The Diamondback Moth, *Plutella xylostella:* Resistance Management is Key for Sustainable Control

IRAC

Insecticide Resistance Action Committee

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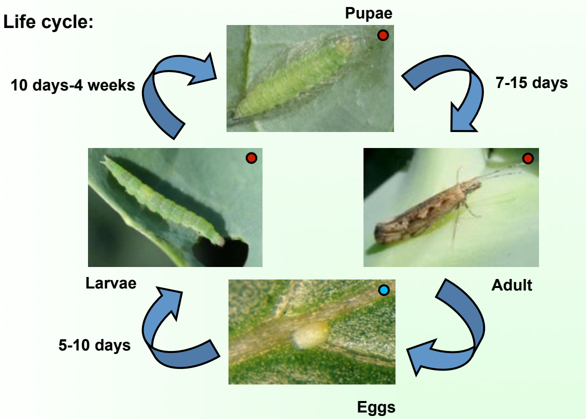
Introduction and Biological Background

Diamondback moth (*Plutella xylostella* L.) is a highly migratory and cosmopolitan species, and is one of the most important insect pests of cruciferous crops worldwide. Globally, direct losses and control costs are estimated to be US$ 1 billion (1).

Life cycle:



In temperate regions, *P. xylostella* is unable to overwinter and therefore annual outbreaks are attributed to migration, but in tropical and sub-tropical regions there can be a large number of continuous generations per year (*e.g.* up to 21 in Taiwan) (2) .

P. xylostella is considered to be one of the most difficult pests to control. Continuous insecticide applications have been, and in many regions still are, the main tool employed for crop protection.

Cases of *P. xylostella* resistance to insecticides were reported in the 1950's. Today this species shows resistance to most insecticide classes, including recently introduced compounds with new modes of action (3).

References

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Plutella xylostella Damage in Cabbage

Treated with insecticide | Not treated with insecticide

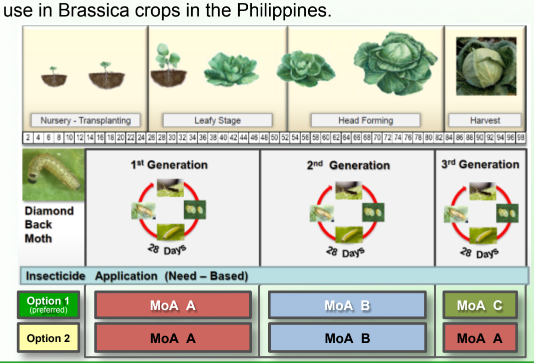
Resistance Mechanisms

Several biochemical mechanisms are described as conferring resistance to insecticides in diamondback moth populations. Many of these mechanisms listed below act in concert and can provide resistance factors of 1000-fold or greater.

1. **Enhanced metabolic detoxification mechanisms** (3,4)
2. **Insensitive acetylcholinesterase**
3. **Reduced Cry1C binding to target site in midgut membrane and reduced conversion of Cry1C protoxin to toxin** (5)
4. **Reduced penetration** (6,7)
5. **Target-site resistance** (7-10)

Resistance Management (example)

The figure below shows a resistance management strategy developed for use in Brassica crops in the Philippines.



General IRM Tactics

A combination of all available tools for *P. xylostella* management should be used to prevent the development of insecticide resistance:

- resistant varieties
- refuge crops
- biological control with natural enemies, e.g. *Cotesia plutellae*
- insecticide applications with mode of action rotation and windows approach
- crop hygiene

The resistance monitoring method for *Plutella xylostella* (IRAC Method No. 018) is available on the IRAC website and should be used to evaluate insecticide susceptibility.

Chemical Control of *Plutella xylostella*

- Select insecticides based on known local effectiveness and selectivity
- Rotate insecticides by mode of action group, using a window approach
- Use only insecticides registered for diamondback moth control
- Always follow the directions for use on the label of each product

MoA	Primary Site of Action	Chemical Sub-group or Exemplifying Active
1	Acetylcholinesterase inhibitors	1A:Carbamates 1B:Organophosphates
2	GABA-gated Cl channel antagonists	2B: Phenylpyrazoles (Fiproles)
3	Sodium channel modulators	3A: Pyrethroids, Pyrethrins
4	Nicotinic acetylcholine receptor agonists	4A: Neonicotinoids
5	Nicotinic acetylcholine receptor allosteric activators	Spinosyns
6	Chloride channel activators	Avermectins, Milbemycins
11	Microbial disruptors of insect midgut membranes and derived toxins	*Bacillus thuringiensis var. kurstaki*
13	Uncouplers of oxidative phosphorylation via disruption of the proton gradient	Pyrrols
15	Inhibitors of chitin biosynthesis, type 0	Benzoylureas
18	Ecdysone receptor agonists	Diacylhydrazines
21	Mitochondrial complex I electron transport inhibitors	21A: Tolfenpyrad
22	Voltage-dependent Na channel blockers	22A: Indoxacarb 22B: Metaflumizone
28	Ryanodine receptor modulators	Diamides
UN	Compounds of unknown/uncertain MoA	Azadirachtin, Pyridalyl

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