POTATO APHIDS: PREVENTING INSECTICIDE RESISTANCE

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Potato viruses are a serious threat to potato production. Aphids that spread viruses in potatoes have been found in Hawke's Bay to be resistant to commonly used insecticides, and Crop & Food Research scientists and industry are working together to prevent resistance spreading.

wingless green peach aphid

The main threat lies in lowered yield and quality through aphid-transmitted viruses, such as potato leaf roll virus and potato virus Y, although aphid feeding can also damage crops.

Any build up of aphid-borne virus in seed crops could be serious as it is likely to be amplified in later plantings of seed, process and table potatoes and to spread to other areas of New Zealand.

In a three-year project funded by MAF's Sustainable Farming Fund and the potato industry, we aim to combat resistance through a insecticide management strategy for all potato growers in New Zealand. As well as protecting the full range and efficacy of existing chemical treatments, such a strategy is also likely to help growers save on the cost of chemicals.

Research to support the programme has five different angles:

* a survey on growers' management practices for aphid/virus
* field trials to look at the efficacy of commonly used insecticides
* a review of scientific literature on management of viruses through aphid control
* establishing methods for monitoring aphid populations to indicate when to spray
* informing growers of aphid flights and aphid management strategies through the AphidWatch website (www.AphidWatch.com)

Meetings will also be held in spring to pass on to potato growers our research information to date and tips to assist with controlling aphids.

This article outlines first year results including the grower survey and field trials on foliar insecticides. Monitoring aphid populations in potato crops is also discussed along with future research directions.

GROWER SURVEY ON APHIDS & INSECTICIDES

Survey results indicate that chemical use, particularly in seed production, could potentially lead to the spread of resistant aphids. Some potato crops in Canterbury had three or more sequential applications of one class of insecticide. Frequent use of an insecticide provides ideal conditions for insecticide resistance to build. However, at present there are few alternatives for seed producers.

Sixteen out of 74 registered seed potato growers and 12 out of 356 registered fresh or processing potato growers responded to the survey in the 2001-2 season. Although the response from the fresh growers was too small to be representative, 15 of the seed growers came from the 66 seed growers in Canterbury, so the replies for that group were considered to reflect the situation for all seed growers in New Zealand.

Insecticide use:

The majority of seed growers used imidacloprid to control aphids, with over half of the seed tuber paddocks treated at one third less than the label rate.

In addition to the insecticide seed treatment, seed potato growers reported that 16% of their potato crops received between three and six applications of either an organophosphate or a carbamate insecticide, a practice that could potentially induce aphid resistance to these classes of insecticides.

Timing and haulme desiccation:

Applications of desiccants when peak aphid flights occur means the tubers are at risk of virus infection when aphids colonize foliage regrowth. Peak aphid flights were recorded as coinciding with when many of the potato crops were being desiccated. Regrowth occurred on 48% of paddocks, yet no grower sprayed to control aphids or checked whether they were present.

We believe this is important in limiting virus infection. (see Aphid/virus management by David Teulon in Grower 56 (2): 52-53).

Virus management:

Most seed growers rouged diseased plants to prevent virus transmission. Most did not use strategies to prevent insecticide resistance in aphids but, those who did, mainly alternated different chemical insecticide classes.

Only 13% of seed growers washed their vehicles between paddocks with a high-pressure water jet, probably an effective method of preventing virus transmission between paddocks.

Other effective strategies used included sowing certified seed or virus-resistant cultivars, and early elimination of aphid host plants.

FIELD TRIALS

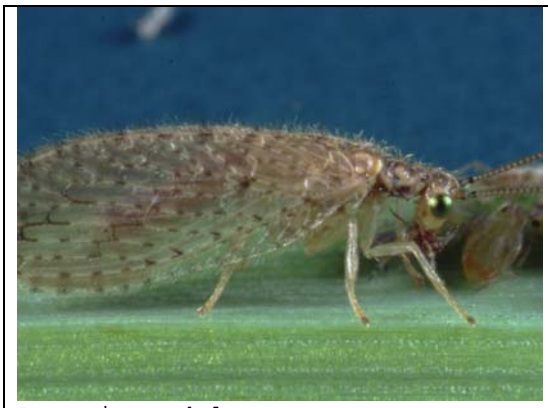
Field trials are being set up every year for the next three years at Lincoln and Pukekohe to evaluate the effectiveness of current industry practice in controlling aphids to limit the spread of potato viruses. Last season the effect of two foliar insecticide strategies were compared on numbers of aphids and their predators in potato foliage. An organophosphate applied fortnightly on a calendar basis was compared with a synthetic pyrethroid applied on a spot basis, whenever aphid populations rose above a set trigger point (10 aphids per 150 leaves). These insecticides were applied to foliage grown from potato seed that was either untreated, or was treated with the systemic insecticide imidacloprid. The effects of these four insecticide treatments were compared to untreated potatoes. The potato haulms were desiccated and tubers harvested as per industry practice.

The first year's trials gave interesting results. At Lincoln, the seed treatment reduced populations of wingless aphids per 150 leaves in mid December from 41 aphids in the untreated controls to 3 aphids in imidacloprid-treated plots. This seed treatment combined with either six fortnightly applications of an organophosphate, or one strategic application of the synthetic pyrethroid, kept aphid numbers below the threshold.

At Pukekohe, the seed treatment and four fortnightly applications of the organophosphate were not necessary until mid January due to the absence of aphids, and thereafter the treatment resulted in higher numbers of wingless aphids (98 aphids/150 leaves) than in the untreated plots (11 aphids/150 leaves).

We speculate that aphid numbers rose at Pukekohe because repeated spray applications killed the aphids' naturally-occurring predators that were found in the trial (hover fly larvae, lacewing adults and larvae and ladybird adults and larvae) (Figure 1). This means that when the aphid flights came in there would be few natural predators left to keep aphid numbers down.

The following years' trials should confirm whether this observation was a one-off event or a real effect that will need to be addressed in developing an insecticide management strategy.



Lacewing adult

Syrphid fly adult

Parasitoid *Aphidius* species

Lacewing larva

Syrphid fly larvae

Lady bird adult

Figure 1: Predators of aphids on potatoes. Collectively, these predators reduce aphid populations on potato plants, but are killed by the commonly used insecticides methamidophos (Tamaron®) and lambda cylambda-cyhalothrin (Karate® with Zeon Technology).

FORECASTING APHID TROUBLE: SCOUTING METHODS & APHIDWATCH

The numbers of aphids dispersing to fresh fields - and taking virus with them - varies greatly from year to year. The reasons for these fluctuations are unknown but may include insecticide use, frosts or herbicide use on their host plants.

Knowing when the aphid flights are peaking can provide growers with useful information on when to spray crops and Crop & Food Research (with funding from the Foundation of Arable Research and the MAF Sustainable Farming Fund) monitors the numbers of aphids flying throughout the season.

Traps used in the monitoring programme are based at Hilton, Rokeby, Lincoln and Courtenay in Canterbury; and near Hastings in Hawke's Bay.

Aphid flight data is updated weekly over the potato growing season and is available on the Aphidwatch website: www.AphidWatch.com/potato/index.htm

The site also has information on management of potato viruses, potato spindle viroid, and of aphid populations. It has aphid identification keys, and photos of different aphid species and the insects that prey on them.

Scouting (crop inspection) is another useful method of establishing aphid numbers. It is recommended to scout weekly while roguing for virus.

From relevant literature overseas, it has been suggested a practical way of scouting is to look at the underside of three leaves on each plant, over about 50 plants. One leaf each should come from the top, middle and bottom of each plant. Currently, it is advised to spray with a registered insecticide if more than 10 aphids are found in that sample of 150 leaves, but the relevance of this threshold for spraying under New Zealand conditions is still to be confirmed.

McCain Foods and Wrightson are also collecting information on aphid infestation and virus infection in potatoes.

Grower meetings will be held in the spring to assist with scouting tips.

NEXT YEAR & BEYOND

Research will continue in both North and South Islands to establish the efficacy of certain insecticides on aphids in the field, the impact of insecticides on the natural enemies of aphids and to develop action thresholds for growers to manage their crops. Convenient methods of detecting aphid numbers in potato crops will also be investigated.

Scouting and monitoring work will continue. Aphid populations will be looked at under various management regimes and compared with flight data to provide scouting and prediction systems (Figure 2). We invite potato growers to participate in this monitoring of aphids and virus infection in potato crops, so we can relate aphid flights recorded in the suction traps to aphid and virus infestations.

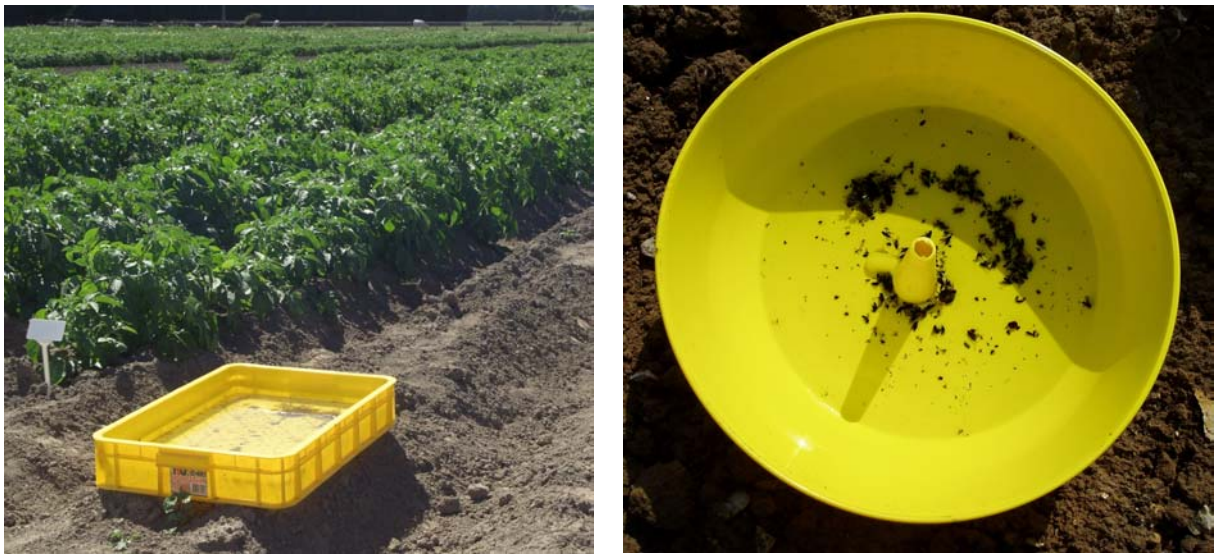


Figure 2: Yellow pan boxes (left) or bowls (right) can alert growers as to when to inspect the potato plants for aphids to time appropriate times to spray insecticides.

We would also be interested to receive insecticide spray diaries so we can monitor current insecticide use. Individual spray diaries would be confidential and contributors would remain anonymous.

We will also be assessing existing levels of aphid resistance in laboratory trials. In this work populations of aphids collected in potato crops are sprayed with different doses of commonly used insecticides. Resistance to a particular insecticide is detected when a higher dose than expected is required to kill the aphids.

We would be very interested in hearing about any aphid populations that are not being controlled by insecticide applications in potato crops.

Finally, all this information will be bought together in an insecticide management strategy, which will focus on the areas with most intense insecticide use.

Abridged from Potato Aphids: Preventing Insecticide Resistance, in Grower October 2003, Vol. 58 No. 9: 49-50.