IPM in Australian potato crops and the threat from potato psyllid.

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Abstract

We describe here the IPM strategy that we developed for Australian potato crops and the pests with which it must deal. The potential impact of potato psyllid on this IPM strategy is a serious concern and has the potential to destroy the strategy that is currently in place, and that some growers have used successfully for over 13 years. The main foliar pests that we must deal with are potato tuber moth (PTM) (*Phthorimaea operculella*), several other caterpillar species, and aphid species including green peach aphid (*Myzus persicae*).

Introduction

IPM requires an integrated set of control options for all pests, both major and minor, that are encountered in any crop. Potato crops are no different and there are beneficial species that occur in potato crops worldwide, cultural options that are available and also selective pesticide options. We describe here how an IPM approach to potato pests was developed in Australian crops. Our work on potato tuber moth (PTM) began in 1986 when organochlorine insecticides (including DDT and dieldrin) were still permitted for use on some potato crops in Australia, and use of organophosphates and synthetic pyrethroid insecticides were standard practice.

There is an extensive literature relating to PTM and its biological control and Australian work prior

Potato tuber moth and damage to potato crops.

to ours include papers by Briese (1981) and Callan (1974). Studies that we have carried out on the

relative importance of different species of parasitoids have shown that there are established populations of parasitoids of PTM and that these vary according to location (Horne 1990). The objective of our studies was the development of an IPM system for all potato pests. The papers published on potato IPM topics by Paul Horne and co-workers is summarised by Horne and Page (2008).


Orgilus lepidus

Materials and Methods

As in any IPM strategy, the primary controls are biological and cultural, supported by selective pesticides, only when necessary. Broad-spectrum insecticides such as synthetic pyrethroids, organophosphates, and others must be avoided as foliar sprays. The major pests that are encountered in Australian potato crops are PTM, *Helicoverpa armigera* (Hubner), green peach aphid (*Myzus persicae* (Sulzer)), potato aphid (*Macrosiphum euphorbiae* (Thomas)), onion thrips (*Thrips tabaci* Lindeman), tomato thrips (*Frankliniella schultzei* (Trybom), western flower thrips (*F. occidentalis* Pergande), whitefringed weevil (*Naupactus leucoloma*) (all exotic species to Australia), looper caterpillars (*Chrysodeixus argentifera* (Guenee) and *C. eriosoma* (Doubleday)) and potato wireworm (*Hapatesus hirtus* Candeze), but there are many other minor, local or infrequent pests. Potato wireworm in Australia is different to species of potato wireworm elsewhere in the world and has a very different life-history (Horne & Horne 1991). A range of native and introduced natural enemies of these pests are used in IPM strategies. The most important of these are native predators: damsel bugs (*Nabis kinbergii* Reuter), pentatomid bugs (*Oechalia schellembergii* (Guerin-Meneville), brown lacewings (*Micromus tasmaniae* Walker), ladybird beetles (*Coccinella transversalis* Fabricius*, Hippodamia variegata* (Goeze) and *Harmonia conformis* (Boisduval) and red and blue beetles (*Dicranolaius bellulus* (Guerin-Meneville)). There are many parasitoids of the pests, and these include native species that attack the native pests, and also introduced species such as *Orgilus lepidus* Muesebeck, *Apanteles subandinus* Blanchard and *Copidosoma koehleri* Annecke and Mynhardt that parasitise PTM.

Cultural controls are equally as important as the biological controls and include soil preparation and management, irrigation, location of plantings, seed source and variety selection. Cultural controls such as rolling, watering, and harvesting early or hilling were more important options proposed than spraying insecticides. A major cultural control that we needed to implement was a good “hill” made of fine soil (not cloddy soil) which provided good soil cover over developing tubers. Soil management is a critical component of our IPM strategy.

Selective insecticides such as *Bacillus thuringiensis* sp. *kurstaki* (BT) sprays are sometimes used, but the typical control of pests is achieved by biological and cultural means. Growers who have changed from conventional control based on insecticides to an IPM approach have made significant

Copidosoma, and parasitizing PTM larvae on left.

reductions in pesticide use, with associated savings (eg from 7 insecticides per crop to none (O'Sullivan & Horne 2000). Growers successfully using IPM include those producing certified seed, crisping, processing, ware and organic crops, and some growers have been using the strategy for over 13 years.

The approach we took required monitoring for all pests that occurred during the life of the crops and recommending actions that would control that pest without interfering with control of other pests. That is, applying actions that would not kill biological control agents for other potato pests. All monitoring and advice reported here concerns commercial farms, not plot trials or small trial results within commercial crops.

Results and Discussion

When we commenced research on PTM in 1986 there was almost total reliance on chemical insecticides as the basis for control of all pests. This appears to be the current situation in other countries such as the USA and UK now. The potato industry had very little knowledge of biological control agents and how these could potentially be used in an IPM strategy. Although there was interest from the potato industry there was also scepticism and a need for both scientific information and on-farm demonstration of IPM. This situation is one that we have encountered in a range of horticultural and broad-acre cropping industries and our approach to dealing with it is by simultaneously gathering entomological information and providing commercial demonstrations of IPM (Horne, Page & Nicholson, 2008).

We were able to show that parasitoids of PTM and aphids were present in all areas where potatoes were grown and that they exerted considerable control pressure on these two key pests. The main parasitoid recovered from samples was the larval parasitoid *Orgilus lepidus*, followed in importance by another larval parasitoid *Apanteles subandinus.* The egg-larval polyembryonic parasitoid *Copidosoma koehleri* was found from most locations but was far less abundant than the larval parasitoids (Horne 1990).

Suddenly we needed to be aware of all pesticide inputs (and not only for PTM management) and we realised that we had totally ignored the potential biological control provided by predators (as well as parasitoids) and that the cultural controls of hilling and irrigation were at least as important as parasitoids of PTM. We now had to deal with all pests of potatoes in a compatible way, not just promote the parasitoids of PTM. This was entirely possible, as there are IPM compatible options for all aphids, caterpillar and other pests of potatoes in Australia (Horne 2000). Table 1 provides an example of the integration of several options in a compatible way. To assist growers and others in recognizing the beneficial species as well as the pests a guidebook was prepared which was

distributed to all potato growers in Australia (Horne, DeBoer & Crawford 2002).

In Australia there is a problem with tomato spotted wilt virus in potatoes and this is vectored by several species of thrips; onion thrips (*Thrips tabaci* Lindeman), tomato thrips (*Frankliniella schultzei* (Trybom) and western flower thrips (*F. occidentalis* Pergande). Control of these pests without recourse to broad-spectrum insecticides is essential to overall control of pests, including PTM (Horne & Wilson 2000). Obviously, broad-spectrum foliar sprays of insecticides targeting thrips will have massive detrimental effects on the biological control of potato moth and aphids (and aphid vectored diseases). Growers using IPM understand that they have beneficial species that help to control key pests and also avoid the development of secondary pests.

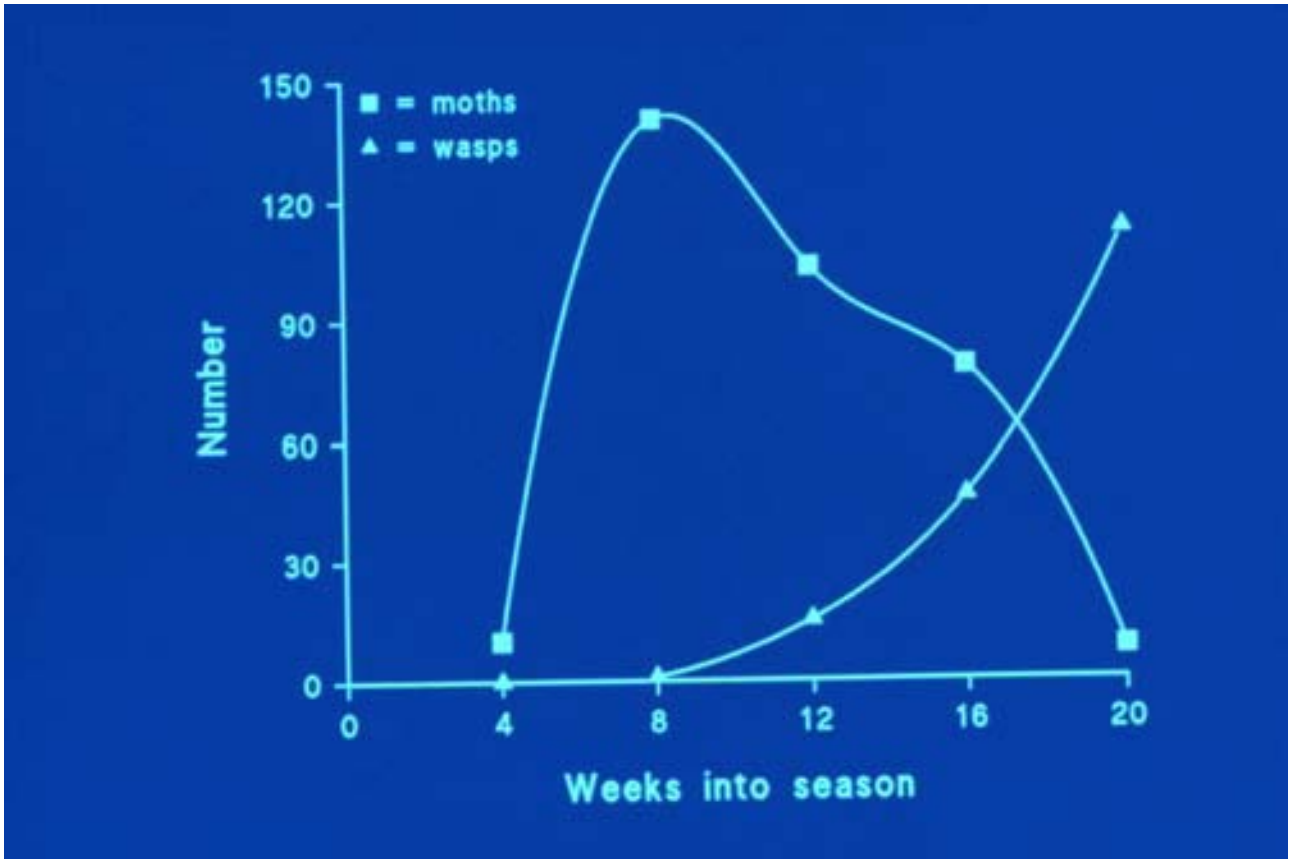
Table 1: An example of a typical IPM strategy for potatoes integrating several control options

Pest	Beneficial	Cultural Control	Pesticide support
PTM	*O. lepidus* *A. subandinus* *C. koehleri*	Soil management Irrigation	Spray after senescence
Green Peach Aphid	Parasitic wasps Ladybird beetles	Weed control	Pirimicarb
Other Aphids	Parasitic wasps Ladybird beetles	Weed control	Pirimicarb
Heliothis	Damsel bugs Parasitoids	-	NPV, BT
Loopers	Damsel bugs Parasitoids	-	BT
Whitefringed weevil	*Carabidae*	Avoid infested areas	Insecticide before planting
Potato Wireworm	*Carabidae*	Avoid infested areas	Insecticide before planting, seed dressing

Our observations show that broad-spectrum insecticides applied to control pests such as caterpillars can cause aphid flare. We believe that this is a general principle that can be extrapolated to many situations. Control of potato psyllid (*Bactericera cockerelli*) with foliar applied insecticides would cause interference with the biological control of the other main pests of potatoes in Australia, and so destroy the main elements of an IPM strategy. There are known predators of potato psyllid outside Australia that belong to the same groups as those native Australian species that are already important in control of other potato pests. It is not known how effective these native species will be in controlling potato psyllid and this needs to be studied as soon as possible.

Conclusion

One of the main issues that we had to deal with in Australia was the integration of several pest issues (e.g. potato moth and aphids and looper caterpillars) and the recognition that an inappropriate spray for one would disrupt control of other pests. This apparently simple issue is a stumbling block for IPM adoption in a range of horticultural and broad-acre crops in which we work. We need to develop biological and cultural control options for potato psyllid so that potato farmers using IPM can continue to do so.



Impact of parasitoids in potato crops.

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