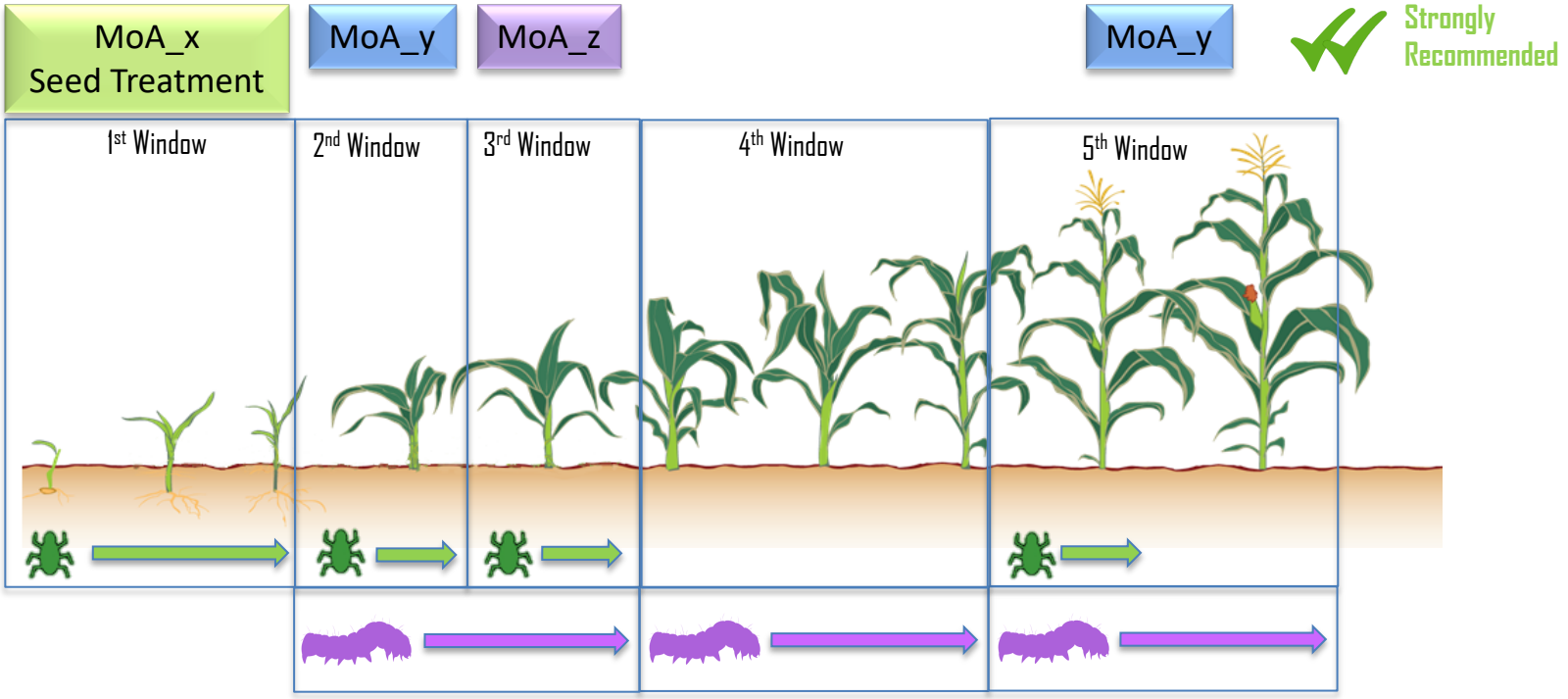
6. Correct identification of the target pests can improve the effectiveness of the insecticide application

- 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.
- 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 both, Pea Aphid and Green Peach Aphid 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.

- Systemic active ingredients can be applied either directly to the soil, as a seed treatment or as a foliar spray.
- Systemic activity may extend the residual efficacy and the length of the MoA spray window and needs to be considered 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), use an effective foliar product with a different MoA.



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.
- For efficient control, ensure good spray coverage and optimal retention of the insecticide product by following label instructions.

9. Ensure that insecticide applications target the most appropriate target insect life stage.

- Some insecticide MoA are active against specific life stages of the target insect pest and therefore may either be ineffective or only provide partial control of other life stages.
- 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 product affected by resistance 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. The mixture statement can be down loaded here.

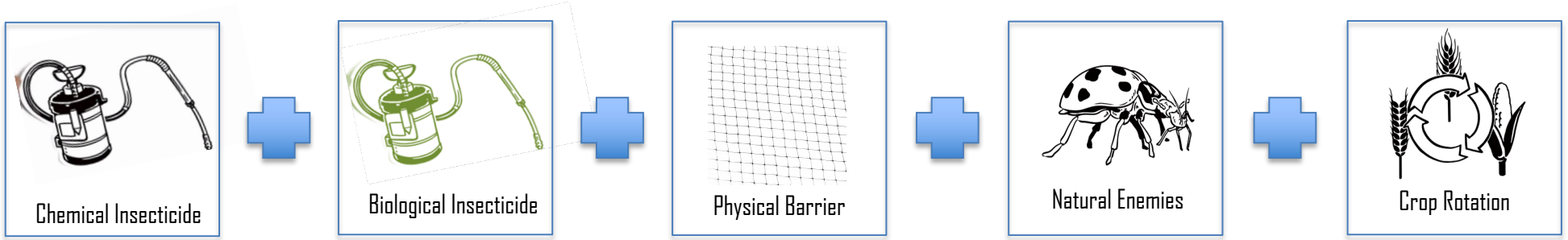
12. Use Integrated Pest management (IPM) practices to protect crops from pest damage and reduce the risk of insecticide resistance.

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:

Integrate effective control techniques including cultural, chemical, biological and plant biotechnology pest control measures, which minimize effects on non-target organisms. Some management options for sucking pests include:

a) Apply at established pest threshold levels for insecticide applications. Identify species, pest stages, population densities, and presence of natural enemies so rational pest control decisions can be made.
b) Use pest resistant or damage tolerant crop varieties.
c) Practice sanitation and removal of infested post-harvest crop residue and other pest insect host plants, including the consideration of weed management.
d) Avoid year-round cultivation of susceptible crops to limit survival of treated pest populations.
e) Conserve beneficial organisms, such a pollinators, insect predators and parasitoids.



Example of an IPM combination

13. 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 become 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/Methods team working group website: https://irac-online.org/methods/
- Reporting of field failures to IRAC company representatives is also a good way to detect early shifts in pest sensitivity.

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

- There have been some cases of metabolic cross resistance between molecules belonging to different MoA groups.
- 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.

15. 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.
- Illegal products may also 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