Insecticide Resistance Action Committee

Country Diamide Working Groups

Expectations, Responsibilities, Process

Industry Response to Maintaining Susceptibility to Diamide Chemistry

Presentation Outline (1)

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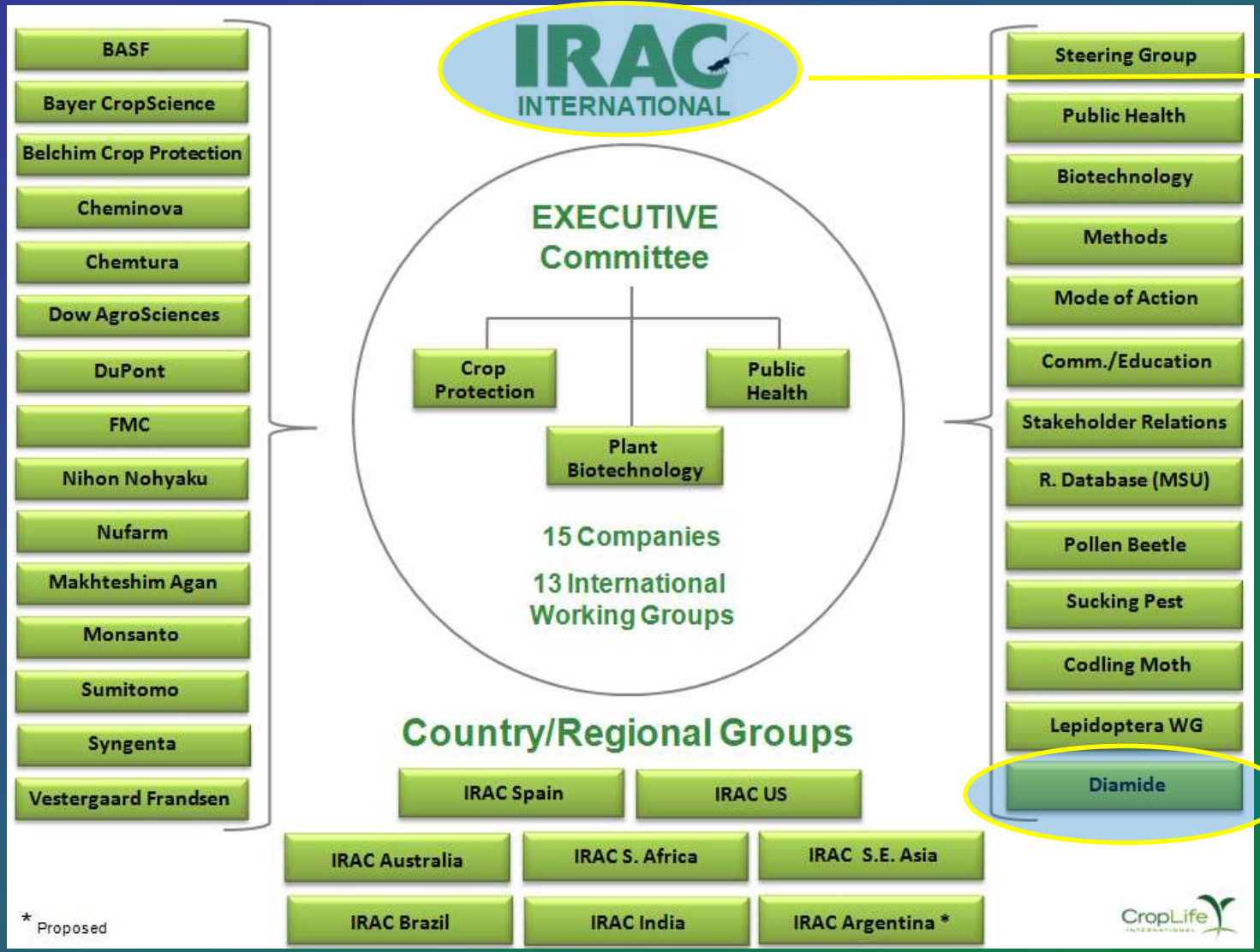
International Diamide Working Group



Global Diamide Working Group

Insecticide Resistance Action Committee

OBJECTIVE:
Development of IRM strategies for Group 28 insecticides (Ryanodine Receptor Modulators) to proactively maintain insect susceptibility and delay the evolution of resistance.

Bayer CropScience syngenta NIHON NOHYAKU CO.,LTD. DUPONT

- **2008 August: IRAC Response to Intensity of Use**
  - New global committee formed prior to major registrations of a new MOA class
- **2008 September: Global Action**
  - Published Global IRM Guidelines for Diamides several "high risk" species
  - Identified high risk situations and emerging pest issues
- **2009 January: Country Action**
  - Initiated country Diamide working groups - develop local IRM guidelines
  - Engage industrial and technical communities – Align IRM

IRAC

Insecticide Resistance Action Committee

Country Diamide Working Groups

Country Diamide Working Groups (CDWG's) are being established globally and will be industry's main advocates to maintain diamide susceptibility

17 CDWG's exist as of Feb 2011 (Italy, Morocco, Turkey in progress)

1	**Argentina**	**Jorge Morre**	**DuPont**
1	Argentina	Guillermo Fucci	DuPont
1	Argentina	Earle Gastaldi	Bayer
1	Argentina	Ruben Meoni	Bayer
1	Argentina	Daniel Ferreras	Syngenta
1	Argentina	Matias Balsa	Syngenta
1	Argentina	Daniel Courreges	Syngenta
1	Argentina	Liliana Cichon	Consultant
1	Argentina	Gamundi Juan Carlos	Consultant
1	Argentina	Mariana Sosa	Consultant
1	Argentina	Daniel Igarzabal	Consultant
2	**Brazil**	**Fabio Silva**	**DuPont**
2	Brazil	Amauri Peloia	Syngenta
2	Brazil	Alexandre José da Silva	Syngenta
2	Brazil	Luiz Weber	Bayer
2	Brazil	Paulo Aramaki	Syngenta
2	Brazil	Waldemar Sanchez	Bayer
3	China*		
3	China*	Yong C Hahn	DuPont
3	China*	Yong Zhang	DuPont
3	China*	Ya-Fei Pan	DuPont
3	China*	De-You Zhao	DuPont
3	China*	Wang Tao	Syngenta
3	China*	Meng Xiangqing	Syngenta
3	China*	Quansheng Hu	Bayer
3	China*	Motomu Moriya	Nihon Nohyaku
3	China*		Nihon Nohyaku
	* Note. Group not yet formed (need to appoint Chair vs. members)		
4			
4	India*	Rajul Edoliya	DuPont
4	India*	Vineet Singh	DuPont
4	India*	Satyanarayana	Bayer
4	India*	Subhrabitan	Bayer
4	India*	Rakesh Goel	Syngenta
4	India*	Deshmukh Rajendra	Syngenta
4	India*	Asaithambi Manickam	Nihon Nohyaku
	* Note. Group's first meeting will be March 5th (need to appoint Chair vs. members)		
5	Indonesia	Fei Ling	Syngenta
5	Indonesia	A. Marsudi	Syngenta
5	Indonesia	Agus Triwiyono	Syngenta
5	Indonesia	Iskandar Zulkarnain	DuPont
5	Indonesia	Guntur Sinaga	DuPont
5	Indonesia	Tatang Rukmana	Bayer
5	Indonesia	No representation from Nihon Nohyaku	
6	Japan	**N. Nonaka**	**Nihon Nohyaku**
6	Japan	M. Nishizuka	Bayer
6	Japan	M. Shiraishi	DuPont
6	Japan	T. Katori	DuPont
6	Japan	S. Sugii	Syngenta
6	Japan	H. Nishino	Syngenta

7	Korea*	Yong C Hahn	DuPont
7	Korea*	Ik Hwan Chang	DuPont
7	Korea*	Ung Park	DuPont
7	Korea*	SangSu Kang	Syngenta
7	Korea*	YongGwon Kim	Syngenta
7	Korea*	SangSoon Park (mkt)	Bayer
7	Korea*	JongRyul Bang (R&D)	Bayer
7	Korea*	Yeong Seok	Sojita Agro Corp for Nihon Nohyaku
8	Malaysia*	Ooi Kok Eng	DuPont
8	Malaysia*	Lee Kam Loong	DuPont
8	Malaysia*	Ngim Jeremy	Syngenta
8	Malaysia*	Mohd Hezri Sairi	Bayer
8	Malaysia*	No representation from Nihon Nohyaku	
	* Note. Group not yet formed (need to appoint Chair vs. members)		
9	Mexico	Abel Toledo	Bayer
9	Mexico	Andres Flores	Bayer
9	Mexico	Maurilio Flores	Syngenta
9	Mexico	Jose Del Refugio Munoz	DuPont
9	Note. Leadership of the team will be rotated every semestre (2nd semestre 2009: A. Toledo		
10	Philippines	**Florence Vasquez**	**Bayer**
10	Philippines	Nap Saavedra	Syngenta
10	Philippines	Rodelio Macatula	DuPont
10	Philippines	Oscar Edralin	DuPont
10	Philippines	No representation from Nihon Nohyaku	
11	**Spain**	**Josep Izquierdo**	**Bayer**
11	Spain	David De-Scals	DuPont
11	Spain	Elena Astor	DuPont
11	Spain	Luis Martin	Syngenta
11	Spain	Federico Gonzalez	Syngenta
11	Spain	Jose Luis Robles	Bayer
11	Spain	Pablo Bielza	Consultant
12	**Thailand**	**D. Dumrongsak**	**Syngenta**
12	Thailand	S. Jumroon	Bayer
12	Thailand	T. Saroch	DuPont
12	Thailand	T. Tanaka	Nihon Nohyaku
12	Thailand	S. Sahaya	Entomologist from DOA
12	Thailand	S. Sukonthabhirom	Entomologist from DOA
	Note. DOA (Department of Agriculture)		
13	**USA**	**Caydee Savinelli**	**Syngenta**
13	USA	Ralph Bagwell	Bayer
13	USA	Dan Sherrod	DuPont
13	USA	James Adams	Nichino America
14	**Vietnam**	**Dao Xuan Cuong**	**Syngenta**
14	Vietnam	Pham Quang Hung	DuPont
14	Vietnam	Bui Van Kip	Bayer
14	Vietnam	Tran Quang Hien	Nihon Nohyaku
14	Vietnam	Nguyen Trung Thanh	Consultant

IRAC
Insecticide Resistance Action Committee

Factors That Affect Evolution of Diamide Resistance

- **Target Organism:**
  - Several "high risk" species
  - Genetic variability
- Product:
  - Insecticidal activity and length (residual) of control

We have no control over these conditions

- Intensity of Use:
  - Over-dependency on single MOA
  - Number of applications per crop cycle and per year
  - Use rate per application, spray interval
  - Four companies offering two actives with same MOA

Here is where we have the only opportunity to prevent or delay the evolution of resistance !!

Maintaining Insect Susceptibility is an Industry Priority

Range of Products in Diamide Chemical Group

Global formulations that contain Diamide chemistry are increasing and not obvious to growers

- **Multiple Diamide products are often labeled for the same crop**
- **Growers are unable to determine that the active ingredients chlorantraniliprole, flubendiamide and all the various formulations contain the same MOA**

- DuPont - 5 formulations of Chlorantraniliprole
- Syngenta - 2 formulations Chlorantraniliprole + 6 formulated mixtures
- Nihon Nohyaku - Flubendiamide + 2 premix products
- Bayer CropScience - Flubendiamide + 2 premix products

In total 20+ different trade names with products containing Diamides and potentially 2+ new Diamide actives in 2012 – 2020.

***Rynaxypyr® is the registered Trade name for the technical material chlorantraniliprole**

Recommended Guidelines for Starting and Maintaining Country Diamide Working Groups

Step I: Understand the Objective

- **Objective**: Maintain insect susceptibility and delay the evolution of resistance to diamides.
- **Who**: Country experts from manufacturers and distributors of Diamide products and from the local technical community.
- **Responsibility**: Develop, implement, and communicate Diamide IRM guidelines to customers and influencers.

- Country representatives from the Diamide manufacturers: DuPont, Nihon Nohyaku, Syngenta and Bayer.
- Representatives from local distributors who sell for the Diamide manufacturers
- Key industry influencers who will help educate and implement the IRM plan: Local experts from Universities, Government, advisors, consultants, extension organizations

IRM Guidelines are developed by the Country Diamide WG working with local industry influencers. They are typically adapted from the Global Diamide IRM Guidelines

The focus is to implement IRM strategies before resistance occurs. Ideally just at launch or soon after.

Step II: Organize and Meet

- Country participants will be contacted by the Global Diamide WG.
- The first meeting will be initiated by a representative from one of the manufacturing companies.
- Choose a leader who will coordinate meetings and agenda, be accountable for documenting meeting minutes and action items, and who will communicate with the Global Diamide WG.

- A member of the Global Diamide WG will help initiate the first meeting and agenda. This person will also continue to advise the country Diamide WG as they progress.
- It is highly recommended that country WG teams include company R&D personnel. Additional Marketing/Sales/ Business personnel are advisable but not mandatory
- The addition of key industry experts is recommended once the WG team has met a few times, understands their roles, and begins work on the IRM guidelines.
- Team leadership can be alternated over time

Step III. Review IRAC's Code of Conduct & Antitrust Rules

The Code is designed as a point of reference to establish standards of Conduct when IRAC Committees or individual IRAC Members are representing IRAC. This, along with the IRAC Antitrust Guidelines, forms the basis by which all IRAC Committees should operate.

The Code is also intended to reassure individuals and groups that interact with IRAC that the sole objective of the Committee is to counter the development of insecticide or acaricide resistance through joint technical strategies.

**** See full details in slides 21-26***

DO:

- Have an agenda and adhere to prepared agendas for all meetings.
- Take minutes and object if they do not accurately reflect the discussion.
- Consult legal counsel on all antitrust questions relating to meetings.
- Protest against any discussions or meeting activities which appear to violate the antitrust laws and leave any meeting in which they continue.

DON'T

….in fact or appearance, in meetings or other forum, formally, informally or even in jest, discuss or exchange information regarding:

- Pricing policies/changes, credit terms, production, capacity, inventories
- Changes in industry production, capacity or inventories.
- Bids on contracts
- Distribution or marketing plans of particular products
- Matters relating to actual or potential individual customers or suppliers

Step IV*: Review Global Diamide IRM Guidelines

1. Communicate the IRAC MOA Category (Group 28) to customers agencies).
2. Avoid repeated and exclusive use of Group 28 insecticides throughout a crop cycle for a pest species with more than one generation.
3. Use “Treatment Windows” of ca. 30 days and rotate with different Insecticide Mode of Action (MOA) groups to avoid exposure of consecutive pest generations to the same MOA.
4. For short cycle crops (< 50 days), consider the duration of the crop cycle as a “Group 28 insecticide treatment window”, thus alternate to different modes of action during subsequent plantings at the same farm location.
5. Do not expose more than 50% of the crop cycle to the same MOA group.

*** See full details in slides 27 to 40***

PDF Adobe

Global Diamide IRM Guidelines (view in presentation mode)

Step V: Select Target Crops & Insects

- Review crops and insects on the Diamide labels
- Identify the insects that pose the highest risk for resistance development
  - Based on historical evidence
  - Based on potentially greatest exposure to Diamide chemistry
- For high risk pests, determine the potential total number of Diamide applications based on review of directions of use on the available labels
- Based on the above criteria, prioritize the species and the crops that require greater effort and focus activities of the Diamide working group on these species and crops

Step VI: Plan to Communicate Diamide MOA/IRM Guidelines & Add to Labels

All company representatives agree on the IRM Icon and language and develop a plan and timeline to add these to the company labels and to incorporate these guidelines into communications to users and influencers.

IRM Statement for Label

Example 1: Comprehensive Version – Preferred

Insecticide Resistance Management (IRM)

General Recommendations: Repeated and exclusive use of ____ (product name) or other Group 28 Insecticides may lead to the development of insect resistant populations in some crops. Maintaining the longevity of ____ (product name) as an effective pest control tool for growers is critical, thus an insecticide resistance management (IRM) strategy should be established in the area of use. ____ (product name) should wherever possible be incorporated into an Integrated Pest Management program that includes cultural and biological control practices in association with the IRM guidelines detailed below. Consult your local agricultural authorities or company representative for more details.

Unless directed otherwise in the specific crop/insect sections of the label, the following practices are recommended to prevent or delay the development of insecticide resistance to ____ (product name):

- Apply ____ (product name) or other Group 28 insecticides using a "window" approach to avoid exposure of consecutive insect pest generations to the same mode of action. Multiple successive applications of ____ (product name) are acceptable if they are used to treat a single insect generation.
- Following a "window" of ____ (product name) or other Group 28 insecticide, rotate to a "window" of applications of effective insecticides with a different mode of action.
- The total exposure period of all "Group 28-active windows" applied throughout the crop cycle (from seedling to harvest) should not exceed 50% of the crop cycle.
- Avoid using less than labeled rates when applied alone or in tank mixtures.
- Target most susceptible insect life stages, whenever possible.
- Monitor insect populations for product effectiveness. If poor performance cannot be attributed to improper application or extreme weather conditions, a resistant strain of insect may be present. In this situation, ____ (product name) or other products with a similar mode of action may not provide adequate control. If insect resistance is a reasonable possibility, immediately consult with your local company representative or agricultural advisor for the best alternative method of control.

For additional information on insect resistance, modes of action and monitoring visit the Insecticide Resistance Action Committee (IRAC) on the web at http://www.irac-online.org.

Example 1

Insecticide A® 50 SC

Active Ingredient: [Compound name]

Formulation details

Group	28	Insecticide

MOA Icon and wording for Label

RESISTANCE MANAGEMENT

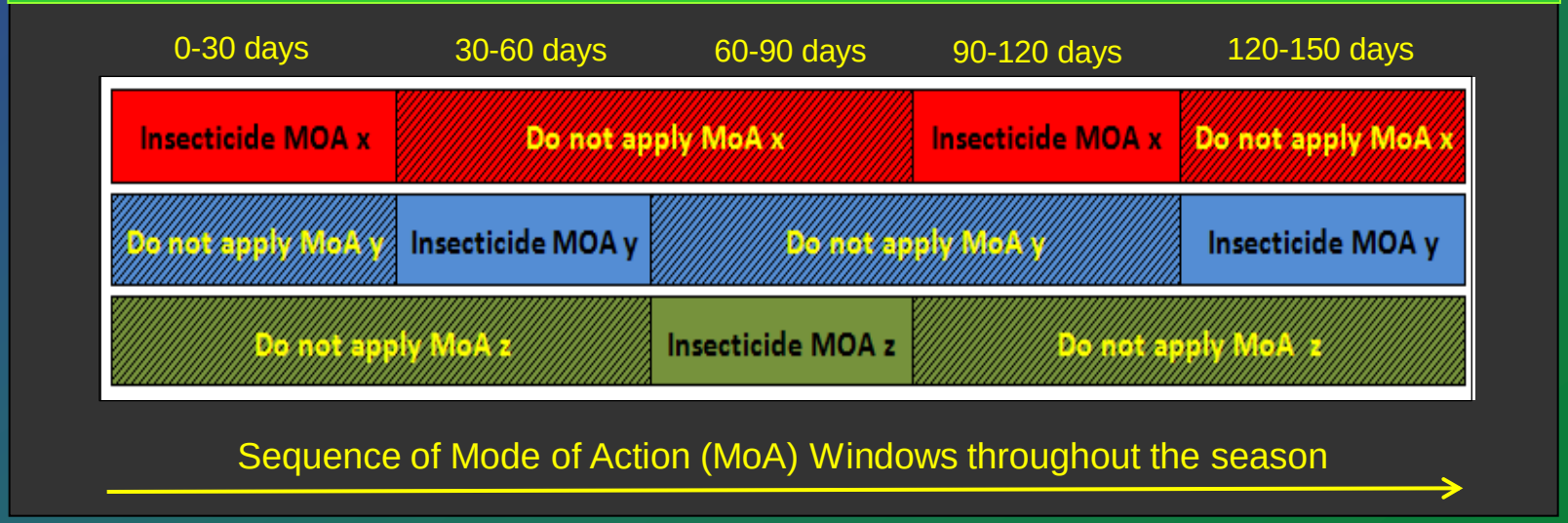
Some insect pests are known to develop resistance to products after repeated use. Because resistance development cannot be predicted, the use of this product should conform to sound resistance management strategies established for the crop and use area. Syngenta encourages responsible product stewardship to ensure effective long-term control of the insects on this label.

Voliam Flexi contains a Group 4A insecticide (thiamethoxam, belonging to the neonicotinoid class of chemistry) and a Group 28 insecticide (chlorantraniliprole, belonging to the anthranilic diamide class of chemistry). Insect biotypes with acquired or inherent resistance to Group 4A or Group 28 insecticides may eventually dominate the insect population if Group 4A or Group 28 insecticides are used repeatedly as the predominant method of control for targeted species. This may result in partial or total loss of control of those species by Voliam Flexi or other Group 4A or Group 28 insecticides.

Step VII: Plan to Develop IRM Guidelines by Crop (See Slides 28 to 40 for more examples)

- Diamide company representatives agree on the IRM rotation scheme & guidelines for their priority markets.
- Visually illustrate these recommendations using crop and insect phenology charts.
- Demonstrate the concepts of "not treating successive generations" and the "Treatment Window" concept.

Example: Insecticide Mode of Action (MoA) "Window" Approach – 150 day cropping cycle



Step VIII: Plan to Educate Growers & the Ag Community

1. Develop Training Materials for Knowledge Transfer:
 - Power Point file (company logos signature)
 - Publish inter-company IRM Guidelines (brochures, Extension communications)
 - Company labels

2. Train, Gain Alignment, Recruit Implementers:
 - Company sales reps and other personnel
 - Government and University experts
 - Regulators, advisors, consultants, technicians
 - Distribution channel
 - Growers

3. Take Advantage of:
 - Grower and distribution channel meetings
 - Industry trade shows
 - Crop Protection and Entomology Meetings
 - Technical meetings and symposiums

Ensure Influencers include the IRM recommendations into their communications.

Step IX: Plan to Take a Leadership Role Once Resistance Occurs

Group 28 Diamide Products: Action Plan To Address Insect Resistance: Guideline for High Risk Insect Pests in Targeted Markets

Time

PROCESS – PROCEDURES - ACTIONS	RESPONSIBILITY
INITIAL STEPS: (PRE-LAUNCH AND EARLY POST-LAUNCH)	
1. Establish standard diamide insecticide bioassays to test targeted insects 2. Develop baseline data on feral populations in targeted markets with diamide products 3. Establish "Diagnostic Doses" for diamide products and targeted insect pests.	1. Company, GDWG, IRAC Int'l 2. Company (option-with GDWG) 3. Company (option-with GDWG)
IDENTIFICATION, CONFIRMATION, AND COMMUNICATION OF SUSCEPTIBILITY SHIFT IN INSECT PEST POPULATION	
4. Conduct susceptibility testing in targeted markets- monitoring for lower than expected mortality at diagnostic doses: 4.1 proactive monitoring program 4.2 testing in reaction to field performance issue	4.Company or Local DWG or Contractor
5. Determine reduced susceptibility in insect population: 5.1. replicate diagnostic dose bioassay (comparison with baseline) 5.2 conduct full dose-response bioassay (comparison with baseline) - optional 5.3 determine LC_{50} for susceptible population (calculate RR) - optional 5.4 assess extent of susceptibility by regional monitoring (ID field failures, grower practices)	5. Company or Local DWG or contractor
6. If reduced susceptibility <u>is confirmed</u> by testing above: 6.1 GDWG develops a message, approved by the affected company, that explains the status of confirmed insect resistance and communicates it to all appropriate entities. 6.2 check for cross-resistance to other Group 28 products (including selected other products) 6.3 identify resistance mechanisms	6.1 Affected Company + GDWG 6.2 Company option 6.3 Company option
MITIGATION ACTIONS	
7. Country Diamide WG (if established) develops a case-adjusted IRM mitigation plan in conjunction with Global Diamide WG and local technical experts 8. Local Diamide WG aggressively implements the mitigation plan (training, monitoring, adjusts use recommendations) with assistance from academic and industry influencers 9. Further restrictions of product use 10. Continue susceptibility monitoring	7 .Country and Global Diamide WG's and local influencers 8. GDWG, local DWG, influencers 9. Manufacturer option 10. Company, Local DWG or Contractor

Local Diamide WG involvement

Step X. Communicate Social Advantages of IRM & Industry's Response to Insect Resistance

Diamide manufacturers and distributors:

- …are responsible stewards of their products and strongly promote discriminate use of insecticides.
- …are committed to work with regulatory agencies, Ag ministries, University and Extension services, growers, and the Ag Industry to protect the environment. Delaying or preventing resistance by implementing IRM strategies promotes use of the labeled product rate which optimizes the amount of insecticides applied, reduces environmental loading, and helps conserve diversity of non-target organisms. Historically, grower response to increasing insect tolerance is to significantly increase use rates.
- ….lead the industry in developing and implementing resistance prevention activities to ensure the longevity and diversity of pest control technologies available to solve grower's pest problems.

Revisiting Step III. Review of IRAC's Code of Conduct & Antitrust Rules

The Code is designed as a point of reference to establish standards of Conduct when IRAC Committees or individual IRAC Members are representing IRAC. This, along with the IRAC Antitrust Guidelines, forms the basis by which all IRAC Committees should operate.

The Code is also intended to reassure individuals and groups that interact with IRAC that the sole objective of the Committee is to counter the development of insecticide or acaricide resistance through joint technical strategies.

**** See full details in slides 21-26***

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- Changes in industry production, capacity or inventories.
- Bids on contracts
- Distribution or marketing plans of particular products
- Matters relating to actual or potential individual customers or suppliers

Insecticide Resistance Action Committee

IRAC Code Of Conduct and Anti-Trust Guidance

For use by Country Diamide Working Groups developing IRM guidelines to optimize and maintain insect susceptibility when applying multiple insecticides with the same mode of action to the same crop

***Excerpt from the* IRAC Constitution**
Issued, November 2009 Version 6.2

Approved by: IRAC Executive Committee

Further information is available at: www.irac-online.org enquiries@irac-online.org

IRAC Code of Conduct

The Objectives of the Code

The Code is designed as a point of reference to establish standards of Conduct when IRAC Committees or individual IRAC Members are representing IRAC. This, along with the IRAC Antitrust Guidelines, forms the basis by which all IRAC Committees should operate.

The Code is also intended to reassure individuals and groups that interact with IRAC that the sole objective of the Committees is to counter the development of insecticide or acaricide resistance through joint technical strategies.

The Principles of the Code

1. Committees using the IRAC name and brand do so on the condition that they follow the IRAC Code of Conduct.

2. Committee meetings, discussions, minutes, recommendations and publications etc should relate solely to Committee administration and insecticide resistance matters. Companies and their representatives are free to follow their own commercial strategies against the background of recommendations given and accepted by IRAC; however it is important to maintain the integrity of the IRAC brand.

3. Resistance management is an essential part of product stewardship but misuse of resistance data or information can harm industry and IRAC's long term interests.

- Resistance statements must be scientifically and technically sound, verifiable and relevant.
- There should be no misuse of research results or quotations from technical scientific or IRAC literature to discredit competitor products or promote proprietary products.
- Any recommendation must be in line with agreed basic IRAC anti-resistance concepts

4. IRAC external communications should always include the IRAC name and preferably the IRAC branding rather than the individual's personal, company or group affiliation.

5. IRAC external emails should ideally conclude with a "footer" making it clear that the correspondence is from IRAC and include the position, Committee or Team represented.

6. When providing contact address details for IRAC external communications ideally they should be given as "IRAC followed by Committee/Team Position and Care Of…." followed by the individual's personal, group or company address and telephone etc.

7. IRAC Committees or an agreed representative group of members should have the opportunity to view and comment on all IRAC external communications apart from those pertaining to routine administrative matters.

8. IRAC presentations, publications and posters etc should all include the IRAC branding and where possible exclude personal, group or company affiliations unless required to do.

9. IRAC presentations, publications and posters etc should be circulated in good time (ideally at least 7-14 days) to the appropriate local Committee to provide the opportunity for comment, prior to circulation or use in external forums.

Antitrust Guidelines
Guideline Introduction

- IRAC Committees and IRAC Members should be aware that while some activities among competitors are both legal and beneficial to the industry, group activities of competitors are inherently suspect under the antitrust laws. Agreements or combinations between or among competitors need not be formal to raise questions under antitrust laws, but may include any kind of understanding, formal or informal, secretive or public, under which each of the participants can reasonably expect that another will follow a particular course of action.

- All IRAC Members have a responsibility to see that topics, which may give an appearance of an agreement that would violate the antitrust laws, are not discussed during meetings, conference calls or in any other forum. It is the responsibility of each member in the first instance to avoid raising improper subjects for discussion and the purpose of the Antitrust Guidelines is to assure that participants are aware of this obligation.

- The Do's and Don'ts presented below highlight only the most basic antitrust principles. Each participant should be thoroughly familiar with his/her responsibilities under the antitrust laws and should consult counsel in all cases involving specific situations, interpretations or advice.

Further information is available at: www.irac-online.org or enquiries@irac-online.org

DON'T

Do not, in fact or appearance, in meetings or other forum, formally, informally or even in jest, discuss or exchange information regarding:

1. Individual company prices, price changes, price differentials, mark-ups, discounts, allowances, credit terms, etc., or data that bear on price, e.g. costs, production, capacity, inventories, sales, etc.

2. Industry pricing policies, price levels and price changes, differentials, etc.

3. Changes in industry production, capacity or inventories

4. Bids on contracts for particular products; procedures for responding to bid invitations.

5. Plans of individual companies concerning the design, production, distribution or marketing of particular products, including proposed territories or customers.

6. Matters relating to actual or potential individual customers or suppliers that might have the effect of excluding them from any market or of influencing the business conduct of firms toward such suppliers or customers.

Further information is available at: www.irac-online.org or enquiries@irac-online.org

DO

1. Have an agenda and adhere to prepared agendas for all meetings.

2. Get minutes taken and object if they do not accurately reflect the discussion and actions taken.

3. Consult with legal counsel on all antitrust questions relating to meetings.

4. Protest against any discussions or meeting activities which appear to violate the antitrust laws and leave any meeting in which they continue.

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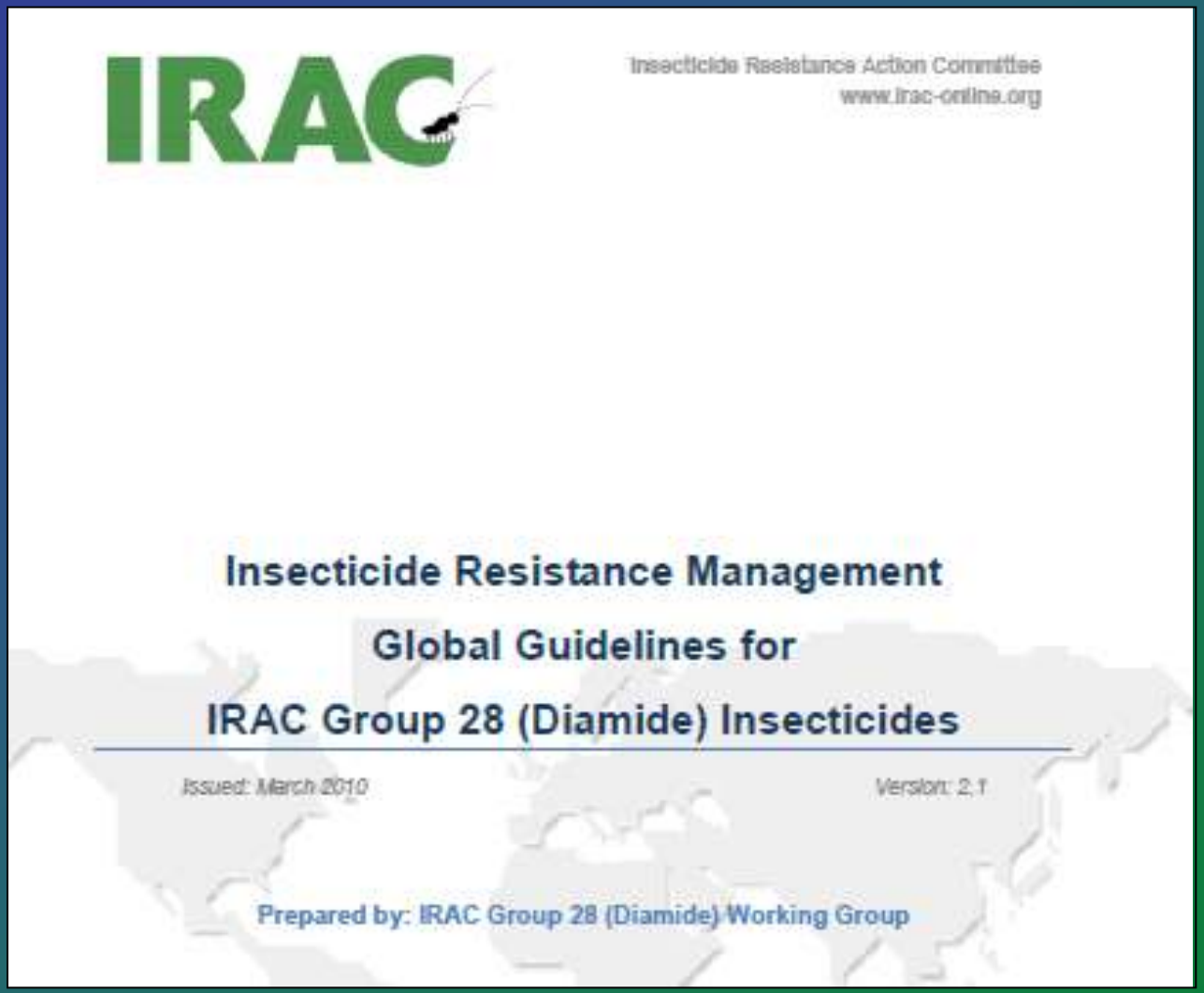
Revisiting Step IV: Review Global Diamide IRM Guidelines



Guideline 1: Communicate IRAC MOA Category (Group 28) to Users

→ Labeling and Identification of Group 28 Insecticides:

- Growers need to recognize and understand which products they can rotate.
- Identification of the insecticide MOA should be on the label; either on the first page or in the IRM section and included in technical brochures.

Example 1

Insecticide A® 50 SC

Active Ingredient: [Compound name]

Formulation details

Group	**28**	**Insecticide**

Example 2

Insecticide A ® 50 SC
Insecticide B ® 25 SC

Active Ingredients: [Compound names]

Formulation details

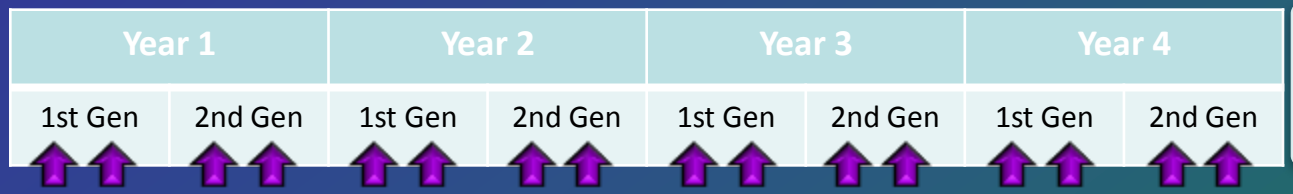
Group	**3**	**Insecticide**
Group	**28**	**Insecticide**

General Positioning Guidelines

IRM guidelines below show least to best product rotaton recommendations

Insecticide Resistance Action Committee

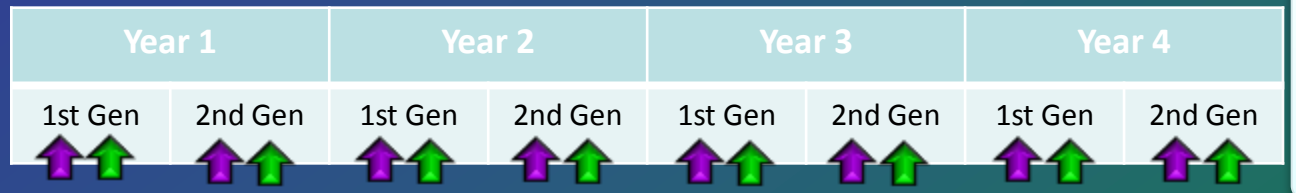
Maintaining insect susceptibility greatly depends on rotation of Diamide insecticides with effective products with a different MOA that eliminate Diamide-resistant individuals. Rotation with products that provide poor control of the target pest increases the risk of developing Diamide resistance.



No alternation/rotation

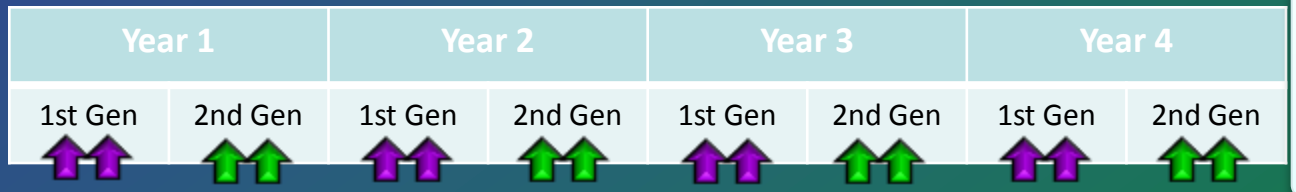
High selection pressure

No recovery of sensitive population.



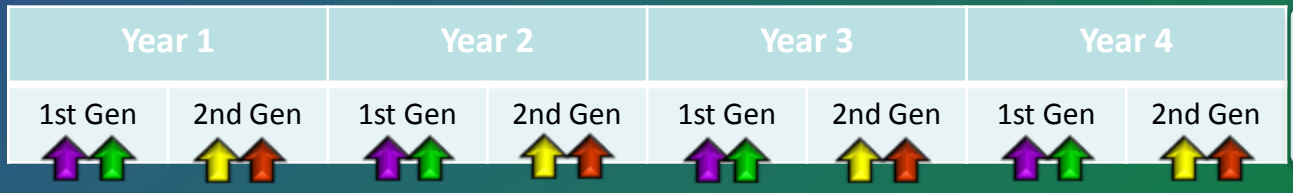
Rotation within generation

Consecutive generations exposed to same MoA. Selection pressure doesn't change between generations. Risk of resistance development for both ai's



Rotation among generations

Following generations are not exposed to same MoA. Selection pressure doesn't increase within the generation. Recovery of susceptible population.



Rotation within and between

Ideal situation (very low risk) Not alway applicable with good efficacy.

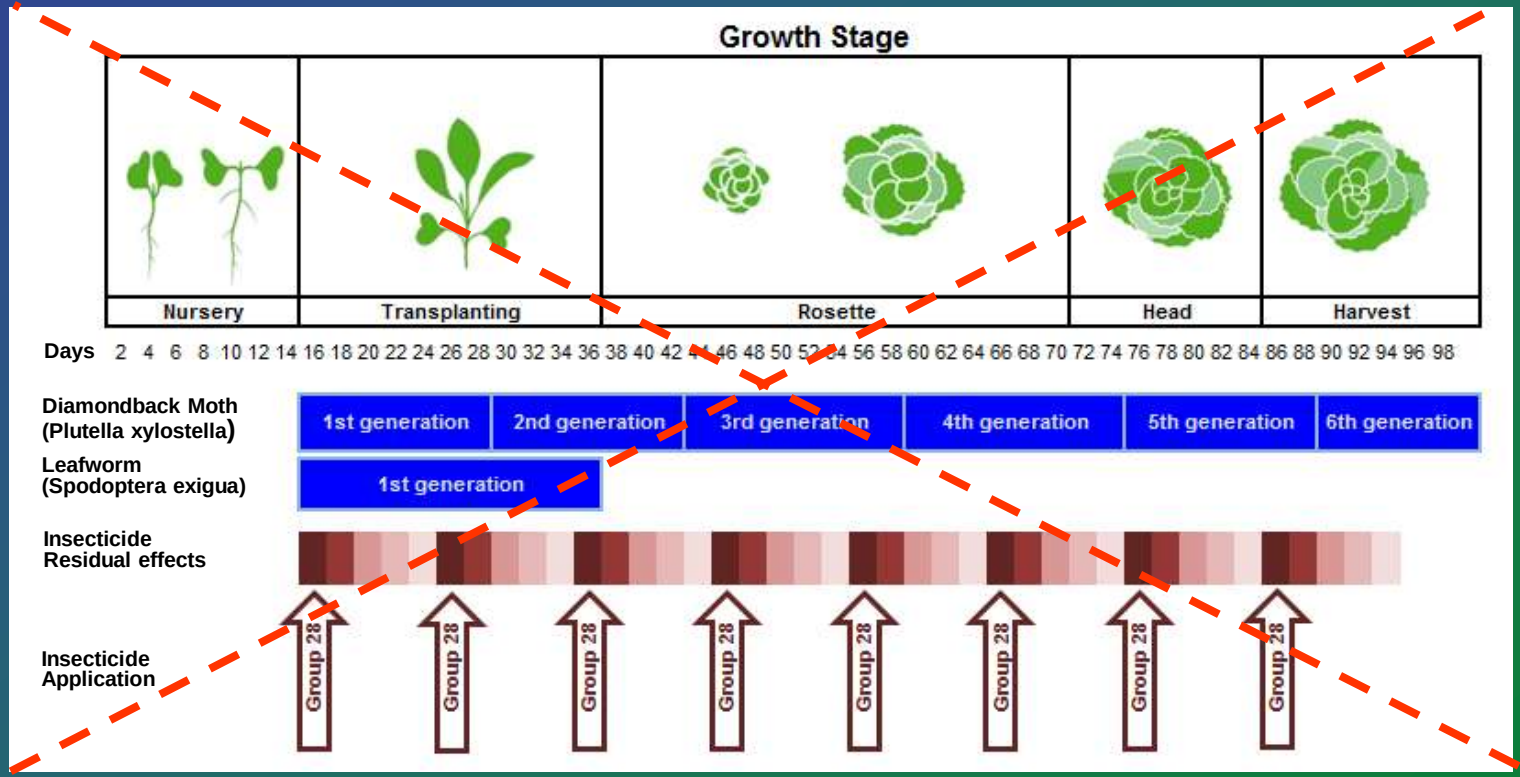
MoA 1 MoA 3
MoA 2 MoA 4

Guideline 2:
Avoiding Excessive Use of Diamides

→ **Avoid exclusive use of Group 28 insecticides throughout a crop cycle for a pest species with more than one generation**

"DO NOT expose successive pest generations of the same species to the same insecticide mode of action"

Scheme below → NOT RECOMMENDED



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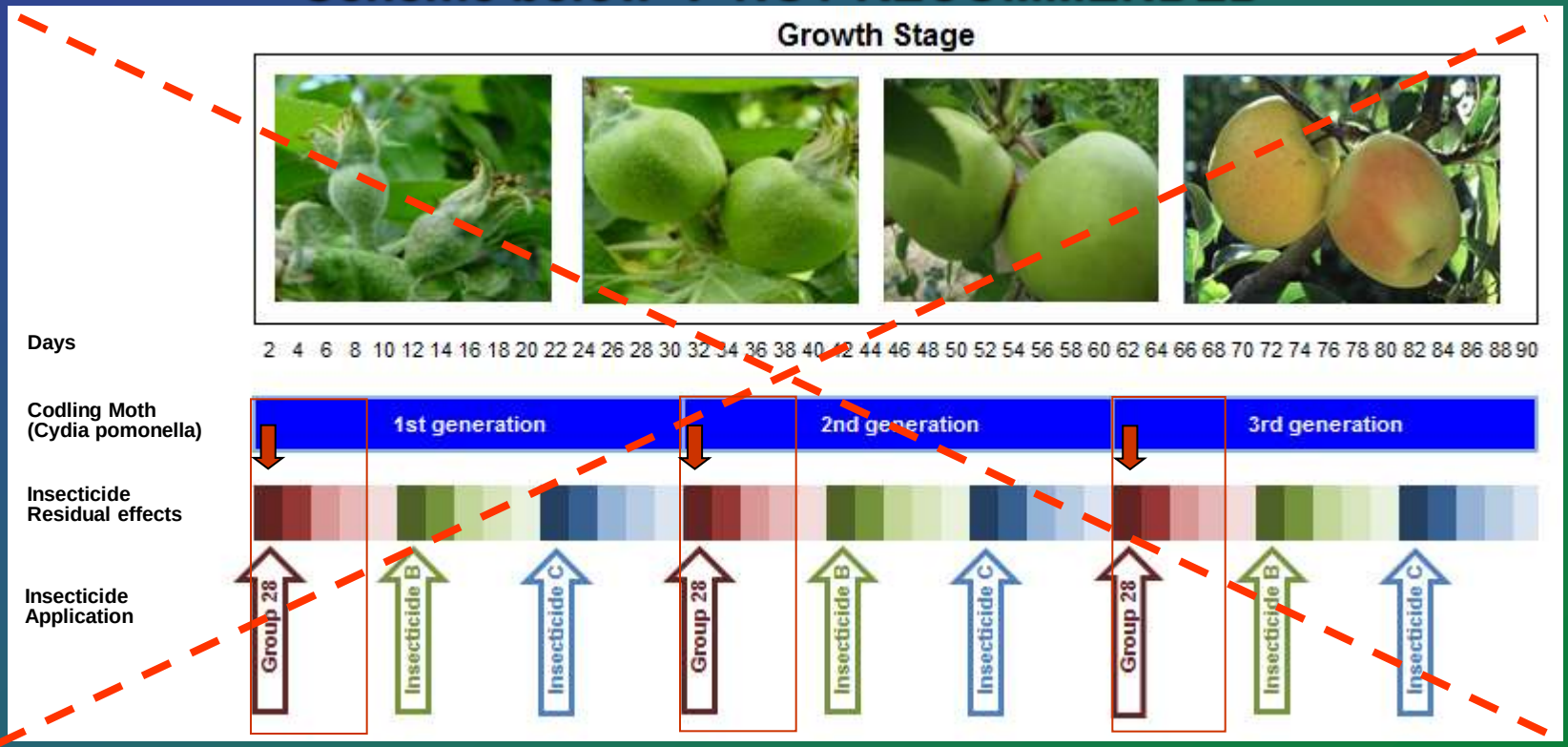
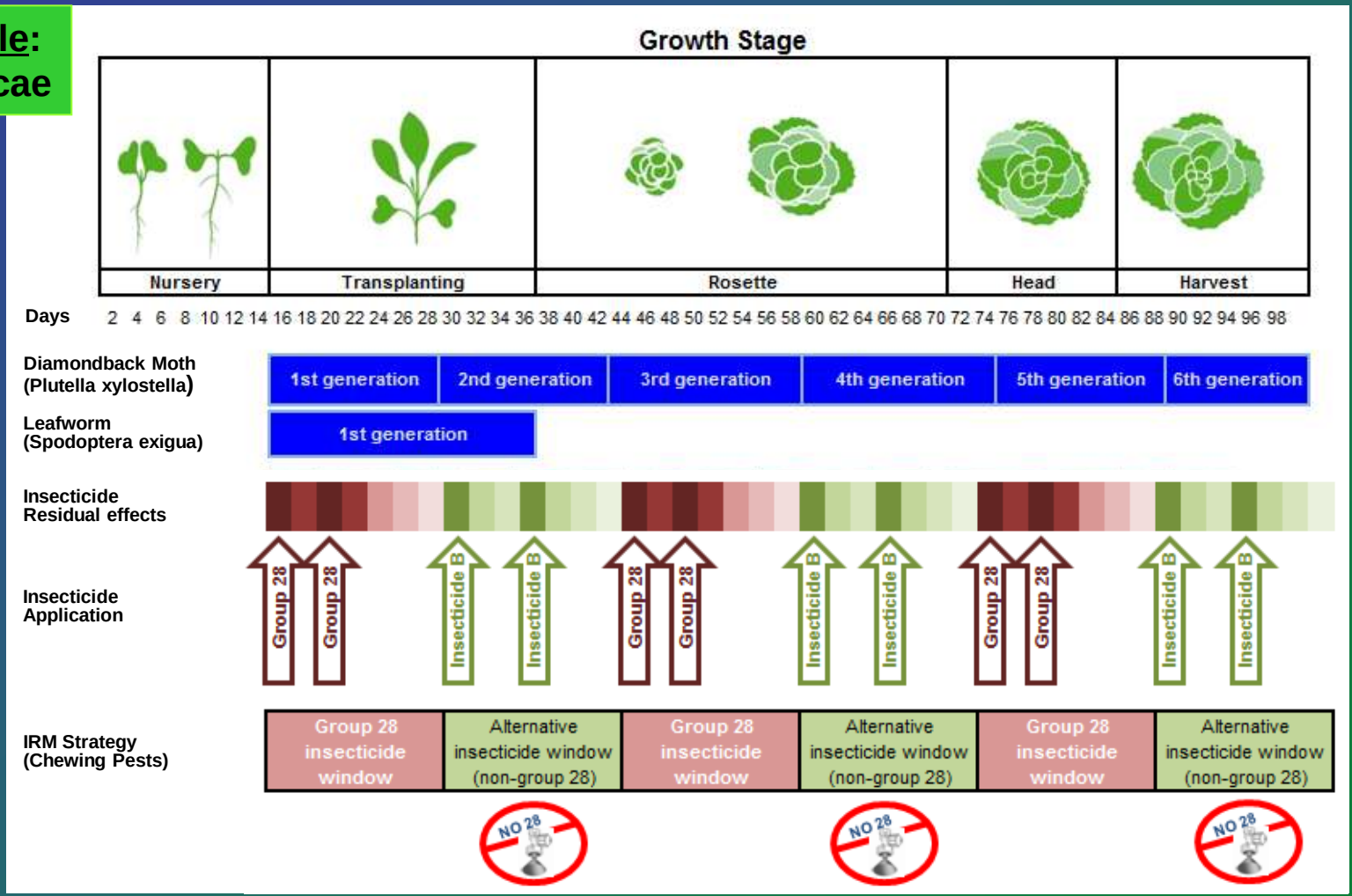


Guideline 3: Use of "Treatment Windows"

→ Use "Treatment Windows" of approximately 30 days and rotate with different Insecticide Mode of Action (MOA) groups to avoid exposure of successive pest generations to the same MOA.

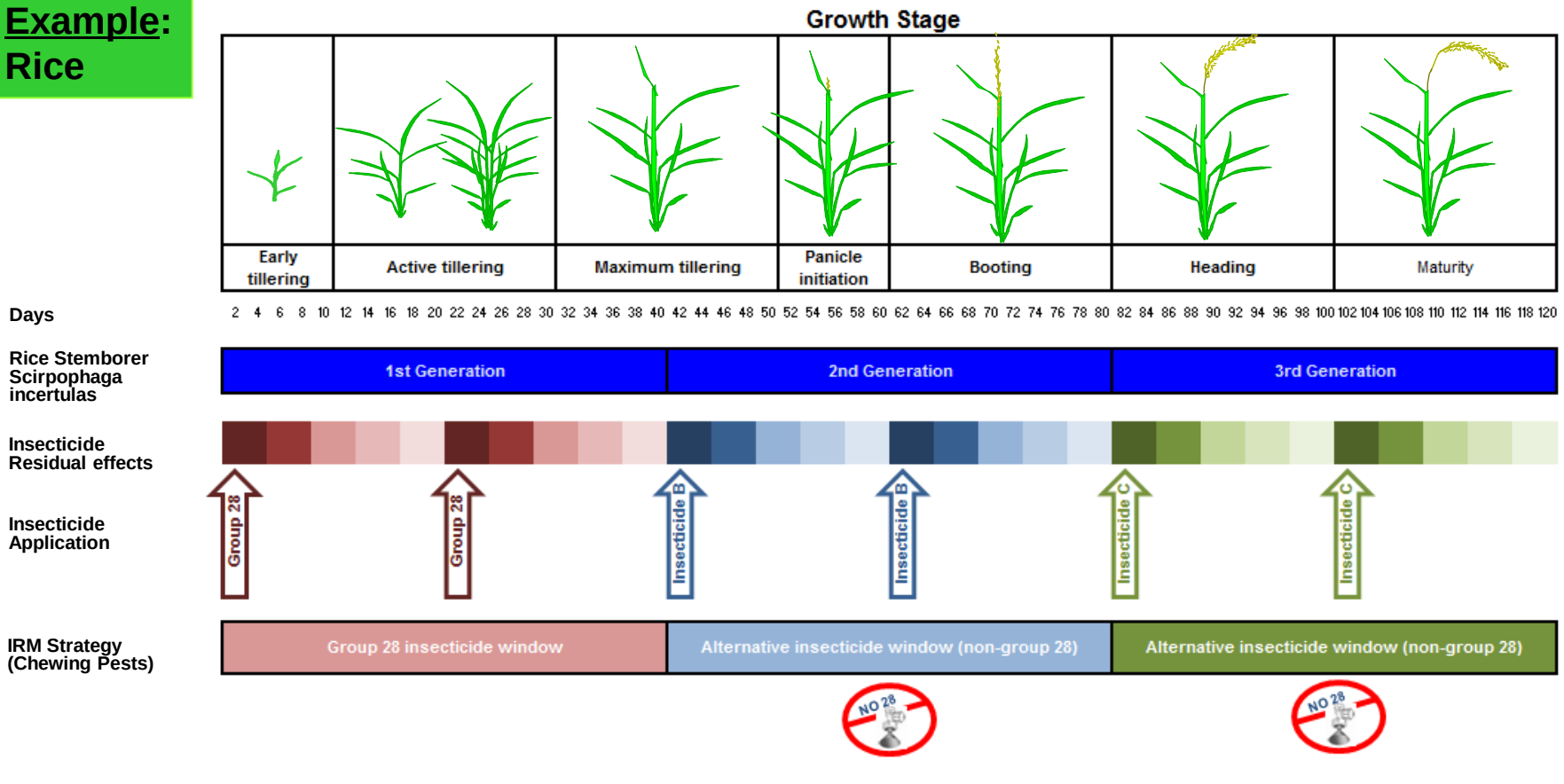
Example: Brassicae



Guideline 3: Use of "Treatment Windows"

→ Use "Treatment Windows" of approximately 30 days and rotate with different Insecticide Mode of Action (MOA) groups to avoid exposure of successive pest generations to the same MOA *(It is recommended to not spray the 3rd generation since then more than 50% of the crop would be exposed to diamides)*

Example: Rice



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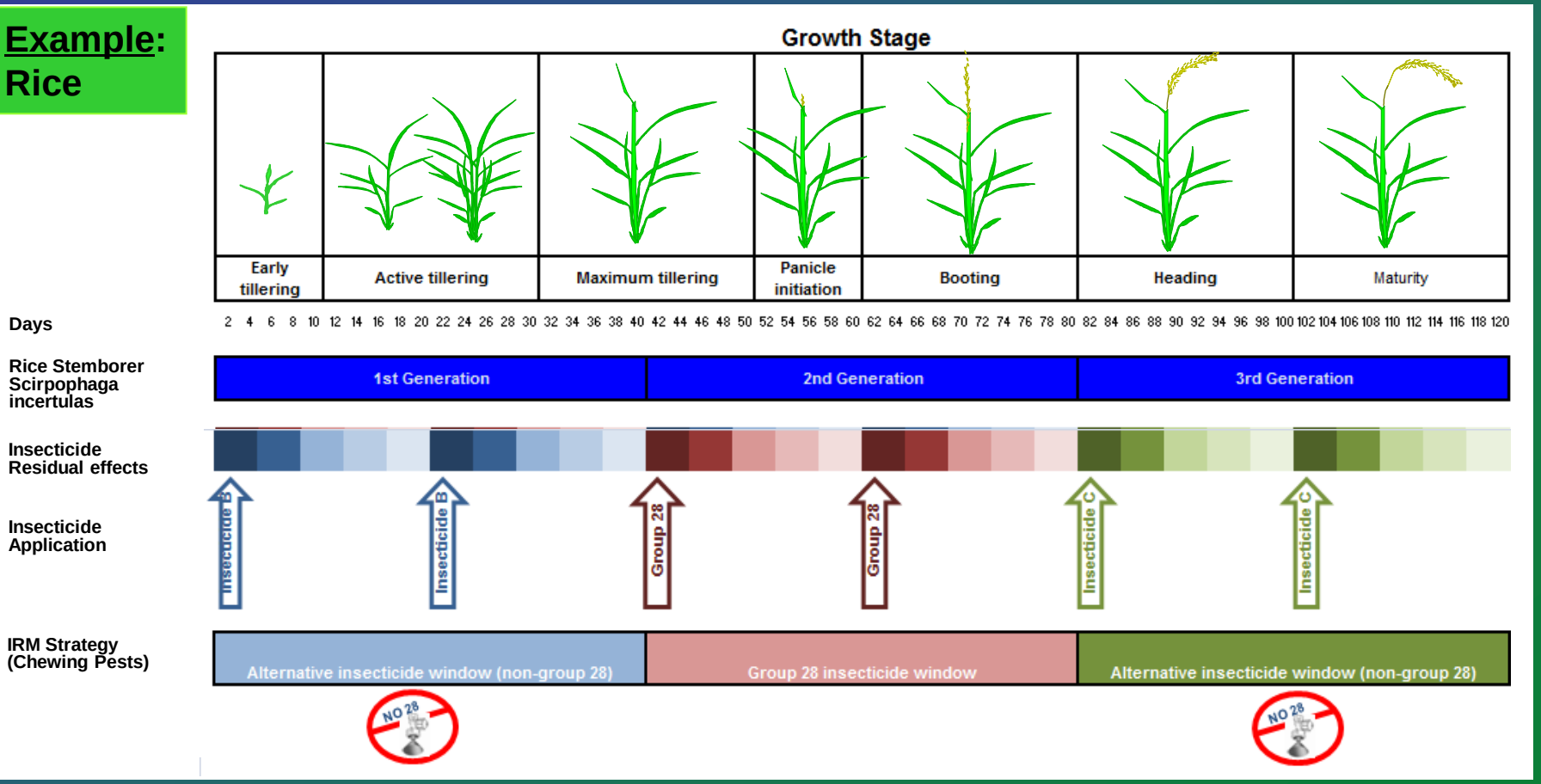
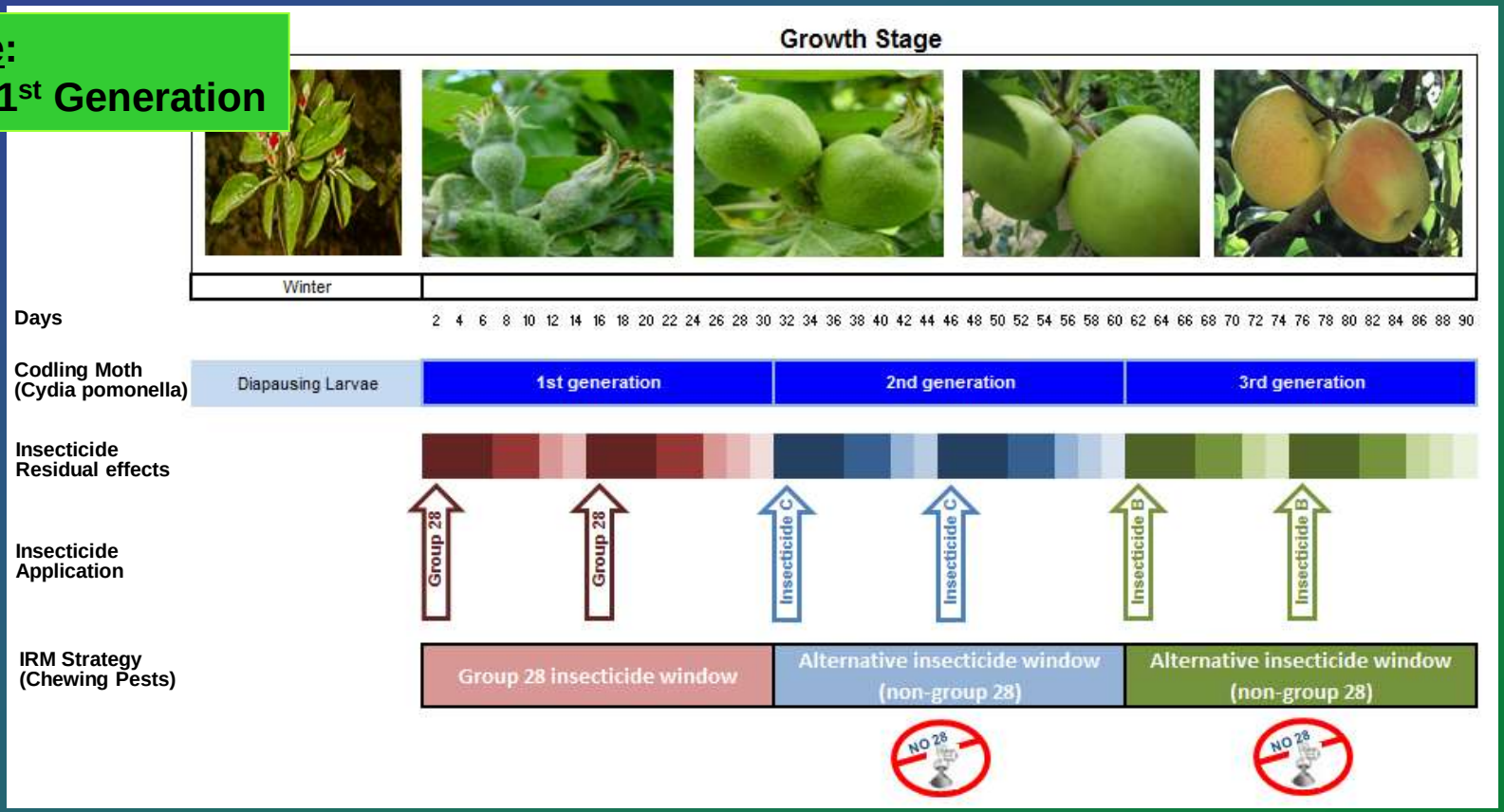
Example: Rice



Guideline 3:
Use of "Treatment Windows"

If you spray 1st generation with IRAC 28 insecticide:
Do not spray 2nd or 3rd generation ! ***(It is recommended to not spray the 3rd generation since then more than 50% of the crop would be exposed to Diamide insecticides)***

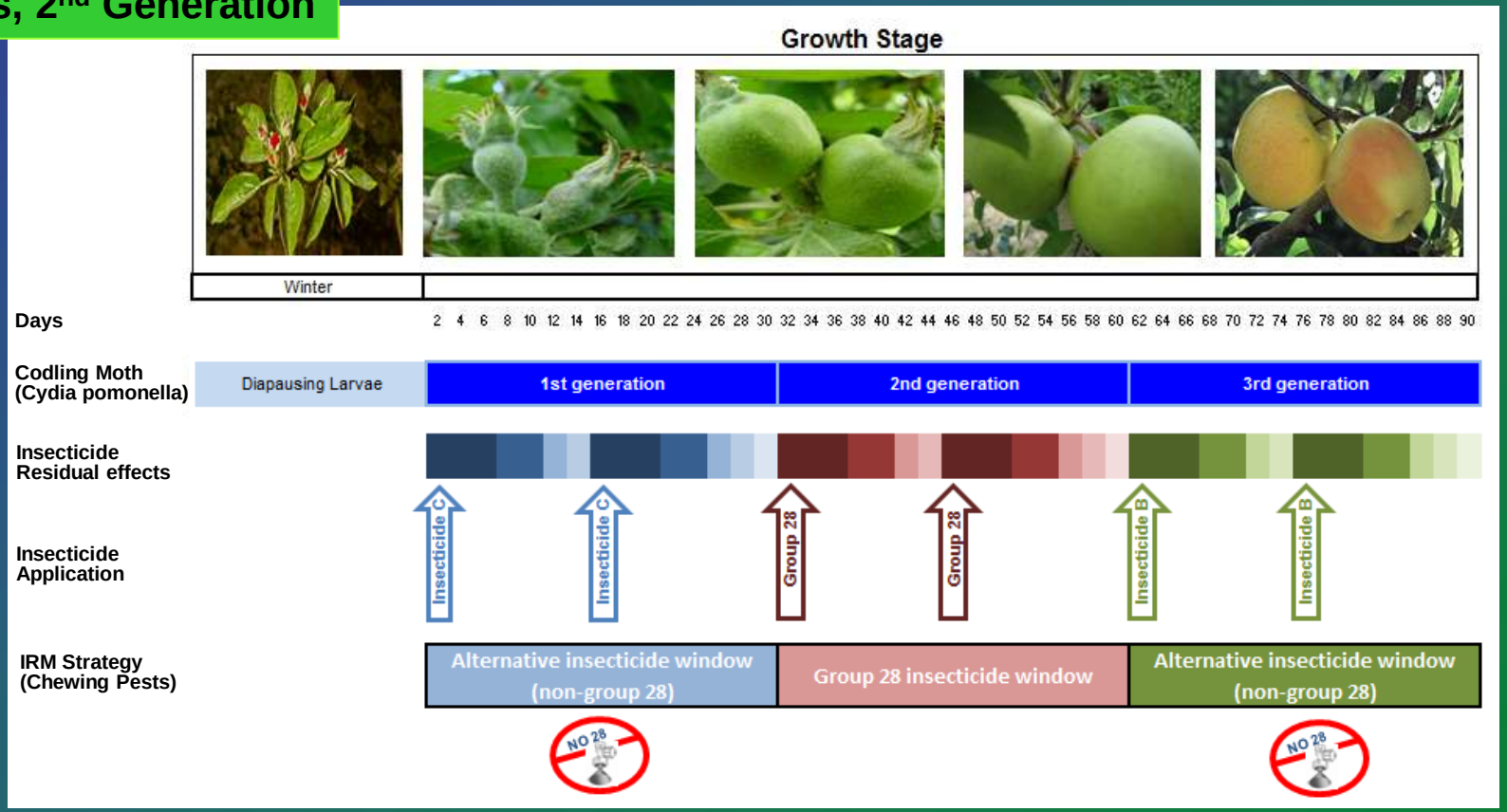
Example:
Apples, 1st Generation



Guideline 3:
Use of "Treatment Windows"

If you spray 2nd generation with IRAC 28 insecticide:
Do not spray 1st or 3rd generation

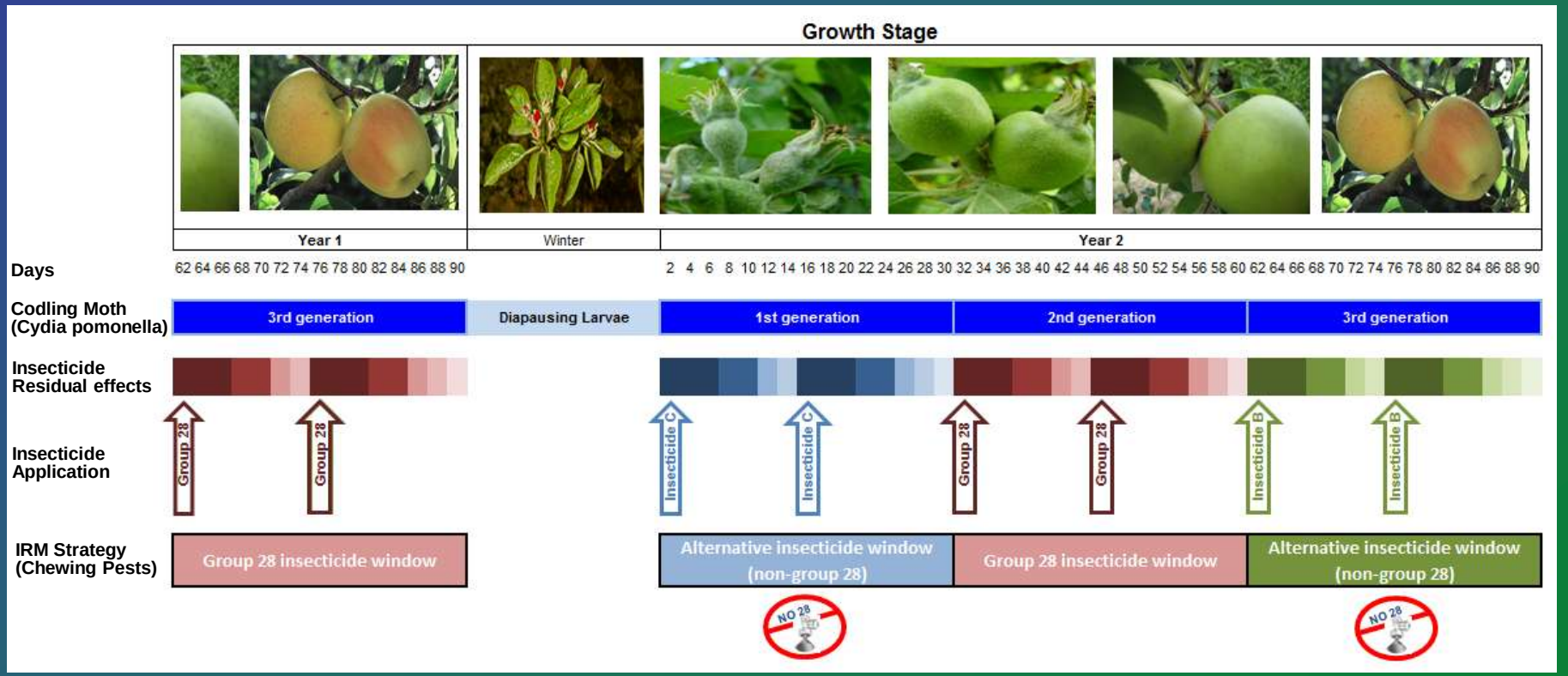
Example:
Apples, 2nd Generation



Guideline 3:
Use of "Treatment Windows"

If you spray 3rd generation with IRAC 28 insecticide:
Do not spray the 1st generation of the following year

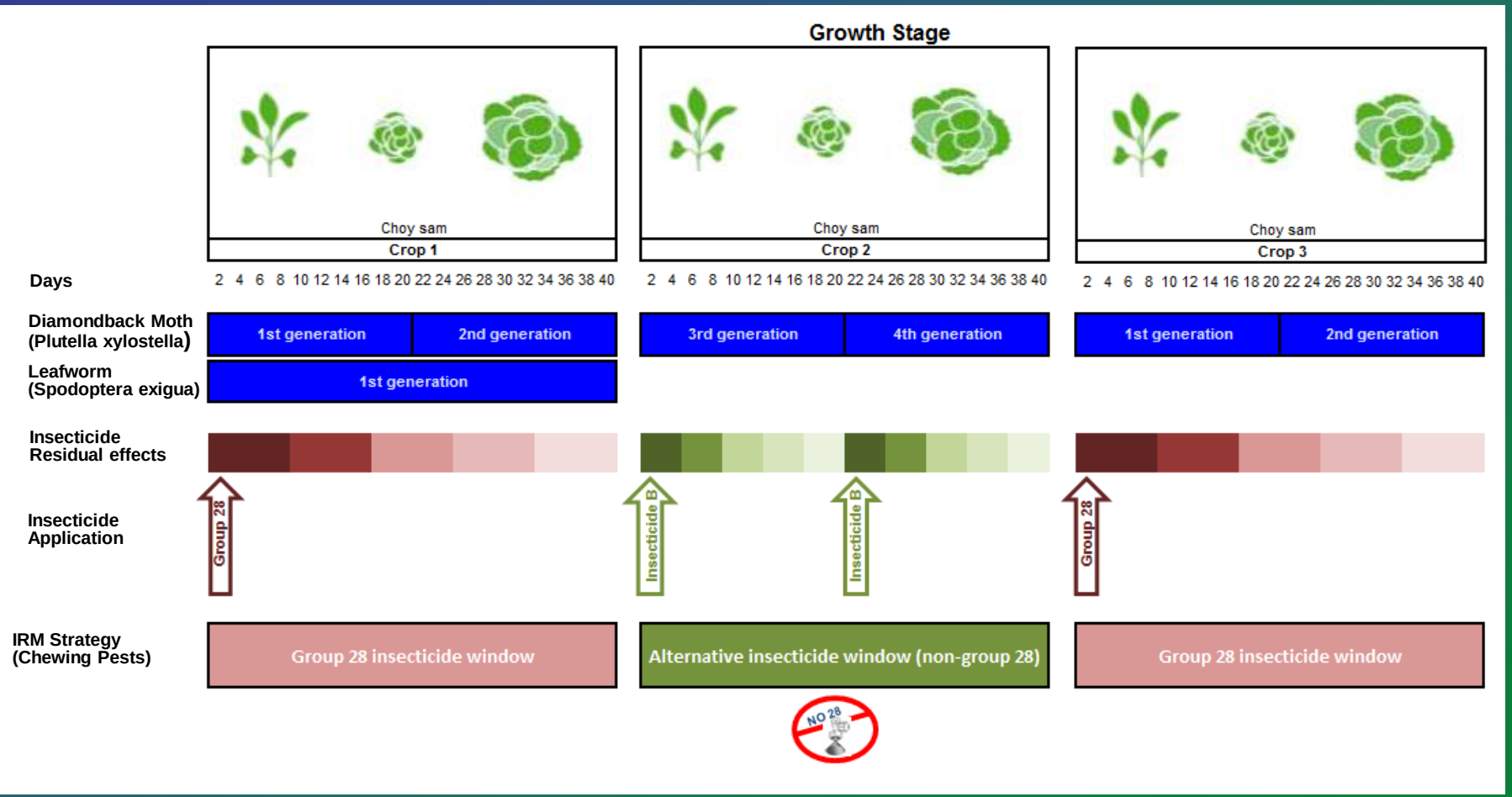
Example:
Apples, 3rd Generation



Insecticide Resistance Action Committee

Guideline 4: For Short Cycle Crops, a "Treatment Window" is a Crop Cycle

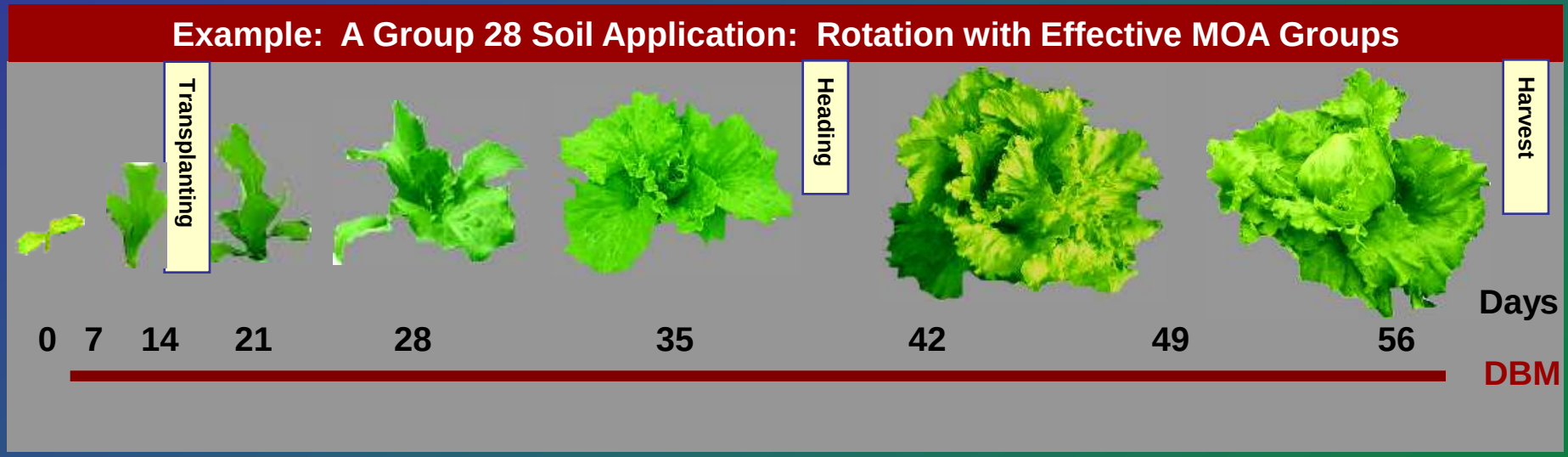
→ For short cycle crops (< 30-50 days), consider the duration of the crop cycle as a "treatment window". Alternate to different modes of action during subsequent plantings at the same farm location.



Guideline 5: Do Not Expose > 50% of Crop Cycle to the Same MOA Group

Example: Leafy Vegetables – Soil Application:

Use treatment windows (approx 30 day windows) and avoid exposure of > 50% of crop cycle.



Group 28
1 soil application only
(drench, drip, seedling tray)

Non-Group 28 Insecticides
with different MOA's

Active Window
< 50% of Crop Cycle =
5-35 days

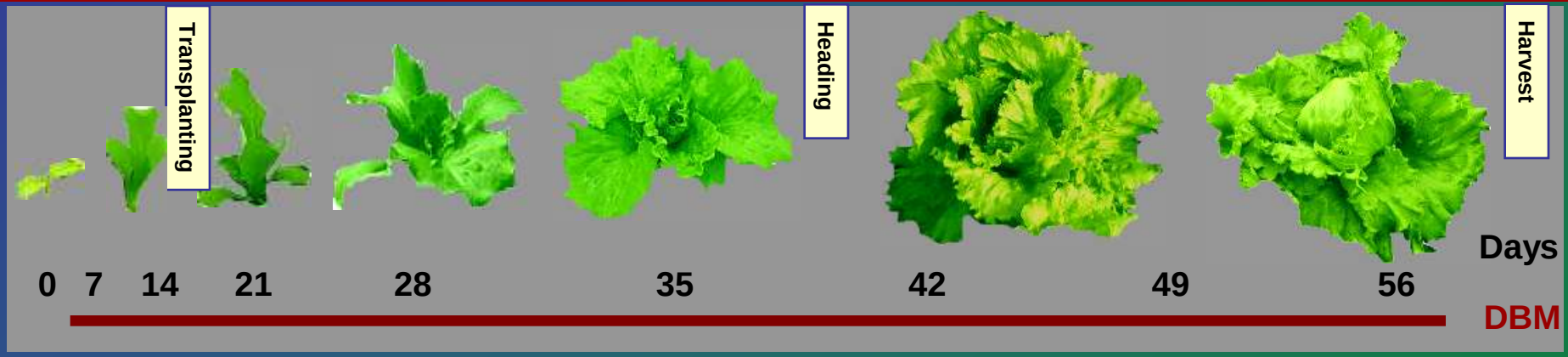
Free Window
(at least 50% of Crop Cycle = 35-60 days)

Guideline 5: Do Not Expose > 50% of Crop Cycle to the Same MOA Group

Example: Leafy Vegetables – Foliar Application:

Use treatment windows (approx 30 day windows) and avoid exposure of > 50% of crop cycle.

Example: 2nd foliar application with a Group 28 insecticide → Rotate with Effective MOA Groups



Non-Group 28	Group 28	Non-Group 28
Free Window #1 4-21 days	Active Window < 50% of Crop Cycle = 22-44 days	Free Window #2 45-56 days

← Sum of Free Windows > 50 % crop Cycle →

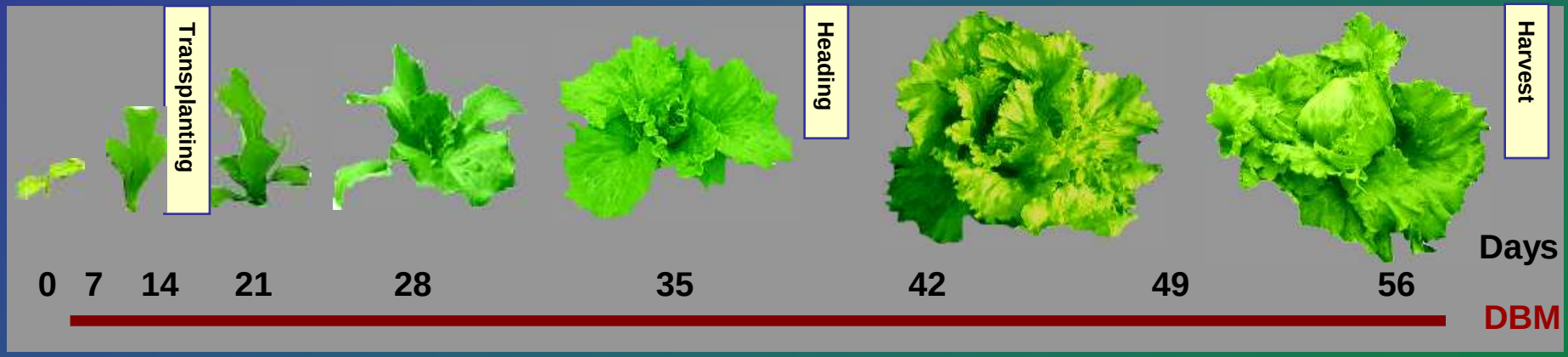
Insecticide Resistance Action Committee

Guideline 5: Do Not Expose > 50% of Crop Cycle to the Same MOA Group

Example: Leafy Vegetables – Foliar Application:

Use treatment windows (approx 30 day windows) and avoid exposure of > 50% of crop cycle.

Example: 1st Foliar application with a Group 28 Insecticide → Rotate with Effective MOA Groups



Group 28

Non-Group 28

Active Window
< 50% of Crop Cycle = 12-42 days – Spray after transplanting

Free Window >42 days
(at least 50% of the Crop Cycle)

Suggested Additions to Country IRM Communication

Maintaining Susceptibility of Diamide Insecticides:

An Industry Resp

International IRAC does not want individual company names advertised. So ideally you need to remove this line and add the line below (IRAC and CropLife) and also add the next slide that shows all the companies in IRAC

Insecticide Resistanc

Strategies

From The _____Diamide ouncil

Bayer CropScience , DUPONT , syngenta and CropLife

A joint program of IRAC and CropLife

Please add this slide. This will give even greater impact on this communication since it states that all these companies support the Diamide IRM strategies and other products are required as rotation partners.

IRAC Executive Member Companies

IHON NOHYAKU CO.,LTD.

Bayer CropScience

DUPONT
The miracles of science™

Chemtura

Dow AgroSciences

FMC

BASF
The Chemical Company

Nufarm

MONSANTO
imagine

MAKHTESHIM AGAN

SUMITOMO CHEMICAL

BELCHIM
Crop Protection

CHEMINOVA

VESTERGAARD FRANDSEN
DISEASE CONTROL TEXTILES

Insecticides That Are “Diamides”

There are different products available in the market t[illegible] represent two different, but related, chemical classes of in[illegible]icides

Product Trade Name	Insecticide Chemistry	[illegible]y
Prevathon®	Anthranilic Diamide	[illegible]
Voliam Flexi®	Anthranilic Diamide/ Neonicotinoid	[illegible]
Fenos®	Phthalic Diamide	Bayer

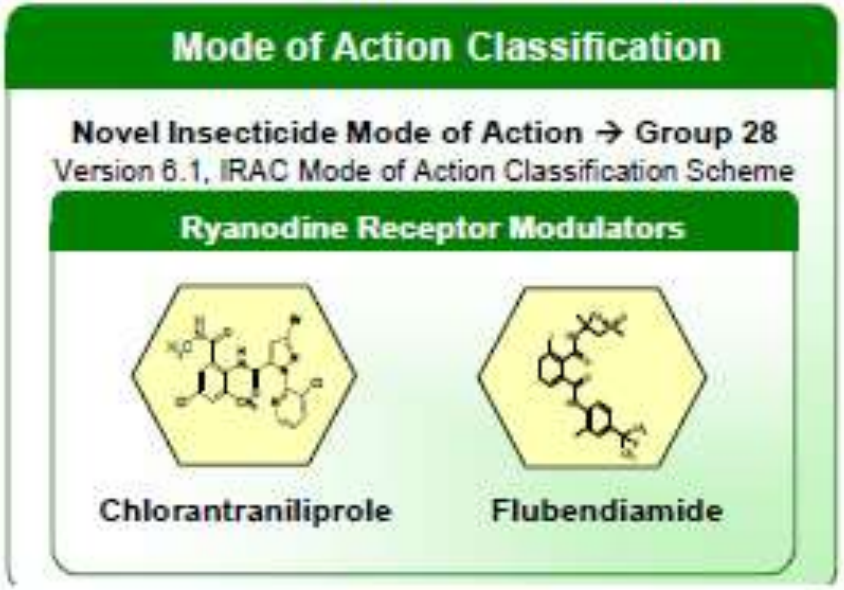
List the diamide products by trade name available in your country

Based on their common chemistry these products are generally referred to as “Diamides”

How Do Diamides Kill Insects –
What is their Mode Of Action???

Diamide Insecticides (Fenos®, Prevathon®, Voliam Flexi®) Disrupt Muscle Function in Insect Pests Causing Paralysis and Death

- The "Mode of …n" of Diamide insecticides is the disrupti… the ryanodine receptors in muscle cells… stops muscle function.
- The Diamid… calcium ion movement into the muscle… ulting in cell dysfunction and musc… sis of the target insect pest.
- Diamide… sified by the Insecticide Resista… Committee (IRAC) as …8



Good idea to add this slide that explains how diamide insecticides affect insects.

…nd Voliam Flexi® are …oup 28 Insecticides

Benefits of Maintaining Insect Susceptibility to Diamides

1). Increased Product Longevity:

- more effective products are available for a lon
- growers have more pest control options; inc
  selection

2). Growers Save Money:

- no need to increase dosage increased to ma
- no need to tank mix to control pests

3). More Stable Crop Production:

- better assurance of good pest control
- expect more consistent crop protection and stable yields

4). Protection of the Environment:

- less active ingredient applied to ecosystem
- more control over spray program and products used; not in survival mode

Good slide to add. Need to define what are the benefits to growers.