

## Aphids and Aphid-borne virus disease in potatoes

ISSN 0142 7695

ISBN 1 85482 706 5

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Aphids can damage potato plants directly through feeding damage and indirectly by transmission of several virus diseases.

- Management of aphids on ware crops differs from that on seed crops, where preventing virus transmission is of most concern.
- Several aphid species may be commonly found on potatoes, but differ in importance regarding virus transmission.

### Introduction

Decisions on the management and control of aphids on potato crops depend on whether the crop is being grown for seed or ware. Aphid control is necessary on seed potato crops in order to prevent the spread of potato leafroll virus and viruses which cause mild and severe mosaic. Aphids are the vectors for these viruses and virus control is essential to maintain the health of Scottish seed potatoes for further production in the UK and overseas. On ware crops yield reductions can be caused by heavy infestations of aphids (false top roll) through their feeding on the sap, causing leaves to curl in response to drought stress, and by primary infection with some viruses. Chemical control of aphids in ware crops may be necessary in these situations.

### Aphids as vectors of viruses

Aphids can transmit several viruses to potato crops, and the ability of individual aphid species to transmit viruses differs depending on the virus and the strain of the virus.

The most important viruses transmitted by aphids to potatoes in Scotland are potato leaf roll virus (PLRV), potato virus Y (PVY<sup>O</sup> and PVY<sup>N</sup> (veinal necrosis)) and potato virus A (PVA).

PLRV is a persistent virus, which means that it is acquired from infected plants by aphids only after a feeding period of several hours, and transmission by the aphid is then delayed for several hours because the virus has to pass through the digestive system of the aphid and replicate in its salivary glands before transmission may occur. Once the virus has been acquired by an aphid, the aphid remains infective for the rest of its life.



Figure 1: Potato leaf roll (PLRV) symptoms

In contrast to PLRV, PVY<sup>O</sup>, PVY<sup>N</sup> and PVA are non-persistent viruses, which are rapidly acquired by an aphid when it feeds on an infected plant. These viruses are carried on the aphid mouthparts, and they can be passed on to another potato plant within a few minutes of the aphid feeding on an infected plant. Consequently, winged aphids which briefly probe plants to determine whether they are suitable host-plants, then move onto another plant, can quickly spread non-persistent viruses within the crop.

PLRV is transmitted by relatively few aphid species, and virtually all PLRV transmission in Scotland is by *Myzus persicae*, the peach-potato aphid. The symptoms of primary infection, which can occur in the season of virus transmission, but which are not often seen in Scotland, are an upward and inward rolling of the young leaves, occasionally with a purpling of the leaves. The virus then passes to the developing daughter tubers. Secondary infection (tuber-borne) is seen in plants grown from seed that were

infected with PLRV. The symptoms appear first as a rolling of the older, lower leaves, not the upper leaves as with primary infection, and the leaves become leathery and tough due to an abnormal accumulation of starch (Fig. 1). Infected plants are stunted, and produce fewer leaves and smaller tubers.

Although PVY<sup>o</sup> is mainly spread by the peach-potato aphid (*Myzus persicae*), many other aphids can also transmit the virus, but not as effectively. Infection may result in a decrease in leaflet size, distortion of leaflets, dwarfing of plants, mottle and systemic necrosis whilst some cultivars exhibit leaf drop streak (necrosis and dropping of leaves). These symptoms are referred to as severe mosaic.

PVY<sup>N</sup> (Fig. 2) and PVA symptoms tend to be less distinct, showing only as a mild mottle, referred to as mild mosaic. Nevertheless, there is a loss of vigour and yield potential in plants arising from infected tubers, particularly if more than one virus is present in a plant.



Figure 2: Veinal necrosis (PVY<sup>N</sup>) symptoms

However, it should be noted that there is variability in the severity and expression of virus symptoms, depending on the potato variety. PVY<sup>o</sup>, for example, only results in a mild mosaic in some varieties.

Viruses have to be acquired by aphids feeding on infected plants, and the main sources of virus are from planting infected seed tubers, potato volunteers, and potato dumps.

### Aphids commonly found on potatoes

Whilst many aphid species may be found on potatoes, they may not necessarily be multiplying on the crop, simply landing on the foliage, feeding briefly, then flying off to a suitable host-plant for colonising. However, this may allow transmission of non-persistent viruses such as PVY<sup>o</sup> and PVY<sup>N</sup>.

Winged females of the aphid species which colonise potatoes may fly into the crop from May onwards, and give birth to live young, forming groups of aphid colonies, usually on the undersides of leaves.

**The peach-potato aphid** (*Myzus persicae*) is the most important aphid species affecting potatoes, as it is the most

effective vector of the most important aphid-borne viruses and can also cause direct feeding damage if numbers are allowed to build up (Fig. 3a). This aphid gets its name from its overwintering host the peach tree on which it lays eggs.

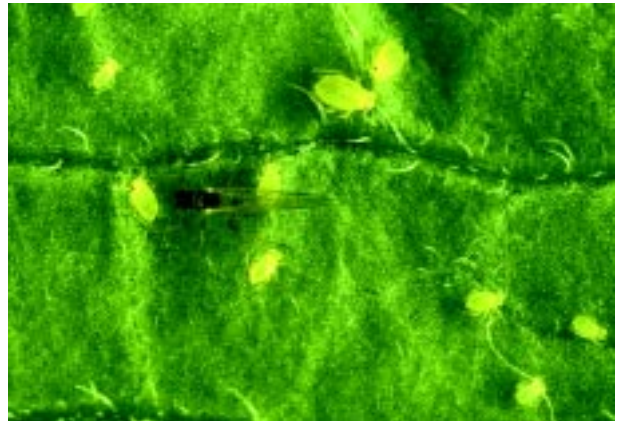


Figure 3a: Peach-potato aphid

It can also survive the winter both as an adult or immature nymph on brassicas, weeds, and within glasshouses. Winged adults fly into potato crops from May onwards, and numbers and timing of flight depend on the severity of the winter. Mild winters allow greater survival of overwintering aphids and earlier flight. Once on the crop, the winged females deposit live young, which multiply rapidly, peaking in numbers usually in late July-August.

**The potato aphid** (*Macrosiphum euphorbiae*) which overwinters on weeds and roses (Fig. 3b) is usually the first species to appear on potato crops. Whilst it is not as effective a virus vector as the peach-potato aphid and is not known to transmit PLRV in Scotland, its numbers can build up rapidly on the upper leaves of plants and cause 'false top roll' of the leaves.



Figure 3b: Potato aphid

**The glasshouse and potato aphid** (*Aulacorthum solani*) may also be found on potato crops (Fig. 3c). Numbers rarely rise to damaging levels, but it can be a vector of PLRV and PVY viruses.

Whilst these are the most common aphids found on potato crops, other species may occasionally be seen and they can act as vectors for potato viruses.



Figure 3c: Glasshouse and potato aphid (Courtesy of SASA © Copyright)

## Aphid control

### Ware crops

Several systemic insecticides can be incorporated at planting to prevent early aphid attack; for example, aldicarb, oxamyl, phorate, but these often 'run out of steam' before the main influx of aphids occurs and are best used when the crop is planted late.

Depending on the season, a heavy aphid infestation can lead to yield loss if aphid numbers peak when tuber bulking occurs in August. If aphid numbers on average exceed 5 per leaf, then application of an aphicide may be necessary. When checking plants for aphids, look at the top, middle and lower leaves, and monitor the whole crop, not just the headlands.

Insecticides recommended for use against aphids in ware crops are listed in Table 1.

<b>Table 1.</b> Insecticides recommended for aphid control on ware potato crops (correct at July 2000)	
<i>Insecticide a.i.</i>	<i>Examples of products</i>
deltamethrin + pirimicarb	Evidence
demeton-S-methyl	Metaphor
dimethoate* (excl. <i>Myzus persicae</i> )	Barclay Dimethosect, BASF Dimethoate 40
lambda-cyhalothrin + pirimicarb	Dovetail
lambda-cyhalothrin pirimicarb	Hallmark Zeon, Lambda-C Aphox, Phantom
pymetrozine	Plenum

\* latest application 30th June in year of harvest

Potato crops should not generally be entered within 24 hours of spray applications, but for specific treatments, read the label.

### Seed crops

The Scottish Agricultural Science Agency (SASA) manage and administer the Scottish Seed Potato Classification Scheme on behalf of the Scottish Executive, Rural Affairs Department (SERAD).

Crops grown for seed under the Scottish Seed Potato Classification Scheme (SPCS) arrangements must meet very strict tolerances for virus symptoms during growing crop inspections. Table 2 overleaf gives the tolerances for virus diseases for each class of seed.

As virus levels can build up rapidly when conditions are suitable for virus spread, the aim of the SPCS is to produce seed that is either free of virus or has very low levels of virus. This strategy minimises the spread of virus in Scottish crops and offers customers growing potatoes in warmer climates seed with minimal virus. The earliest generations of classified seed (Pre-basic and VTSC) must be free from virus and this helps to minimise virus in later generations of seed production.

SASA monitors crops in seven Aphid Control Areas in Scotland for the appearance of aphids and issues Aphid Control Alerts to seed growers once aphids are detected in monitored crops within each area. Growers are also advised to monitor their own crops, and begin aphid control measures as soon as aphids are seen.

Where aphid numbers in a crop are found during regular check inspections to be above SASA's threshold, classification is withheld until the results of laboratory tests on a sample of the harvested seed show that it meets the 4% tolerance for virus in daughter tubers in the EU Seed Potatoes Marketing Directive.

Because PVY<sup>O</sup> and PVY<sup>N</sup> viruses are transmitted within just a few minutes by aphids feeding on leaves, an insecticide is needed which will prevent aphids from feeding. This is the role of pyrethroid insecticides found in product mixtures or in tank mixes with a carbamate insecticide.

In order to combat both types of virus transmission by aphids, it is recommended that seed potato growers apply a mixture of a pyrethroid and a carbamate insecticide to seed crops as soon as an Aphid Control Alert has been issued by SASA for their area. Trials have demonstrated that the first sprays in the programme are much more important than the later treatments in limiting virus spread. Treatments should be applied every 10-14 days until burning down.

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**Table 2**

Virus Disease Tolerances for Seed Crops (Maximum percentage plants affected)

	<i>Pre-Basic and VTSC</i>	<i>Super Elite</i>	<i>Elite</i>	<i>AA</i>
Leafroll	Nil	0.01	All virus 0.5 including only 0.1 severe virus	All virus 1.0
Severe Mosaic	Nil	Nil		
Mild Mosaic	Nil	0.05		

**Table 3.**

Insecticides and insecticide mixtures recommended to prevent virus transmission by aphids in seed potato crops (correct at July 2000)

<i>Insecticide a.i.</i>	<i>Examples of products</i>	<i>Max. No. of applications</i>
lambda-cyhalothrin + pirimicarb	Dovetail, Hallmark Zeon + Aphox*	8
lambda-cyhalothrin + pymetrozine	Hallmark Zeon + Plenum*	2 or 3**
deltamethrin + pirimicarb	Evidence	4

\* Tank-mix of two products

\*\* 3 applications if using reduced rate of Plenum

Elimination of potato dumps and roguing of plants exhibiting virus symptoms within growing crops will also help prevent acquisition and spread of virus by aphids.