Grower Summary

Investigating the timing of transmission of carrot viruses to improve management strategies

FV 460

Interim report 2022

Project title:	**Investigating the timing of transmission of carrot viruses to improve management strategies**
Project number:	FV 460
Project leader:	Dr Adrian Fox, Fera Science Ltd
Report:	Yr 2 Annual report, March 2022
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Location of project:	York and Warwick
Industry Representative:	Ian Holmes, Strawsons Howard Hinds, Root Crop Ltd
Date project commenced:	January, 2019

DISCLAIMER

AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

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GROWER SUMMARY

Headline

Following the discovery of several novel viruses infecting carrots in the UK, research is investigating the key vectors and timing of transmission of carrot yellow leaf virus and carrot red leaf virus. Flights of Willow-Carrot Aphid appear to track well with transmission of carrot red leaf virus.

Background

Within carrot crops the key viruses of concern are carrot necrotic dieback virus; Carrot yellow leaf virus and the viruses of the carrot motley dwarf complex, the principal virus of which is Carrot red leaf virus (CtRLV). Carrot necrotic dieback virus (CNDBV, formerly Anthriscus strain of *Parsnip yellow fleck virus*) and carrot yellow leaf virus (CYLV) are also viruses which can have a major impact on carrot crops. Previous work (FV 382 a and b) indicated that CNDBV is not a major disease observed in mature carrot crops. This may be the consequence of the virus being associated with seedling death, reducing the incidence of the virus from previous field samples. However, these previous studies indicated that both CtRLV and CYLV can be present at very high incidences (up to 100% of sampled plants). CtRLV is a persistently transmitted virus and facilitates the transmission of two other pathogenic viral agents (carrot mottle virus and carrot red leaf associated viral RNA) of the Carrot Motley Dwarf complex (CMD). CMD is associated with leaf reddening and mottling. There are no available data on yield losses associated with CMD but the complex has been linked to an impact on marketable yield through excessive lateral root hair development and root splitting (kippering). CYLV was the subject of previous AHDB funded studies (FV 382 a and b). Whilst there are no available data on yield losses associated with this virus, the previous studies strongly implicated this virus with quality losses due to development of internal necrosis in carrot root (Adams et al. 2014). Therefore, this study focuses on CtRLV as a proxy for transmission of the CMD virus complex, and CYLV as a virus thought to be present in high incidence for which minimal epidemiological information is available.

The aim of this study is to identify the timing of transmission of CtRLV and CYLV throughout the growing season and to correlate this to aphid flight data gathered from yellow water pan traps in the field. A further objective of the project is to compare the different methods used for monitoring aphid flights (Suction trapping and in-field yellow water traps), and also to see

whether these new data can be used to refine the current models used for predicting flights of willow-carrot aphid (*Cavariella aegopodii*).

Summary

Year 1 (2019)

Greater virus transmission was recorded in the trials at Warwick than at Stamford Bridge. Most of the virus detected throughout the growing season was carrot red leaf virus (CtRLV) at both sites, with carrot yellow leaf virus (CYLV) being occasionally detected throughout the season. Aphid flights at both sites followed a similar pattern throughout the season, though fewer aphids were caught in the traps at Stamford Bridge. At Stamford Bridge CYLV was detected in a single week, from one bulk sample (Week of 21-May). Peak transmission at the Yorkshire site was just under 4.5% transmission, in the week of the 14 May. The trials at Stamford Bridge did not show a good relationship between aphid flights and virus, a reflection of the limited virus transmission at the Stamford Bridge site.

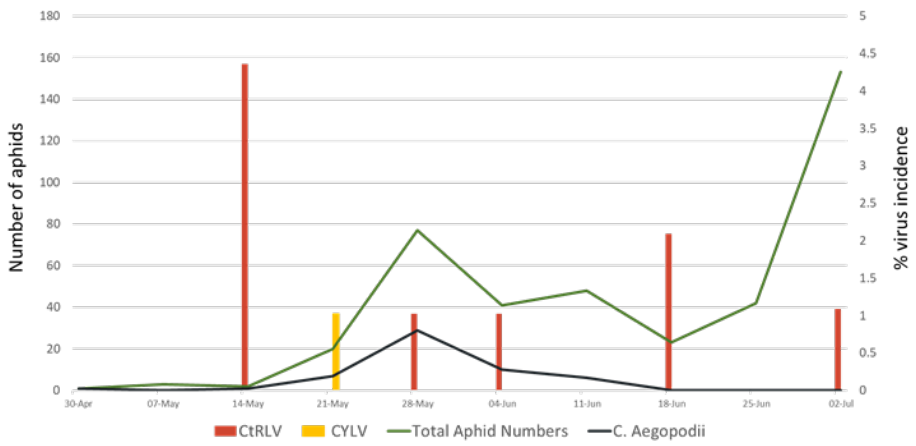

Figure1. Showing the limited virus transmission recorded at Stamford Bridge, Yorkshire. Virus content in plots is shown in the bars (Red for CtRLV, yellow for CYLV), and aphid flight data in the lines on the graph (Green for total aphid flights, Black for willow-carrot aphid).

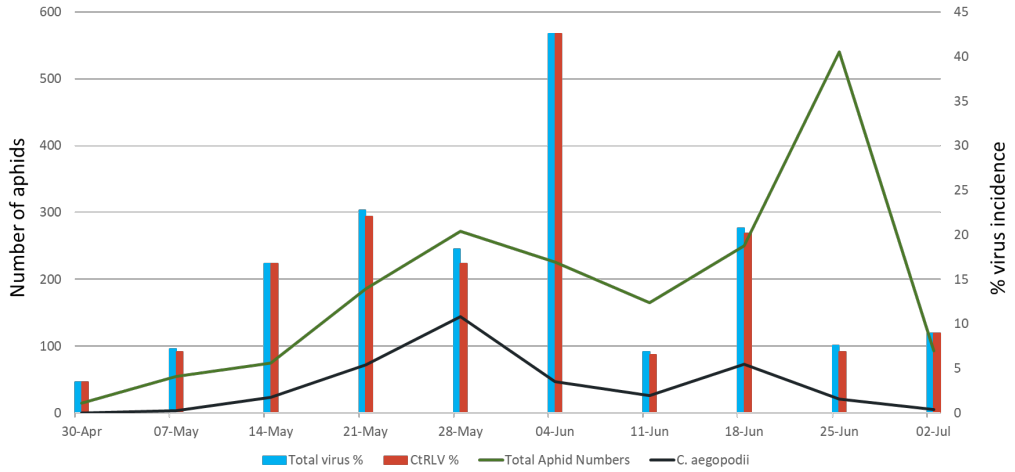

Figure 2. Virus transmission recorded in trial plots at Warwick University. Virus content is shown in the bars (Blue for total virus content, Red for CtRLV), and aphid flights in the lines on the chart (Green for total aphids, Black for willow-carrot aphid)

The trials at Warwick had greater incidence of virus transmission throughout the season, with a peak transmission of 43% in the week 4-June. Carrot yellow leaf virus was only detected sporadically throughout the season, in the weeks 7-May, 21-May, 28-May*, 11-June, 18-June, 25-June*. To reduce diagnostic costs all samples were tested as “pooled leaves”, also termed “bulk samples”. Each week 100 leaves from the test plot were sampled as 25 4-plant bulks. The percentage of virus incidence was then calculated based on the number of bulks testing positive each week. All findings were a single positive bulk per week, except * where there were two positive bulks detected. From looking at the pattern of flights of the individual aphid species at Warwick, transmission appears to track movements of *Cavariella aegopodii,* but this will be further refined in the coming seasons.

Year 2 (2021)

Following a year hiatus due to COVID affecting the ability of staff at both Warwick and Fera to conduct field work, the year 2 of the trial was rolled over to 2021. The trial at Fera was conducted at a field in Buttercrambe, less than 2 km North of the Stamford Bridge site used in 2019. The first week of the trial (uncover and aphid trapping) was approximately 2-3 weeks later than in 2019, occurring in the week of 18 May, rather than 30th April, however, this aligned well with the relative aphid predictions and the relative abundance of aphids caught at both the Fera and Warwick site were in line with a similar the phenology (timing of the life cycle) of the various species across both years of the trial.

In a similar pattern to the 2019 trial, there was very little transmission recorded in the Fera trial, with a maximum transmission of 1% of any virus across the entire trial in the weeks of

15 June, 6 and 13 July. Aphid numbers were negligible throughout the season. C. aegopodii remained low throughout the entire season rarely getting above single figures in any week. Consequently, with both transmission and vector numbers so low, it is difficult to draw any further conclusions from this part of the trial.

The pattern of virus transmission and aphid catches on the Warwick trial are shown in figure 3. Transmission increased rapidly in the early weeks of the trial (18 May – 8 June), peaking on 1 June, where all plant samples tested were positive for virus, with 95% of the virus detected being CtRLV. Carrot yellow leaf virus was also detected in the weeks of 1 and 8 June, although this was only present at low incidence (~5% of virus detected). Throughout this early part of the trial vector numbers corresponded well to transmission, with the majority of aphids caught in yellow traps being the willow carrot aphid. Later in the trial (29 June onwards) a second peak of virus transmission was recorded, which do not correspond with a rise in numbers of willow-carrot aphid. However, during this period there was a rise in the catches of *C. pastinaceae* (parsnip aphid) representing a large proportion of the small peak in aphid catches at 6 July. It should be considered that this species, not identified as a factor in the previous trial, may be driving this late season transmission.

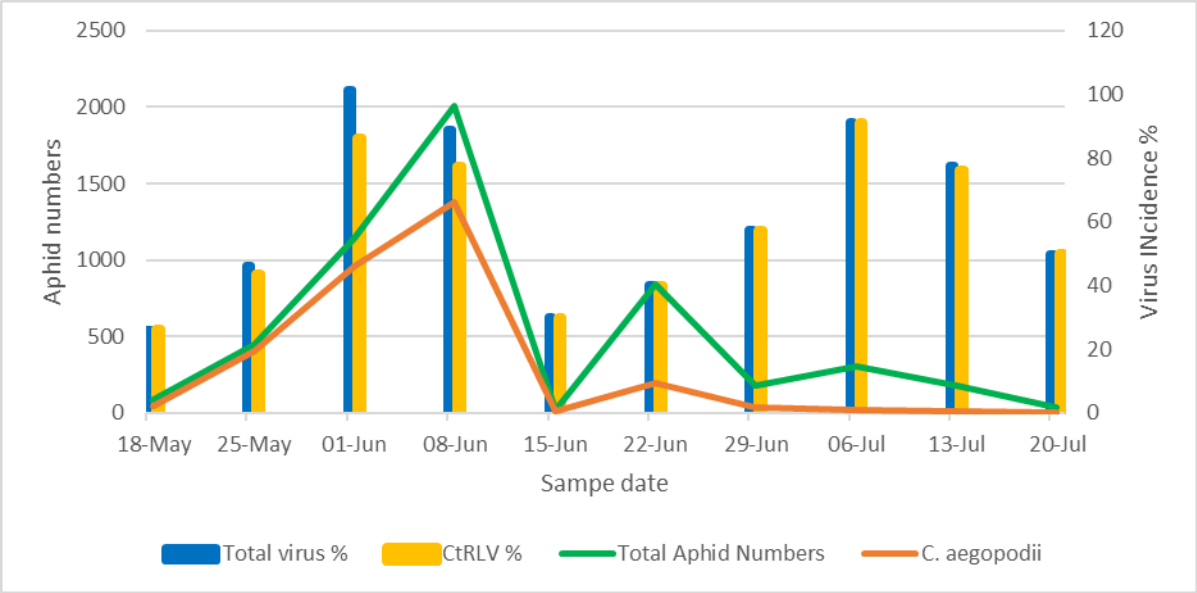

Figure 3. Virus transmission recorded in trial plots at Warwick University. Virus content is shown in the bars (Blue for total virus content, Yellow for CtRLV), and aphid flights in the lines on the chart (Green for total aphids, Orange for willow-carrot aphid)

Comparisons of monitoring data collected in different ways (plant sampling, suction traps, water traps) suggest that all approaches are broadly measuring the 'same thing'. Additionally,

on the strength of these data the day-degree forecast for willow-carrot aphid (*C. aegopodii*) appears to be relatively robust, whereas it may be more difficult to forecast the activity of peach-potato aphid (*M. persicae*) and the parsnip aphid (*C. pastinaceae*).

Financial Benefits

As this report is based on trials to assess the timing of transmission of viruses to inform a subsequent control trial, financial benefits for growers cannot be assessed at this point. In year 3 of the project (2022) the focus of field work will be on a control trial to look at optimising control strategies through a replicated block trial based at Warwick crop centre.

Action Points

As these are first year data of a multi-year project, there are no action points for growers at this stage.