Colorado Potato Beetle

(*Leptinotarsa decemlineata*)

Insecticide Resistance Action Committee

Introduction

Leptinotarsa decemlineata is a common pest of potato, but also eggplant, tomato, pepper and tobacco. It is an important pest in North America, Europe and expanding its range in to various parts of Asia, most significantly in China and Iran .

The adults appear from hibernation in May, feed on young leaves, mate, and then start with oviposition. Each female lays eggs in clusters on the undersides of leaves. The larvae hatch 3-14 days later. There are 4 larval instars over a period of 2-4 weeks before the larvae drop to the soil to pupate. Pupation lasts a further 2-3 weeks, before the new adults emerge from the ground. There are usually 1-3 generations each year, with adults overwinter in the soil.

Treatment with insecticides has been the primary control option for growers either through tuber or foliar applied treatments. Timing of foliar insecticide applications are best targeted against small larvae for most effective control, with 1-2 foliar applications normally required per season.

Potato plants can withstand 20-30% foliage loss without impact on potato yields, so it is often not necessary to apply insectiocides unless one or more beetle per plant is observed.

Crop rotation and early/late planting can be used to reduce beetle populations, whilst covering the soil surface with straw-mulch has also been demonstrated as being an effective technique for reducing beetle pupation.

There are also a number of natural and biological control methods which can help to manage *L. decemlineata* (paricularly larvae), including pathogenic fungi (e.g. *Beauveria bassiana*), predatory bugs, carabid beetles and parasitic wasps.

Resistance Status

Insecticide resistance to modern insecticides has been recorded in the Colorado potato beetle since the early 1950's, when resistance to organchlorine insecticides was found in the USA and Europe.

During the 1970 to the mid-1990's carbamate, organophosphate (Group 1) and pyrethroid (Group 3) insecticides were widely used in both North America and Europe for potato beetle control. In some areas of the USA over-use resulted in resistance to all chemical insecticide options available. Resistance to carbamate, organophsphate and pyrethroid insecticides were also reported in Europe, albeit more sporadically than in North America. Although selection pressure was subsequently reduced, the use of group 1 and group 3A insecticides should only be considered with caution and knowledge of the local resistance situation. Resistance to Group 1 & 3 insecticides has been associated with a number of different resistance mechanisms, including enhanced metabolism and target site insensitivity. In the cases of enhanced metabolism there is some evidence to suggest cross-resistance amongst the chemical classes and therefore rotation amongst these MoA groups alone is not recommeded.

Resistance to the neonicotinoid insecticides (Group 4A) was first reported five years after registration in the USA. Subsequent reports of resistance have been made across several US states and Canada, however issues are much less prominent in Europe. Although the performance of Group 4A insecticides can not be assured in several regions in North America they may still provide a useful tool in pest management, especially as they can be used as either foliar treatments or systemic tuber treatments. It is recommended to monitor the performance of these products and consult with local crop advisors on their use.

There have been limited reports of resistance to other insecticides registered for the control of Colorado potato beetle, including avermectin, spinosad, nereistoxin's and diamides, however as yet these appear to be limited to localised occurences.

Table 1: Insecticide modes of action which are registered for the control of CPB and known resistance.
(Not all insecticides groups will be registered for use in all regions and crops. The likely absence of any insecticides belonging to a MoA group within a region is indicated by a grey box. Consult with local advisors to confirm product availability)

Primary Site of Action (MoA)	MoA Group	Insecticide Chemistry	*North America*	*Europe & Asia*
Acetylcholinesterase inhibitors	1A	Carbamates	XXX[1]	XXX
	1B	Organophosphates	XXX	XXX
GABA gated chloride channel blockers	2A	Cyclodiene organochlorines	XXX	XXX
	2B	Phenylpyrazoles (Fiproles)		
Sodium channel modulators	3A	Pyrethroids	XXX	XX
Nicotinic acetylcholine receptor competitive modulators	4A	Neonicotinoids	XX	(X)
Nicotinic acetylcholine receptor allosteric modulators	5	Spinosyns	(X)	
Glutamate-gated chloride channel allosteric modulators	6	Avermectins	(X)	
Microbial disruptors of insect midgut membranes	11A	*Bacillus thuringiensis*	(X)	
Nicotinic acetylcholine receptor channel blockers	14	Nereistoxin analogues		X
Inhibitors of chitin biosynthesis, type 0	15	Benzoylureas		
Moulting disrupter: Dipteran	17	Cyromazine		
Mitochondrial C-I electron transport inhibitor	21A	METI insecticide		
Voltage-dependent sodium channel blockers	22A	Indoxacarb		
Ryanodine receptor modulators	28	Diamides	(X)	
Compounds of unknown mode of action	UN	Azadirachtin		
		Cryolite		

[1]XXX = widespread reports of resistance, XX = resistance reported in several locations, X = isolated instances of resistance, (X) = rare cases of resistance, no entry = unknown. The information presented in this table is based on peer-reviewed published reports of field collected populations of *Leptinotarsa decemlineata* being isolated at a specific time and location before being tested for insecticide susceptibility. Insecticide resistance is a dynamic process, and therefore, the information provided may not exactly reflect the current status of insecticide resistance in all countries or locations.

Resistance Management

It is recommended that the rotation of effective insecticides with different modes of action are used to provide insect control, whilst at the same time reducing the risk of insecticide resistance development. The following should be considered when designing a control programme for Colorado potato beetle:

- Plan ahead. Determine when in a typical season insecticide applications are likely to be needed and plan for the rotation of insecticides with different modes of action, avoiding the consecutive use of products belonging to the same mode of action group (including seed treatments). Plan for contingencies in case extra applications are needed due to untypical pest infestations. Consider the presence of other insect pests that may occuring in the crop and require insecticide treatments.
- Determine which insecticides are most effective for controlling each pest during each application timing. If the presence of other pests which overap with Colorado potato beetle, consider using pest specific insecticides rather than broad spectrum insecticides, which may increase unnecessary resistance selection pressure for either or both pests.
- Evaluate the current insecticide resistance situation in the area (consult local crop advisors and experts). Avoid using insecticides already affected by resistance where possible.
- Consider the impact of the insecticides on non-target arthropds and natural predators, especially during early season applications, where maintaining natural predators can reduce the need for later sprays.
- Consider planting the crop at different timings to avoid peak pest pressure, use straw-mulch to reduce beetle populations and consider the use of biological control agents.
- Always follow insecticide label instructions for application timings, volumes and concentrations.

Susceptibility Monitoring

The susceptibility of Colorado potato beetle and other leaf feeding coleoptera and lepidoptera can be conducted by using leaf dip assays, as described in the IRAC approved method No. 007.

Further details on this methodology and other susceptibility monitoring methods can be found on the IRAC website: www.irac-online.org

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