

37th meeting of the Treater Group

Joint meeting Treater Group and Scottish Aphid Borne Virus Working Group.

4.3.20 by courtesy of SASA

Present

Treater Group	SABVWG
Mark Taplin (chair)	Jon Pickup SASA (chair)
Graham Bannister	Andy Evans SRUC
Craig Chisholm	Sue Cowgill AHDB
Nick Badger	Philip Burgess
Andrew Orr	Rob Scott, McCain
Philip Mortlock	Carolyn Mitchell
John Sarup	Andy Steven, Agrovista
Graham Tomalin	Alison Roberts JHI
Denis Buckley	Christophe Lacomme SASA
Anne Stone	Fiona Hight SASA
	Triona Davey SASA
	John Ellicott SASA
	Colin Herron
	Andy Evans (also TG)
	Eric Anderson (also TG)

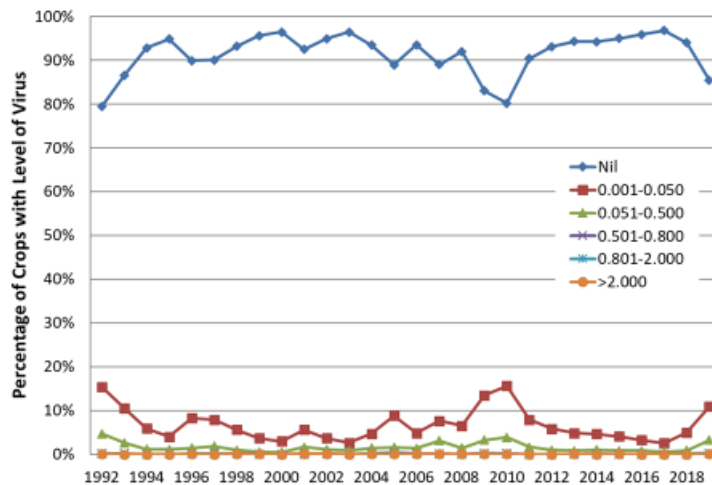
Visitors/presenters Adrian Fox, Fera. Lynn Bradley, APHA

Jon Pickup. The current SPCS

Graph showing virus found in at least one plant in ~ 11% of seed crops.



Total Virus Found at Inspection: 1992-2019



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Downgrading due to virus, of that entered for inspection:

4.7% Scotland.

25% England (17% due to virus in crop, the rest is from neighbouring crops)

38% Netherlands

Post harvest testing. 150 tubers per crop. Only crops deemed at very high risk and with a propensity to support latent (asymptomatic) virus infection have tubers tested.

Propensity. With minor fluctuations from year to year a clear pattern has emerged. Estima and Royal are consistently green with King Edward and Maris Peer consistently red (NB The table shows values which are significantly greater than 1 at the $p < 0.01$ level shaded in red; values which are significantly greater than 1 at just the $p < 0.05$ level shaded in orange; values which are significantly less than 1 at the $p < 0.01$ level shaded in dark green; and values which are significantly less than 1 at just the $p < 0.05$ level shaded in light green). There is usually good agreement between propensity and resistance.

Willow carrot aphid appears to be of increasing abundance, but its importance as a virus vector is not yet clear.

Q Is propensity data gathered from visual inspection? **Ans** Yes for leaf roll and mosaic. Finer detail of exact virus type depends on lab tests.

Q Does roguing cause the difference between the stocks assessed in both England and Scotland and found more often to have virus in England? **Ans** There is more reservoir of virus in England, due to more use of seed saved for more than one year. Also in Scotland there is the power to destroy crop with if 10% or more virus if it is near seed. This only happens in some years, a couple of crops were destroyed last year.

John Pickup would like to compare quickly any virus appearing in England with crops from same stock in Scotland.

Q The model to predict aphid numbers is less good than it used to be; what has changed? **Ans.** Change in species maybe. There is a suggestion that less use of systemic insecticides has had an effect. Temperature may affect symptom expression and John would like to include this in the model.

Comment on dual purpose crops. The worst offenders on propensity are dual purpose. 5 varieties (3 of which are free) account for 60% of virus. One is Maris Peer which has suffered from the poor practice of selling good skin finish for ware and poor for seed. This variety is often grown on farm for several generations.

Discussion

Comment. Crops are not being managed as they should be. We need more knowledge for future but for now, management can be improved.

Comment. Messaging is needed about what should be done.

Q. If voluntary downgrade is accepted then is it re-inspected as it may be grown on for 4-6 weeks and this is a vulnerable period? **Ans.** Lynn Bradley said it will not be re-inspected, so there is a gap. This decision was taken after consultation. It should be noted that voluntary downgrading is uncommon. **Q** In that case where there is voluntary downgrade could the tubers be tested? **Ans** The reliability of the tuber tests is disputed.

Comment A company with crops in England and Scotland is getting problems with the English seed.

Q should we be virus testing all English seed? **Ans** from Lynn Bradley There is a greater background of virus in England but Scottish pre basic seed sometimes has virus.

Q Can willow carrot aphid be main vector in early season? Strawed carrots shelter aphids on volunteer potatoes, close to seed crops of potatoes. It is a struggle to control carrot virus. **Ans** from JP There is no relationship between willow carrot aphid and failure in the aphid prediction model.

Q. The most common aphid in some yellow water traps (YWT) early in the season are willow carrot. Do these aphids have resistance to pyrethroids? **Ans** from Adrian Fox There is some indication of resistance to pyrethroids in willow carrot aphid.

Q on siting of YWT. **Ans** by SC Traps must be in a place where they are emptied daily. The picture would be more complete if those with non-AHDB funded traps would allow their data to be included on the website. **Other comments on YWT** Even in adjacent field the traps can give different results. How can the results from those traps be best used? YWT give some useful indication.

Q in England is the virus strain tested by the inspectorate? **Ans** from AF Its mainly PVY^N

Comment In New Zealand since psyllids have been controlled in ware crops, virus has reduced. The implication is that the virus reservoir in ware crops is a major source of infection for seed crops.

Sue Cowgill Insecticide resistance project led by Steve Foster

The project priority is *Myzus persicae* though other aphids have also been tested. It is funded by 15 partners including AHDB and agchem companies.

Steve needs live insects. He establishes a screening dose using insecticide-sensitive aphids. The dose chosen for each different insecticide is towards the higher end of the responses to allow him to readily detect any reduced sensitivity or resistance. He uses the screening doses to test field collected samples of live aphids.

Some *M. persicae* have a low level of resistance to neonicotinoids, but are still controlled at field rate. But overseas there are clones of this species with strong resistance. Rapid turnover of *Myzus* clones takes place, which represents a risk of new clones with resistance arriving.

Q Is there big resistance pressure due to lack of insecticides? **Ans** No reduced sensitivity has appeared to flonicamid or to spirotetramat. But only about 20 clones a year are being tested, mainly from Eastern England. More samples are needed, and from a wider geographic area including Scotland.

Myzus clones often have target site resistance to pyrethroids, including super kdr, of which there are 3 variants. Molecular assays for a specific resistance can be done on dead insects.

Testing other pests. Steve Foster will accept samples of other aphids, where people think they have had failure of control e.g. black bean aphid. He also wants to get test more samples of other aphids (willow-carrot aphid, bird cherry-oat aphid). It's hard to interpret results for the willow-carrot aphid due to lack of a fully susceptible base line. A range of susceptibility is found. Some grain aphids have kdr resistance and pyrethroids applied at full field rates should be effective, but if waves arrive a 7 day spray programme won't be enough.

It may be possible to send containers and instructions, to help collaborators send samples to Steve Foster.

Comment In Ireland a shift in sensitivity in bird cherry-oat aphid has been observed.

Adrian Fox Post harvest virus testing of potato tubers

Ideally use virus free seed and grow resistant varieties in absence of vectors.

The current resistance scores for varieties are based on PVY^O, not PVY^N

Testing - what it can do.

- Definitive, not subjective.
- Identify strain
- Identify stock with excessive virus irrespective of symptom
- Predict what's likely to be there at end of season

What testing cannot do

- Identify something which is not being tested for (complete form correctly)
- Identify something that is not in the tubers sent for testing (take a representative sample and remember that the sample is a tiny proportion of the total tubers)
- Predict impact
- Predict what will be in the daughter stocks.

Visual crop inspection

- Cost effective
- Tight tolerance 0.02 is one plant in 5,000
- Depends on symptom expression
- Probably won't pick up primary infection (some varieties with primary infection shows symptoms, e.g. Maris Peer. This is not 'hard and fast' but a general principle.
- Some varieties are tolerant, don't show.

Sampling must be representative

- Ideally sample after burn down before harvest.
- Use a W pattern across field
- Take one tuber per plant, of representative size
- Less good to sample from boxes. If necessary, take from at least 10% boxes.

Q Is there an effect of field size on sampling? **Ans** If sample is representative it doesn't matter whether a large or small area. **Q** If infection is coming into field from one side what should the pattern be? **Ans** If for detection, sample on edges. If seeking the % infection in the field, then use a W or grid. **Q** At harvest should 1-2 tubers be tested from every box? **Ans** No direct comparison has been made of this approach compared with the W sampling. But if the sample is 'representative' of the stock then this approach could work, but would need validation.

Comment Growers can be too busy pre-harvest, so in practice sampling has to be out of store.

Response. In some cases sampling is done out of the field, an agronomist reported 20-30/year from his seed growers, followed by the ELISA test since early sampling gave enough time to use this.

Test methods compared

Growing out test

Stages: cut section of tuber rose end, Gibberellic acid treated, grown, leaf sampled, ELISA (a serological test with antibodies). Samples from 4 tubers combined.

Direct test.

Stages: cut core from stolon attachment point of tuber. Automated ball bearing system to break up tuber material. Bead extraction method with iron filings coated with silicon which extracts virus. PCR. Samples from 4 tubers combined.

Differences between the 2 methods are due to:

- Virus strain differences
- Primary v secondary infection
- Virus distribution in tuber
- Virus titre in tuber and in plantlet

Timing. Early in season real time PCR may over estimate but later on in storage the 2 methods give more equal results.

Q How can we account for variety tolerance to PVY? **Ans** This is a difficult topic.

Q How do the 2 methods compare **Ans.** The 2 tests may not appear to align because the samples are from different tubers or from different parts of the tuber. So Fera sampled the same tubers by the 2 methods for a true comparison. When the plantlets are tested by PCR this gives the same results as the ELISA test

Q Why does Fera not provide confidence limits as routine with test results? **Ans** We could, but it leads to long conversations to explain the meaning of the confidence limits. We are discussing plans to give full interpretative data on the website.

Interpretation of test results

England and Wales:

>10% - don't plant

Less than 4% - OK

Inbetween 4% and 10% action depends on variety and its risk.

Scotland:

Farm saved seed should be less than 4% infected

Bulk sizes. In the Netherlands 200 tubers are tested in bulks of 50 tubers.

Q Was 2019 a blip? **Ans.** Yes, but on the background of rising risk due to:

- Loss of actives
- More vectors with insecticide resistance
- Virus in input seed and virus in volunteers

Q Should there be a single test per tuber? There could be a market demand for such a service. **Ans** We could, but it would only make a difference at higher infection levels, when the seed shouldn't be grown anyway.

Comments SASA has done extensive survey to assess both methods (down to each individual tuber). The two methods gave comparable results. One caveat of growing-on ELISA is, in some cases, the poor efficacy of dormancy break (sprouting) soon after harvest or due to other disease present in the crop.

SASA plan to make available a table of Confidence Interval as a guide to interpret virus test results. A coordinated action with Fera following up from a previous AHDB meeting.

Ali Roberts. Mature plant resistance (MPR).

Reporting on a 5-year project involving JHI, University of St Andrews and US partners.

Aim was to identify if MPR was functional against PVY, to compare virus strains, potato cultivars and susceptibility at different physiological stages.

- 4 cultivars: Desiree, Maris Piper, Atlantic and Shepody.
- 4 timepoints: 6-leaf, stolon forming, tuber forming and flowering.
- 4 virus strains: PVY^O, PVY^N, PVY^{N-Wilja}, PVY^{NTN}.

All our results were from glasshouse experiments, but data is largely backed up by historical literature and recent field results conducted by Christophe Lacomme (SASA; see below).

The prevalent virus strain in the environment is the most important factor in predicting tuber infections. If PVY^{NTN} or PVY^{N-Wilja} is present in the environment, there is almost a 100% chance that tubers will become infected if the plant is inoculated.

The interaction between virus strain and cultivar is complex. There is a lack of information available on the type of resistance present in different potato cultivars and how this holds up to the strains of PVY prevalent today.

Timing of infection can be highly significant, with infection reducing by flowering stage for some strains/cultivars. Flowering is a good indicator of the onset of MPR.

PVY^{NTN} is a more aggressive pathogen than PVY^O and is capable of replicating faster and to higher levels than PVY^O.

Take-home message: There is a reduction in virus titre in both leaves and tubers as plants mature. MPR, if functional for a given virus strain:cultivar combination, occurs around flowering and can protect all tuber infection for PVYO. BUT, MPR was not effective in preventing tuber infection with PVY^{N-Wilja} or PVY^{NTN}. Given that NTN is the most prevalent viral strain in the UK, MPR is of little utility in protecting tuber infection in the UK at present.

Q: Should we be growing seed at sea level? Ans: The risk is obviously greater at sea level (since altitude reduces aphid numbers), but that's also where most of the land suitable for seed production is situated.

Q: Does flowering mark a temporal moment in the crop, or is there a physiological change at flowering that impacts MPR? Ans: Flowering is critical developmental stage where gene expression changes greatly. We know that genes associated with flowering are also associated with tuberization. Alison believes that MPR is a physiological phenomenon that is probably connected to flowering, or a related developmental shift, in some way.

Resistance genes.

We do not know which R genes are present in which variety. Academics can't access this information so farmers certainly can't. Ideally molecular tests would be run to detect markers for resistance in common varieties which could help cultivar selection and management of PVY risk. Published data from SASA (Davie et al, 2017, Virus Research) has demonstrated that potato cultivars harbouring Ry genes (Ry_{sto}, Ry_{adg} present in potato cultivars Sante or Tacna for example) providing extreme resistance to PVY are efficient against all strains and recombinant variants of PVY tested. Ideally molecular tests would be run to detect markers for resistance in common varieties.

Christophe Lacomme PVY incidence in tubers in relation to plant development

The presentation report a three-year study on the efficacy of Mature Plant Resistance of Maris Piper (the most widely grown cultivar for seed production in Scotland), towards two strains of PVY, including PVY^o (a strain that is no longer prevalent in Scottish seed crops) and PVY^{NTN} EU-NTN subspecies, the currently most prevalent PVY species in Scottish seed crop. Crops were infected mechanically at different times in the season and virus incidence was assessed in tubers. For both types of virus there was a decrease in virus incidence with increasing time into the season. But PVY^{NTN} could still be detected even when inoculation was performed later in the season. For both virus strains, there is a significant decrease of virus incidence when plants are older/infected later in the season, however, the most prevalent strains have the ability to efficiently infect older plants. This phenomenon is not new, and similar observations were made in the early 1990's.

We assessed the impact of regrowth on PVY infection rate of tubers. A highly indeterminate potato cultivar was used in this experiment. A set of plants were flailed and allow regrowth to occur (i.e cut the stem and let regrow for different period of time) followed by mechanical infection and assessment of PVY incidence in tubers after two weeks. PVY was detected in tubers in 2% of these plants, while PVY was detected in 30% of unflailed control plants.

This shows that efficient flailing is an important means to minimize the impact of late infection and that crops that display regrowth could pose a significant risk of late PVY infection that can lead to PVY transmission in tubers.

Implications for PVY management:

- plant early to ensure that plants display significant level of resistance to PVY infection before high vector pressure build up
- maintain control of aphid and virus transmission all through the growing season to minimize PVY transmission in daughter tubers
- flail efficiently to control late PVY infections up to harvest.

Comment: Further studies in field conditions on a range of cultivars are needed to assess the impact of re-growth in different environments especially of high vector pressure.

Management guidelines Discussion

Andy Evans shared the draft advice for the 2020 season.

Discussion on IPM approaches.

Comments (a) from experience on more than 20 fields of seed, over a number of years. The most important factors are distance from ware crops, volunteers in field and surrounding area, virus free nature of seed.

(b) Recommendations should emphasise removing sources of virus. There may be a skill shortage to rogue effectively, especially in England. (Widespread agreement by attendees)

(c) Ground keepers are a major source of inoculum. (widespread agreement)

(d) Cereal strips are good to purge the stylets of aphids. Such strips can be cleaned of groundkeepers with fluoxypyr and sulphonylureas. If the surrounding cereal land has volunteers the owners can be educated to know it will benefit them to clean up the volunteers.

(e) Request for a campaign on control of volunteers. (widespread agreement but landlords are resistant since they have short term interest Only way to influence is to be part of single farm payment cross compliance.)

(f) Neighbouring ware crops are another important source of inoculum, especially those very close by. Even if they don't look infected. Border strips are effective (widespread agreement)

(g) Advise not to use small out of a ware crop for seed due to risk. Ware crops do not have approvals for the same insecticide programmes as seed. If used, such seed should at least be virus tested.

(h) The intelligence from YWT is not being used sufficiently. It needs to be used and to be highlighted.

Discussion on mineral oils

Mineral oils are more effective than vegetable, yet only vegetable ones allowed after ti.

Risk of mineral oils phytotoxic and might obscure virus symptoms so causing a seed inspector to walk away from field and crop to fail inspection. **Responses (a)** Yet they are used abroad in hotter climates and at higher rates, where more phytotoxicity might be expected. (b) The absence of phytotoxicity from mineral oil plus wetted products isn't made clear.

Q Should treatment be triggered by finds in YWT? **Ans** From agronomist, We put yellow water traps out two weeks before expected emergence.

Comment Advice should recommend use of mineral oils from early crop emergence if aphids are around. All crops in the area should be treated if possible to prevent aphid flying.

Canadians apply mineral oils at 30% emergence. In Scotland growers typically wait till 20% crop cover. (consensus on 30% emergence by attendees).

Discussion on insecticides.

Q Do pyrethroids have a repellent approach to stop probing? **Ans** from AF Not repellent in that carrots with pyrethroids get 100% virus infection. Agronomist to growers of home saved seed said he'd found use of pyrethroids with or without oils led to more infection rather than less. Other agronomists responded (a) industry is using pyrethroids and not oils (b) growers are using mineral oils as far as they can. JP said its unclear if pyrethroids are having a positive or negative effect.

Comment Pyrethroids are being used very much more in other crops due to loss of seed dressings.

Q Should Teppeki be the first insecticide used? Should Biscaya be used first?

Ans Effect of systemics is uncertain. Rate of Teppeki kill may be good enough to reduce virus spread. Kills 20% of parasitic wasps, so will do harm as well as good. We lack evidence on effect of current aphicides on spread of PVY.

Biscaya is only approved for 2020. Biscaya and Insyst can't be used following each other

Suoxophlor is registered in 86 countries. An application from Corteva is with CRD to decide for UK.

Public message

Request from MT of Treater Group. In the main Comms message emphasise the need to reduce virus sources to control the virus. There will also be a chemical message for the seed industry.

AOB

Q. by Lynn Bradley. How attractive to virus transmission are the green stems after flailing? **Ans.** The stem isn't the main attraction, leaves are.

Q How much virus is there in the lower grade seed lots? **Ans** Needs sampling of 30 fields annually of varieties where there is most concern. Monitor from year to year. Discussion around this. In Scotland such sampling has taken place for Estima FG 5, 6, 7.