Insecticide Resistance Action Committee

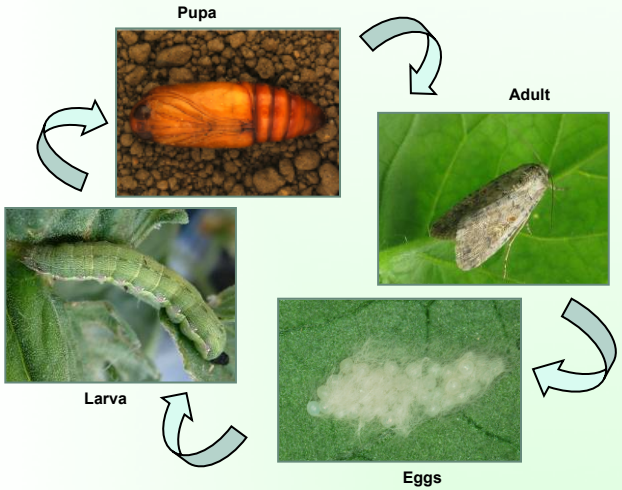
Strategies for Sustainable Control of Beet Armyworm, *Spodoptera exigua*

www.irac-online.org

Introduction and Biological Background

Beet armyworm *Spodoptera exigua* (Hübner) (Lepidoptera: Noctuidae) is a highly dispersive, polyphagous species that can be a serious pest of vegetable, field and flower crops. Susceptible crops include asparagus, cabbage, pepper, tomato, lettuce, celery, strawberry, eggplant, sugar beet, alfalfa, cotton.

Life cycle:



Beet armyworm is native to southeast Asia but is now found in Africa, southern Europe, Japan, Australia and north America.

It lacks a diapause mechanism and can only overwinter successfully in warm regions or in greenhouses. Nevertheless, because of its dispersal abilities, beet armyworm will regularly invade temperate areas and cause damage during the growing season.

The larvae are gregarious and may feed in large swarms, causing devastating crop losses. Larvae feed on both foliage and fruit. As they mature, the larvae become solitary. Damage includes consumption of fruit and leaf tissue and contamination of the crop. One generation can be produced in as little as 21-24 days.

***S. exigua* damage to cabbage and tomato**

Resistance Mechanisms

Several biochemical mechanisms may contribute to the evolution of insecticide resistance in beet armyworm. These mechanisms may act separately or in concert.

1. Enhanced metabolic detoxification, including increased activity of esterases, mixed-function oxidases, and microsomal-O-demethylase.
2. Target site insensitivity.
3. Sequestration by proteases or esterases, efficient cellular repair or an increase in the immune response.

Benefits of Maintaining Insect Susceptibility:

- **For growers:**
  - More choice of control options.
  - Consistent pest control allows higher and more predictable crop yields.
  - Stable crop protection costs.
  - No need to increase the number of applications or amount of control product used.
- **To the environment:**
  - Lower risks to the ecosystem because less pest control product is applied to crops.
- **To the industry:**
  - Increased product longevity with better return on investments.
  - Correct use of insecticides is a critical product stewardship goal.

Integrated Resistance Management

Resistance occurs because of repeated exposure of multiple pest generations to insecticide(s) with the same mode of action. Integrated resistance management strategies take advantage of all available pest management options to decrease insecticide selection pressure on insect populations. A combination of all available tools for *S. exigua* management should be used to prevent the development of insecticide resistance:

- **Chemical control**

- Always follow the directions for use on the label of each product.
- Consult product label or IRAC's website (www.irac-online.org) to determine the mode of action of each product.

IRAC MoA Class	Primary Site of Action
1	Acetylcholinesterase inhibitors
2	GABA-gated Cl channel antagonists
3	Sodium channel modulators
4	Nicotinic acetylcholine receptor agonists
5	Nicotinic acetylcholine receptor allosteric activators
6	Chloride channel activators
11	Microbial disruptors of insect midgut membranes
13	Uncouplers of oxidative phosphorylation
15	Inhibitors of chitin biosynthesis, type 0
18	Ecdysone receptor agonists
22	Voltage-dependent Na channel blockers
28	Ryanodine receptor modulators
UN	Compounds of unknown/uncertain MoA

- **Integrated Pest Management**

- Apply insecticides only when needed by following insect pest pressure and using thresholds.
- Choose crop varieties less susceptible to beet armyworm and consider crop rotation.
- Safeguard predators and parasitoids and/or release natural enemies.

- **Integrated Resistance Management**

- Don't treat successive generations with products of the same mode of action.
- Use an approximately 30 day window to conduct sprays of insecticides of the same mode of action.
- Only reuse a mode of action if 30 days have passed since the previous treatment window.
- Do not apply products of the same mode of action over more than 50% of the crop cycle.
- To avoid treating subsequent plantings of short cycle crops (<50 days) with products of the same mode of action, consider using the duration of the crop cycle as the treatment window.

Photographs courtesy : DuPont Crop Protection, Designed by IRAC Lepidoptera WG, January 2012, Poster Ver. 1.0