# Reducing Insecticide Resistance of Colorado Potato Beetle

Colorado potato beetles (*Leptinotarsa decemlineata*) are quite good at developing resistance to insecticides when they are repeatedly exposed to insecticides that kill the beetles in the same way. Increasing the dose of an insecticide once the number of resistant beetles has begun to increase will not prevent resistance from increasing. The steps provided in this factsheet can reduce the risk of resistance developing.

## Resistance of Colorado Potato Beetle

Resistance of Colorado potato beetle to some groups of insecticides has occurred in Manitoba, and has also been a problem in other areas of Canada. Potato producers can take steps to prevent the development of widespread insecticide resistance in Manitoba. All pest populations have a very small number of individuals that are naturally resistant to a particular pesticide (or pesticide group). These resistant individuals are normally an extremely small portion of the total pest population. Continuous use of the same insecticide or insecticide group will allow resistant individuals to become a greater portion of the total population.

**Figure 1. Larvae of Colorado potato beetle**

### Rotate Insecticides

Insecticides have been categorized into several groups based on their mode of action (see table 1). To reduce insecticide resistance, it is important to rotate between insecticides from different insecticide groups, particularly if several insecticide applications are made in a season. Insecticides in different groups generally kill insects in different ways, whereas insecticides in the same group often kill insects in the same way. Insects that survive application of a particular insecticide may be killed by an insecticide that kills the insect differently. By selecting products from different insecticide groups for an insecticide rotation program, the development of insecticide resistance may be reduced.

### Use Insecticides Only When Needed

Overuse of insecticides can speed up resistance to the chemical. To avoid overuse of insecticides, fields should be monitored to determine the number of Colorado potato beetle per plant. Insecticide application is recommended when Colorado potato beetle larvae or adults are abundant enough that their defoliation will likely result in a yield loss similar to or approaching the cost of controlling them. This number is called an economic threshold. Insect densities at or above the economic threshold should be controlled. The economic threshold will depend on the cost of the control and the value of the crop.

### Time Foliar Insecticide Applications for Maximum Effectiveness

Larvae of the Colorado potato beetle have four stages of growth. Most of the damage by Colorado potato beetle is due to feeding by the largest (fourth) stage of larvae, when they are about 8 mm (1/4 inch) long. If foliar insecticide applications are needed, these should be targeted when the oldest larvae are in the third stage of growth, about 5 mm (1/8 inch) long. Spraying too early means fewer eggs will have hatched and more applications may be needed.

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It is important to read the insecticide label carefully for information about when to spray. Some insecticides work best when applied to small larvae. Some insecticides do not work well under certain weather conditions. For example, many of the pyrethroid insecticides do not work well when temperatures are above 25C. Spraying when conditions favour optimum effectiveness of the insecticide will also increase the level of control.

### Rotate Crops When Possible

For some insects, crop rotation is an important means of reducing resistance development to insecticides. Colorado potato beetles overwinter as adults within the field of origin, and within uncultivated areas near the field, such as woody borders and drainage ditches. Cool spring weather often forces overwintered beetles to walk to a new food source. The farther a potato field is from overwintering sites, the less the probability that it will be colonized by migrating beetles. This can reduce the need for insecticide applications.

One consequence of crop rotation is that early season populations of Colorado potato beetle may be concentrated at the edge of the fields. Sampling should be performed to determine if beetles are concentrated at the edge of the fields, and if so insecticides may need to be applied only to those areas.

**Figure 2. Adult Colorado potato beetle**

### Leaving Untreated Areas

Another means of delaying the evolution of resistance is to leave untreated areas within or among fields. Susceptible populations persist within these untreated areas and mate with newly resistant individuals that arise in adjacent treated areas. These untreated areas may also help preserve natural enemies of crop feeding insects.

### Use Selective Insecticides When Possible

Some insecticides will kill certain groups of insects while not harming or being of reduced harm to other groups. There can be many advantages to using more selective insecticides where possible. Some predators and parasitoids of crop feeding insects can be preserved by using more selective insecticides when possible. Some examples of selective insecticides registered for use against Colorado potato beetles in potatoes in Canada include coragen and rimon; success and entrust will also preserve many species of predaceous insects.

## Selecting an Insecticide

Insecticide rotations should be planned so that insecticides from different insecticide groups are used in consecutive treatments. The following table will help in selecting insecticides from different groups for control of Colorado potato beetle. More information on each insecticide can be found in the Manitoba Agriculture Guide to Field Crop Protection.

**Table 1. Groups of Insecticides Used to Control Colorado Potato Beetle**

| Group | Sub-group | Chemical Group | Trade Name | Active Ingredient |
|---|---|---|---|---|
| **28** | | Diamides | Vayego | tetraniliprole |
| | | | Harvanta | cyclaniliprole |
| | | | Coragen MaX, Coragen | chlorantraniliprole |
| | | | Exirel, Fortenza, Verimark | cyantraniliprole |
| **15** | | Benzoylureas | Rimon | novaluron |
| **6** | | Avermectins | Agri-mek | abamectin |
| **5** | | Spinosyns | Success, Entrust | spinosad |
| | | | Delegate | spinetoram |
| **4** | D | Butenolides | Sivanto Prime | flupyradifurone |
| **4** | A | Neonicotinoids | Actara, Cruiser Maxx Potato Extreme | thiamethoxam |
| | | | Admire, Alias | imidacloprid |
| | | | Assail, Aceta | acetamiprid |
| | | | Titan, Clutch, Nipsit Inside | clothianidin |
| **3** | A | Pyrethroids | Decis, Poleci, Advantage Deltamethrin | deltamethrin |
| | | | UP-Cyde, Ship | cypermethrin |
| | | | Matador, Silencer, Labamba, Zivata | lambda-cyhalothrin |
| | | | Ambush, Pounce, Perm-UP, IPCO Syncro | permethrin |
| **1** | B | Organophosphates | Malathion | malathion |
| | | | Dibrom | naled |
| | | | Imidan | phosmet |
| | | | Lorsban, Pyrinex, Warhawk, Sharphos[1] | Chlorpyrifos (larvae only)[1] |
| **1** | A | Carbamates | Sevin XRL | Carbaryl |
| **6 + 28** | | Avermectins + Diamides | Minecto Pro | Abamectin + Cyantraniliprole |
| **4A + 28** | | Neonicotinoids + Diamides | Minecto Duo | Thiamethoxam + Cyantraniliprole |

| | | | | |
|---|---|---|---|---|
| **4A + 15** | | Neonicotinoids + Benzoylureas | Cormoran | Acetamiprid + Novaluron |
| **4A + 3A** | | Neonicotinoids + Pyrethroids | Concept | Imidacloprid + Deltamethrin |

[1] Retailers are no longer allowed to sell chlorpyrifos (Lorsban, Pyrinex, Warhawk, Sharphos), as of December 2022. Producers have until December 2023 to apply remaining product before the product is officially unregistered and unusable for application.

Additional information on the modes of action of these group of insecticides can be found on the Insecticide Resistance Action Committee website at http://www.irac-online.org/.

Note that most of the current seed piece treatments and in-furrow applications to control Colorado potato beetles are from the same chemical group, the neonicotinoids (group 4A), with the exception of Verimark, Fortenza and Vayego, which are diamides (group 28). Repeated reliance on one chemical group of insecticides to control Colorado potato beetles increases the risk of the beetles developing resistance to the insecticides in this group. If a neonicotinoid or diamide insecticide was applied at planting, either in-furrow or as a seed treatment, do not use a foliar insecticide in the same chemical group later in the season.

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