Factsheet 02/13

Field Vegetables

Asparagus viruses

Dr Peter G Falloon, Aspara Pacific Ltd, New Zealand

Several viruses have been identified in asparagus crops in the UK including Asparagus Virus 1 (AV-I), Asparagus Virus 2 (AV-II), Tobacco Streak Virus (TSV) and Cucumber Mosaic Virus (CMV). Asparagus Virus 3 (AV-III) whilst reported from asparagus crops in Japan has not yet been found in UK crops. It is important to recognise that these viruses are generally symptomless in asparagus fern and absence of adverse symptoms is not necessarily an indication of freedom from these virus infections. Of those viruses found to date in UK crops AV-II is considered to have the greatest effect on yield, especially when in combination with AV-I. AV-II has been shown to shorten the productive life of asparagus and is now thought to be associated with and possibly one of the primary causes of asparagus decline, which had previously been attributed to fungal infection caused by various *Fusarium* species. Multiple virus infection for example AV-I and CMV has also shown reduced vigour and yield. This factsheet summarises findings from HDC projects FV 384 and 384a on the distribution of viruses in UK asparagus crops and provides management strategies for their control.

Action points

- Only plant varieties that have been grown from seed free of AV-II and where management practices during propagation ensure young plants remain disease-free, ask crown propagators for confirmation of virus-free seed
- Do not locate new virus-free plants in close proximity to older fields of asparagus which may have high levels of infection
- Always harvest virus-free fields before cutting older fields; i.e. move from clean to infected
- When mulching autumn fern always mulch younger crops before moving equipment into older, infected crops
- Where practicable thoroughly clean machinery between crops to minimise any risk of virus/disease transfer.

Background

At least eight viruses have been isolated from asparagus crops worldwide. These include two viruses that are spread by aphids (AV-I and CMV), three that can be transmitted by nematodes (Arabis Mosaic Virus (AMV), Tomato Black Ring Virus (TBRV) and Strawberry Latent Ringspot Virus (SLRV)) and one that is spread by thrips (TSV). AV-II and AV-III are not spread by insects or nematodes but can be transmitted from diseased to healthy asparagus plants by mechanical abrasion or in sap on harvesting knives and fern mulching machinery. AV-II is also seed-borne because it can be carried in pollen by bees during feeding and pollination. CMV, AMV, TSV, TBRV and SLRV may also be seed/pollen-borne.

Surveys of UK asparagus crops in 2010 and 2011 in HDC projects FV 384/384a showed that AV-I was the virus most commonly found followed by CMV and AV-II while only a few samples were infected with TSV. Figure 1 shows a surveyed field photographed in fern a year before sampling and although there are no symptoms the asparagus was found to have three viruses present.

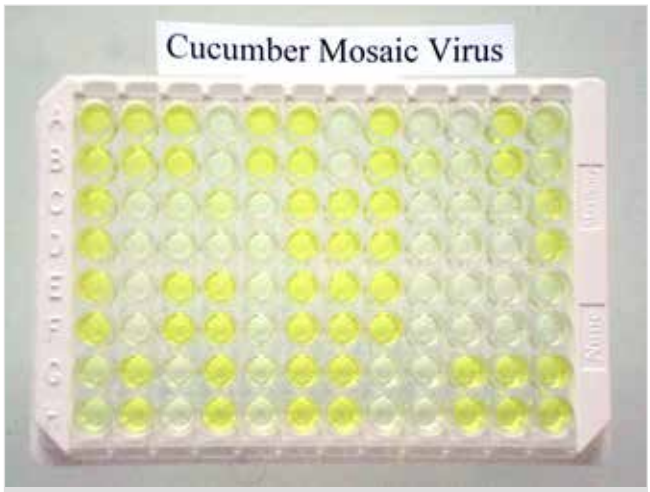
1. Viruses are symtomless in fern.

Symptoms

There are no distinct symptoms associated with the presence of viruses in asparagus, which makes it impossible for growers to tell from visual observation of their crops whether or not they might be infected. Instead, in order to confirm virus presence in asparagus, it is necessary to use laboratory based techniques. The preferred method is the use of a serological (ELISA) assay to detect these viruses in plant samples. Molecular techniques e.g. PCR offer a greater level of sensitivity and specificity compared to serological methods and have the potential in future to further refine virus detection.

Figure 2 shows an example ELISA plate for detection of CMV in UK asparagus crops. A positive virus result is indicated by a yellow colour in duplicate wells which allows approximately 40 individual tests on each ELISA plate. The intensity of the yellow colour provides an indication of the amount of virus present in the sample. Positive and negative controls are also included in each test.

Of the viruses known to occur in UK asparagus crops, most is known about the effect of AV1 and AV-II on yield, spear quality and productive life of the crop. Importantly, studies have shown a synergistic interaction between AV-I and AV-II; i.e. when both viruses are present in the same plant there is a greater effect on plant vigour than the effect of adding the yield decline associated with AV-I to that caused by AV-II alone. Furthermore, asparagus plants infected with AV-II are more susceptible to infection by *Fusarium* species found in the soil.

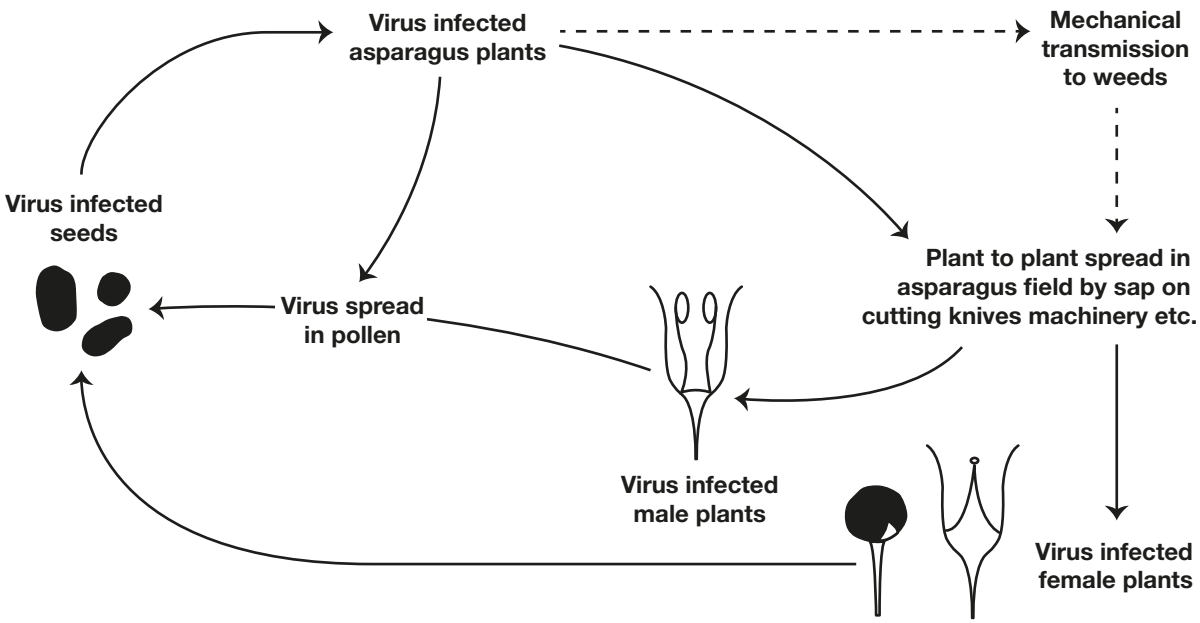


2. An example ELISA plate for the detection of Cucumber Mosaic Virus (CMV) in UK Asparagus crops

Biology and epidemiology of asparagus viruses

Asparagus Virus 1

AV-I, a potyvirus, is a member of the Potato Virus Y group. Under field conditions, AV-I only infects asparagus and is spread from plant to plant by aphids. Efforts to suppress aphids have little effect on its spread. AV-I is not found in asparagus seed so growers should expect their plants to be initially free of the virus, however in the UK 100% of asparagus plants sampled were infected with AV-I within a year of planting. This demonstrates how rapidly it is spread by aphids in the field. The virus alone has little effect on plant growth, yield of spears or longevity of asparagus. AV-I is important because it interacts with AV-II to produce more damage than with AV-II alone.



3. Disease Cycle of Asparagus Virus 2

There is little that growers can do to prevent the spread of AV-I into their crops. Although repeated spraying to kill aphids carrying AV-I may reduce its spread this is unlikely to be economic and will have little effect in the long-term. It is more important that growers concentrate on control of AV-II which, when present in combination with AV-I in the same plant, can cause significant yield reduction.

Asparagus Virus 2

AV-II, an ilarvirus, is transmitted through seed and up to 67% of seeds may be infected.

Within asparagus fields AV-II may be spread from plant to plant via mechanical transmission e.g. on cutting knives or on machinery used for mulching the fern in autumn. AV-II may also spread via pollen from infected male plants to seed produced by females. As the incidence of infected plants increases with time, the proportion of infected seed harvested from AV-II infested seed fields will also increase.

Effect on yield

Recent work has shown that the marketable yield of asparagus can be reduced by up to 50% as a result of virus infection and that the yield reduction is greater in older plants than younger plants. Yield decline increases with age of the plants e.g. virus-free plants produced 18 and 30% more marketable yield than plants infected with only AV-II two and three years respectively after transplanting. In another study AV-II infection caused marketable yields to be reduced by 14%, 28%, 20%, 48% and 57% and yields of reject spears to be increased by 93%, 105%, 207%, 352% and 167% during harvest years 1 to 5 respectively.

The roots of asparagus plants infected with AV-II exude seven to eight times more amino acids and two to three times more glucose and carbohydrate than roots of healthy plants. These exudates stimulate *Fusarium* and are involved in attraction of *Phytophthora* zoospores to root surfaces. Thus AV-II infected plants are more susceptible to *Fusarium* rot than AV-II free plants. It is reasonable to speculate that this may also apply to *Phytophthora* rot though this has not been confirmed scientifically.

Control

Because plant-to-plant spread within asparagus crops results in increased incidence of AV-II infected seed, F2 seed should not be used to establish new plantings.

It is possible to eliminate AV-II from the parents of asparagus hybrids using tissue culture which enables production of virus-free asparagus seed (Figure 4). This process is now being adopted by most asparagus breeders so seed of most modern cultivars should be free of AV-II.

4. Growers should only plant crowns that have been grown from seed tested free of AV-II

When growing asparagus crowns it is important to keep material that is known to be free of AV-II separate from material that may be infected with the virus. Care should be taken to avoid transmission of sap from diseased varieties to varieties free of AV-II e.g. when mulching fern in the crown nursery always mulch fern of varieties known to be free of AV-II first. The same principle applies when digging crowns – always work from clean to diseased as this will avoid possible sap transmission by machinery.

Growers should endeavour to limit the spread of AV-II from old, virus-infected fields to recently planted areas of asparagus. This can be done by;

1. Always harvesting younger, virus-free crops before moving to older crops i.e. go from clean to infected. This pattern should also be followed when cutting autumn fern.

2. At the end of each harvest day, cutting knives should be cleaned with hot, soapy water.

3. Preferably plant new fields a few hundred metres from infected fields as this will help limit the possible spread of AV-II by insects.

4. Growers can have their fields tested for AV-II by sending samples of fresh, green fern or spears to an appropriate laboratory. However, once a field is infested with AV-II it will remain infested for the rest of its productive life so annual sampling is unlikely to provide further useful information.

Although it is possible that AV-II is transmitted by thrips, this has not been well established, therefore spraying for insect control to limit the spread of AV-II is not recommended.

Acknowledgements

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Figure 2. STC Ltd

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AHDB Agriculture & Horticulture DEVELOPMENT BOARD

Horticultural Development Company

Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

T: 024 7669 2051
E: hdc@hdc.org.uk
Twitter: @HDCtweets

www.hdc.org.uk