Control of aphid vectors on the seed potato crop

August 2012
Structure

- Background
- PLRV then PVY/PVA
- Decision support
- Methods of control
- Conclusions
Circulative viruses (PLRV)

- One major vector species - *Myzus persicae*
- Relatively long acquisition and transmission time
- Field inspections identify problems
- Insecticides work in disrupting transmission
Changes in *Myzus persicae* resistant clones

The next major problem will be new resistance mechanisms

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O and P clones resist pyrethroids

Number of aphids mobile 24 hours after treatment with a pyrethroid

Type A

Type O

Type J

P<0.001
Group are currently working on a document about pyrethroid resistant *Sitobion avenae*

Reduction in control on cereals could lead to more aphids of this species moving on to potato crops

<table>
<thead>
<tr>
<th>Members</th>
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<tbody>
<tr>
<td>Chris Bean, UAP Ltd</td>
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<td>Chris Longhurst, Dow AgroSciences</td>
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<td>Michael Tall, Sympenta</td>
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<td>David Monck, GrowCoEurope</td>
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Mosaics (mostly PVY and PVA)

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Vectoring of non persistent viruses

A protein key to plant virus transmission at the tip of the insect vector stylet. Uzest et al.

Infectious particles on tip of aphid stylets

Acquisition and transmission in minutes

Potentially vectored by many species of aphid

Aphids that live on potato and those that do not can transmit viruses
Relative Efficiency Factor: A measurement of how well aphid species spread virus relative to *Myzus persicae*

<table>
<thead>
<tr>
<th>Species name</th>
<th>Common name</th>
<th>Relative Efficiency Factor (PVY)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Myzus persicae</em></td>
<td>Peach-potato Aphid</td>
<td>1</td>
</tr>
<tr>
<td><em>Acyrthosiphon pisum</em></td>
<td>Pea aphid</td>
<td>0.7</td>
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<tr>
<td><em>Rhopalosiphum padi</em></td>
<td>Bird cherry-oat aphid</td>
<td>0.4</td>
</tr>
<tr>
<td><em>Aphis nasturtii</em></td>
<td>Buckthorn-potato aphid</td>
<td>0.3</td>
</tr>
<tr>
<td><em>Metopolophium dirhodum</em></td>
<td>Rose-grain aphid</td>
<td>0.3</td>
</tr>
<tr>
<td><em>Brachycaudus helichrysi</em></td>
<td>Leaf-curling plum aphid</td>
<td>0.21</td>
</tr>
<tr>
<td><em>Macrosiphum euphorbiae</em></td>
<td>Potato aphid</td>
<td>0.2</td>
</tr>
<tr>
<td><em>Myzus ascalonicus</em></td>
<td>Shallot aphid</td>
<td>0.2</td>
</tr>
<tr>
<td><em>Myzus ornatus</em></td>
<td>Violet aphid</td>
<td>0.2</td>
</tr>
<tr>
<td><em>Rhopalosiphoninus latysiphon</em></td>
<td>Bulb and potato aphid</td>
<td>0.2</td>
</tr>
<tr>
<td><em>Aulacorthum solani</em></td>
<td>Glasshouse potato aphid</td>
<td>0.2</td>
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<tr>
<td><em>Hyperomyzus lactucae</em></td>
<td>Currant-sowthistle aphid</td>
<td>0.16</td>
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<tr>
<td><em>Aphis fabae</em></td>
<td>Black-bean aphid</td>
<td>0.1</td>
</tr>
<tr>
<td><em>Brevicoryne brassicae</em></td>
<td>Cabbage aphid</td>
<td>0.01</td>
</tr>
<tr>
<td><em>Sitobion avenae</em></td>
<td>Grain aphid</td>
<td>0.01</td>
</tr>
<tr>
<td><em>Cavariella aegopodii</em></td>
<td>Willow-Carrot Aphid</td>
<td>0.5</td>
</tr>
</tbody>
</table>
REF laboratory tests

Infection by test species divided by infection by the internal control

Comparison with MP2 (Dutch M. persicae) clone

0.01?

Latest REF results from Fera
Field experimental transmission studies

Yorkshire Wolds (Fera)

Pittenweem (SA - Fife)

Gogarbank (SASA - Edinburgh)
Sources of virus

Vertical transmission
Virus in the parental stock

Horizontal transmission
Virus entering the crop

Volunteers can be in neighbouring crops and in the potato field within the crop

Vertical transmission rates are greater than horizontal transmission rates and independent of field generation

Horizontal transmission rates are greater in districts that grow more potatoes

Different potato varieties require different virus management

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Proportion of groundkeeper varieties in SW Plot

- Desiree
- Estima (Mp)

Total from years 1 and 2 after Estima Crop = Years 6 and 7 after Desiree crop

Desiree plants in NE and SW plots

<table>
<thead>
<tr>
<th>Plot</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>NE</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>SW</td>
<td></td>
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% PVA (Desiree SW plot)

- 2009: 100%
- 2010: 20%
- 2011: 80%
Ware and seed proximity

Horizontal transmission rates are greater in areas where more potatoes are grown.

The proximity of ware is more important than the proximity of seed crops.
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Fera - Yellow water traps

Aphid Monitoring in Potato Crops

Historical Data: Samples
10 days prior to 24-Jul

View a summary of 2012.

So far, 519 samples have been received in 2012

Based on industry feedback in 2006, the opportunity to make comparisons with historical data has been provided.

- Choosing "Average Weekly Index" in the Date box above shows the average weekly index for each trap
- Choosing a date shows the index for the most recent sample from each site as long as it has been taken in the 10 days before the date

Key: Weekly Index value
- 0.0 - 2.0
- 2.01 - 10.0
- >10.0
- No Sample received

If a region's bounding box is coloured red, then at least one Peach-Potato aphid has been captured in the last 10 days in that region.
If there is a date to the left of a region, this is the date the first peach-potato aphid was captured in that region.

Please click on a boxed region or use the links below to get more detailed results and cumulative index values:

North Scotland
Borders
Midlands
South West
Angus & Perthshire
Northern England
East Anglia
Grampian

Along with the risk index you need to take into account the following factors when considering the risk of virus spread:

- Mature plant resistance. Crops are generally at their most vulnerable within the first four weeks.
SASA - Suction traps

Cereal aphids and PVY transmission in 2011

The four dominant species of cereal aphids were not particularly abundant in the aphid traps in 2011, the population of the Rose-Grain aphid, the species most strongly associated with the transmission of Potato Virus Y (PVY) in Scotland, was slightly greater than an average year when compared to the previous 28 years. Therefore, it is anticipated that the incidence of plants showing mosaic symptoms will be similar in 2012 to that observed in the 2012 potato crop. However, it is recommended that crops are thoroughly rogued at the earliest opportunity to remove any virus inoculum and to protect the 2012 seed potato crop from infection.

Cereal aphids in 2012

Please note that the graphs below represent actual numbers of aphids caught in Scottish suction traps using a log scale. Viewing population data on a log scale makes it easier to spot subtle changes in numbers when comparing 2012 data to the large number of aphids caught in previous seasons.

Rose-Grain aphid

The total catch of 70 Rose-Grain aphids (Melaphorophum dirhodum) in Scottish traps to 15 July ranks 26th from the last 29 years.

Grain aphid

As of 15 July, 80 Grain aphids (Sitobion avenae) have been caught in Scottish suction traps in 2012. This total ranks 21st from the last 29 years.

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Rothamsted - Suction traps

Aphid bulletin

This web site is designed to bring you up-to-date news on the distribution and abundance of pest aphids at a regional scale. The information is based on data from a network of sixteen suction traps (see map). The traps are emptied daily during the aphid season and the aphids identified to species in most cases. Each trap is representative of what is flying over an area of radius approximately 60 km, but there is considerable local variation in aphid density at ground level. The data are used for fundamental studies on factors affecting the dynamics of aphid populations and to provide sponsors with information that aids aphid control decisions.

The traps have been running for several years (the one at Rothamsted began in 1955). This makes it possible to compare this year’s samples with previous years and hence say whether the current season is high, medium or low risk compared to average. For the time being, we will present simply the raw data but, as the web site develops, we will include interpretations that make it easier to understand and use.

Acknowledgements

Rothamsted Research and SASA are extremely grateful to the institutes where traps are sited and to the staff who deal with the samples.

Contacts

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SASA - Edinburgh Dr Jon Pickup (jon.pickup@sasa.gsi.gov.uk)

Links

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Wind

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Pesticide Usage Survey

- **Pyrethroids**
  - 1996: 19,800 Ha
  - 1998: 22,200 Ha
  - 2000: 15,000 Ha
  - 2002: 10,500 Ha
  - 2004: 12,000 Ha
  - 2006: 15,000 Ha
  - 2008: 25,603 Ha
  - 2010: 45,922 Ha

- **Neonicotinoids**
  - 1996: 2,500 Ha
  - 1998: 2,500 Ha
  - 2000: 3,500 Ha
  - 2002: 3,500 Ha
  - 2004: 3,500 Ha
  - 2006: 4,000 Ha
  - 2008: 4,000 Ha
  - 2010: 2,270 Ha

Number of thousands treated per crop.

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PVY in Scottish Seed Potatoes: 1998 to present

Model: $p = 0.000145$
Adjusted $R^2 = 0.83$

2010:
Prediction 16.0%
Actual: 15.7%

2011:
Prediction 37%
Actual: 7.6%
Some pioneering field trials work being carried out in Fife could lead to a much lower incidence of potato virus disease.

Eric Anderson, potato specialist with Scottish Agriculture, had noticed that other countries were using mineral oil sprays on seed potatoes as a means of repelling the aphids which spread viruses A and Y through crops during the summer period—a technique well established in the Netherlands and the Pas de Calais region of France.

In the UK a different approach had been taken with a total reliance on chemical insecticides.

Mr Anderson was convinced that it was worth while exploring the use of mineral oil—essentially a 2% paraffin mix—applied weekly.

He is now in his third year of trials and is now also experimenting with a 0.5% vegetable oil spray as a more organic alternative.

Yesterday at an open day sponsored by the Potato Council, Scottish Agriculture and potato packers Branston and hosted by Over Rankell Farm, Cupar, he was able to demonstrate plots of different varieties planted with a proportion of virus-infected seed.

Dr Brian Fenton, principal research scientist at the Scottish Crop Research Institute, has been closely involved with the project and explained the magnitude of the aphid problem.

“Myzus persicae, the peach potato aphid, is more implicated in spreading leaf roll, but we have still not seen it in traps this season.

“What we are looking at here is viruses A and Y which can be spread by a number of different aphids, including cereal aphids.

“They can acquire the virus from an infected plant within seconds so it is very important to repel them from landing on the plants.

“To get some idea of the problem imagine goal posts at the end of the field one metre high and ten metres wide.

“Around 1000 aphids an hour could move through that goal every hour from a neighbouring cereal crop.

“Extend the goal to sixty metres wide and over a week around one million aphids could pass through it, so clearly a repellent would be very useful.”

The oils have been proven to work, particularly the paraffin oil, but there has been a perceived problem as regards field inspections.

SASA, the government division responsible for seed certification, was concerned that the oily coating would mask virus disease symptoms on the leaves to the extent that inspectors could not see them.

Hence the deliberate incorporation of some infected plants in the plots.

The leaves of the mineral oil treated plants may look slightly glossier, but the typical mosaic patterns were easy enough to spot yesterday even after a heavy shower of rain.

SASA’s John Kerr said that there were also replicated trial plots in the field used for training seed inspectors and the early indications were that there would be no disease recognition problems.

Mr Anderson said: “It was very important that we cleared this hurdle because the Scottish seed classification system is based on rigorous field inspections.

Andrew Arbuskle, Rural Affairs Editor

The Hutton Institute may not be as visible as locusts and they may not leave such a trail of destruction but the rose grain aphid is increasingly being blamed for spreading virus in potato crops.

Yesterday at trial sites outside Cupar Dr Brian Fenton, from the Scottish Crop Research Institute, said that up to one million of these bugs and their close relatives, the bird cherry out aphid could pass through a potato crop within a week.

The problem is that their feeding habits help spread disease.

“They can land on an infected plant and pick up the disease in seconds and then transmit it to another plant within a few more seconds,” he stated.

Up until now most attention in potato fields has been concentrated on another bug, the peach potato aphid which can transmit the leaf roller virus. However, such has been the success in dealing with this yield reducing disease and in dealing with the vector that it is now quite unusual to come across the peach potato aphid in Scotland.

On the other hand there have been an increasing number of seed potato crops failing to come through field inspections because of mosaic problems.

Scientists work to tackle rose grain aphid

These crops have been infected with a potato virus and the infection was likely transmitted by the rose grain aphid or one of its relatives according to Dr Fenton.

Because there are so many of the aphids and because they move across fields in feeding waves, normal spray control methods are not effective.

As a result, Dr Fenton potato consultant with Scottish Agriculture has been carrying out trial work which involves spraying a highly refined paraffin oil on the plants.

This oil acts as a repellent to the passing bug and after three years of trial work, indications are that it might provide a solution to the problem.

Anderson admitted that there would be yield loss of up to 10 per cent but that this was not significant for seed growers as it only just back the cutting off period by a week or ten days.

The Scottish Agricultural Science Agency (SASA) has been wary of the mineral oil treatment because they felt it might mask other problems in the potato crop.

But Dr John Kerr who heads up the potato section at SASA, said that it now looked as if there was no problem in applying this protective layer. He added that Swiss visitors to SASA last week said they were using this repellent and it was effective.

However, they are dealing with much higher levels of infestation and their experience may not translate to this country.

Growers attending the event were also told of the mechanics of the new testing regime for potato cyst nematodes, which in a previous era were called eelworms.

As from the beginning of this month growers will require to pay for their land to be sampled. The range of costs varies with the scale of the field involved and also its previous history but, for a 20 hectare field, will run between £165 and £205.

The new regime will involve many more samples being taken and the samples being twice the size they have been. To cope with this, SASA have invested in new equipment to deal with the estimated 30,000 lots requiring testing annually.

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Overall Conclusions

- There are many sources of PVY and PVA virus and many potential aphid vector species.
- The aphids that move virus around can vary depending on location, time of year and between years.
- Information is available about aphid species and their numbers to support agronomy decisions.
- The record numbers of rose grain aphids in 2010 was not followed by a year of high incidence of PVY in seed crops but field experiments suggest this species remains as the most important vector of PVY.
- Removing sources of virus, such as groundkeepers, is the most sustainable method of reducing virus pressure on the seed crop.
- Once virus has entered a stock it is likely to remain and increase.
- In areas where ware is grown a careful choice in placing of seed varieties could help keep virus levels down.
- Pyrethroids and neonicotinoids are currently the insecticides of choice.
- Mineral oils are still being evaluated.
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The James Hutton Institute

The Scottish Government
Acknowledgments

• Ron Van Toor, Gaynor Malloch, James and Matt Wood, Thomas Salter
• Fiona Hight, Kim Davie, Ross Holmes
• Larissa Collins, Lisa Blackburn, Michelle Powell, John Magson, Samantha Bennett and Mark Daly
• Stuart Wale and Mike Inglis
• Funding: PCL, FP7 Marie Curie, Scottish Government