Potato insecticides by group and mode of action

Group #	Sub-group #	Mode of Action	Chemical Sub-group or Active Ingredient	Product Name
1	A	Acetylcholine esterase inhibitors	Carbamates	Temik, Vydate, Lannate, Sevin, Furadan
	B		Organophosphates	Dimethoate, Di-Syston, Mocap, Malathion, Methyl Parathion, Imidan, Penncap-M, Thimet/ Phorate, Monitor, Guthion
2	A	GABA-gated chloride channel antagonists	Cyclodiene organochlorines	Phaser/Endosulfan
3		Sodium channel modulators	Pyrethroids, Pyrethrins	Asana, Baythroid, Decis, Ambush, Leverage, others
4	A	Nicotinic Acetylcholine receptor agonists / antagonists	Neonicotinoids	Platinum, Admire, Cruiser, Gaucho, Genesis, Leverage, Actara, Provado
5		Nicotinic Acetylcholine receptor agonists (not group 4)	Spinosyns	Success/SpinTor
6		Chloride channel activators	Avermectins	Agri-mek
9	A	Compounds of unknown or non-specific mode of action (selective feeding blockers)	Cryolite	Kryocide
	B		Pymetrozine	Fulfill
11		Microbial disruptors of insect midgut membranes (includes transgenic crops expressing *Bacillus thuringiensis* toxins)	*Bacillus thuringiensis* var. *kurstaki* Bacillus thuringiensis var. tenebrionensis	Javelin, Dipel, Novodor, etc.
15		Chitin synthesis inhibitor	Novaluron	Rimon
22		Voltage-dependent sodium channel blocker	Indoxacarb	Avaunt
25		Neuroactive (unknownMoA)	Bifenazate	Acramite
26		Unknown mode of action	Azadirachtin	Azadirect, Ecozin

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NATIONAL POTATO COUNCIL

Neonicotinoid Insecticides –

A Grower Approach to Resistance Management Colorado Potato Beetle and Green Peach Aphid in Potato

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What is resistance?

Resistance is an inherited change in an insect's susceptibility to an insecticide. It arises through overuse, extensive use or misuse of the pesticide against a pest species and results in resistant forms of the pest.

Mode of action, target-site resistance and cross-resistance

In the majority of cases, not only does this resistance render the selecting compound ineffective, but it often also confers cross-resistance to other chemically related compounds. Because compounds within a specific chemical group usually share a common target site within the pest, they also share a common mode of action.

Effective resistance management requires multiple strategies and modes of action.

Experience has shown that all effective insecticide resistance management strategies seek to provide conditions that minimize selective pressure for resistance. In practice, alternations, sequences or rotations of compounds with different modes of action provide a sustainable and effective approach to resistance management. This ensures that selection of compounds with the same modes of action is minimized. Applications can be arranged by mode of action spray windows or blocks that are defined by the stage of crop development and the biology of the target pest. The development of resistance is localized, meaning resistance is related to on-farm or nearby actions. The cause and prevention of resistance can only be controlled by growers. Local expert advice should always be followed with regard to spray windows and timings.

What are neonicotinoids?

Neonicotinoids are a relatively new class of insecticides that are so named due to their similarity in structure to nicotine. Both neonicotinoids and nicotine belong to the Group 4 insecticide modes of action. The class contains five active ingredients and 13 products registered, or soon to be registered, on potatoes. All products have activity against Colorado potato beetle and green peach aphids; some products also have activity against other potato insect pests. It is important to remember that all of these products act in the same manner to kill insects.

Why focus on neonicotinoids?

The neonicotinoid class of insecticides has been hugely successful in controlling aphids, beetles and other pests of potatoes. Approximately 52% of U.S. potato acres were treated in 2003 at least once with this group of chemicals, and use is expected to increase in the coming years. Due to the widespread use of these products on potatoes, the historical ability of Colorado potato beetle and green peach aphid to develop resistance to insecticides and the molecular structure of the class of chemistry, there is significant potential for resistance development in insect pests of potatoes. Localized populations of Colorado potato beetles in the Eastern and mid western U.S. have already shown low to moderate levels of resistance to neonicotinoids. Development of resistance to one neonicotinoid insecticide is expected to confer resistance to all other neonicotinoid insecticides within a short period of time. The development of resistance to this class of chemistry is expected to result in a significant economic loss to potato growers and is therefore critical for growers to develop a strategy to prevent neonicotinoid resistance in potatoes.

Neonicotinoids - registered or to be registered on potatoes

Active Ingredient Brand Name	Company	Use Pattern
imidacloprid		
Admire	Bayer	in furrow
Gaucho	Gustafson	seed treatment
Genesis	Gustafson	seed treatment
Provado	Bayer	foliar
Leverage[1/]	Bayer	foliar
thiamethoxam		
Platinum	Syngenta	in furrow
Actara	Syngenta	foliar
Cruiser	Syngenta	seed treatment
acetamiprid		
Assail	Cerexagri	foliar
clothianidin		
Poncho[2/]	Bayer‘	seed treatment
Belay[2/]	Arvesta	in furrow
Clutch[2/]	Arvesta	foliar
dinotefuran		
Venom[2]	Valent	in furrow/foliar

[1/] (package mix with cyfluthrin)
[2/] (not yet registered)

Avoid resistance by . . .

- If a neonicotinoid insecticide (Group 4) was applied at planting, either in furrow or as a seed treatment or at lay-by, do not use a foliar neonicotinoid insecticide later in the season.
- Use neonicotinoid insecticides within the framework of an integrated pest management program. Crop rotation with a minimum of ¼ mile between successive plantings is especially important for management of Colorado potato beetle.
- Apply insecticides only when necessary.
- Use research-based sampling procedures and action thresholds.
- Do not treat all potato fields on one farm or in one localized area with products from the neonicotinoid class.
- Preserve natural controls by using selective insecticides when possible (Success/SpinTor, Rimon, Avaunt, Fulfill, etc.)
- Spot treat when feasible (e.g. field edges).
- Do not apply insecticides below labeled or recommended rates. Application of sub-lethal rates of any insecticide may result in poor product performance, insect damage to the crop and an increased risk of resistance development.

How can I tell what group an insecticide belongs to?

In 2001, the EPA proposed a pesticide labeling scheme aimed at managing resistance based on pesticide modes of action. In this scheme all registered pesticides were classified by mode of action (or target site) and each mode of action was assigned a group with a specific number. For all insecticides there are 26 different groups with 110 insecticidal active ingredients. For potatoes, only 27 different active ingredients are registered and for use on potatoes as of 2005 and these are classified into only 13 groups.