



# Global Effort to Maintain Susceptibility of the Ryanodine Receptor Modulators and Other Insecticide Modes of Action: Efforts of the IRAC International Diamide (Group 28) Working Group

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Insecticide Resistance Action Committee  
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Diamide insecticides are IRAC mode of action Group 28 ryanodine receptor modulators, currently including products containing chlorantraniliprole, cyantraniliprole, and flubendiamide.

## The IRAC International Diamide Working Group

### WHO ARE WE?

The IRAC International Diamide Working Group was created in 2007 to prevent or delay the development of insect resistance to the diamides, a new mode of action chemical class, by founding member companies Nihon Nohyaku/Nichino, DuPont Crop Protection, Bayer Crop Science, and Syngenta and supported by IRAC International and Crop Life membership companies.

### WHAT WE DO AND WHY?

The IRAC Diamide Working Group promotes sustainable use of all insecticides through industry education and implementation of IRM disciplines and strategies. The main objective of the Diamide team is to maintain the longevity of all crop protection products available to growers by preventing or delaying the development of resistance to insect pests.

## Activities of the IRAC Diamide Working Group

✓ Identify and prioritize high resistance risk and respective crop systems.



*Tuta absoluta* *Plutella xylostella* *Spodoptera exigua*

✓ Educate the industry through grower, company, professional, and trade meetings



"Train-the-Trainers" sessions, Philippines, China, *Plutella xylostella* workshops Thailand, Japan Grower Meetings

✓ Create country Diamide IRM Working Groups & provide guidance & tools to effectively implement local IRM programs.

Australia	Argentina	Brazil	China	India	Indonesia	Italy
Israel	Japan	Korea	Malaysia	Mexico	Morocco	Philippines
Spain	Thailand	Turkey	USA	Vietnam	Taiwan	S. Africa

✓ Develop global IRM guidelines for adaptation & implementation in local country markets.

### General IRM Mode of Action Rotation Recommendation

**IRAC** General Positioning Guidelines  
 IRM guidelines below show least to best product rotation recommendations

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 is high.

**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**  
 Local situations vary (see table). Not always applicable with good efficacy.

Guidelines by Danish-Country Group, August 2011

### Status of *Plutella xylostella* resistance to Diamides



*P. xylostella* resistance to diamide products occurred within 18 months after launch of flubendiamide in BangBuaThong, Thailand in 2009. The following year, DBM resistance to all diamides in crucifer production was observed in Cebu, Philippines and in 2011 it was reported in Yin Lin and Chang Hwa, Taiwan, Guangzhou area of China, Bangalore, India, East Java, Indonesia, and NE Brazil. Tolerant populations are localized within countries while susceptible populations still remain. The mechanism of resistance is believed to be metabolic and to-date has been cross-resistant to all diamide products.

✓ Develop testing assays, create baseline susceptibility data, assess field tolerant populations, and help coordinate response plan to resistance.

## Resistant Management Guidelines

- 1) Incorporate IPM practices into insect control program.
- 2) Follow the label. Do not reduce rates. Follow recommended timing of applications and spray volume.
- 3) Know the MoA of insecticides for rotation programs

**GROUP 28 INSECTICIDE**

- 4) Rotate insecticide MoA groups
  - Avoid exclusive use of Group 28 insecticides throughout a crop cycle for a pest species with more than one generation.
  - Apply insecticides using a "window" approach to avoid exposure of consecutive insect pest generations to the same mode of action.
  - A "Treatment Window" is defined as the period of residual activity provided by a single, multiple, or sequence of product applications with the same mode of action within an approximate 30 day period (15 - 45 days depending on local generation time from egg to adult). Generally, this "Window" should approximate the length of a generation of the target pest.
  - Following a "Treatment Window", rotate to a "window" of applications of effective insecticides with a different mode of action.
  - 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.
  - The total exposure period of all "Group 28-active windows" applied throughout the crop cycle (from seedling to harvest) should not exceed approximately 50% of the crop cycle.

## Example of DBM IRM Strategy - China

**IRAC CHINA RICE: EXAMPLE of IRM Strategy Double Crop Rice—Hubei/Zhejiang Provinces**  
 Insecticide Resistance Action Committee

April May June July August September October

**A Possible Example: Focus on Stem Borer**

germination/transplant tillering panicle initiation heading flowering grain formation  
 DAS: 0 10 30 50 70 80 110-130

RLF SRSB

RLF SRSB

MoA A MoA B or C MoA A or D MoA B or E

RLF = Rice Leaf Folder SRSB = Striped Rice Stem Borer

### GROWER INSECTICIDE ROTATION PRACTICE:

- Avoid exposure of consecutive insect generations to Group 28 insecticides.
- Rotate Group 28 Insecticides with other MoA products using a 'window' approach.
- Apply Group 28 products within a "Treatment Window" of no more than 30 days followed by a window with different MoA products for another approx 30 days.
- Multiple successive applications are acceptable if they are used to treat a single insect generation or are used within a window.

