

## Grower Summary

### **SF 148**

Understanding the scale and importance of Raspberry leaf blotch virus and its association with raspberry leaf and bud mite

Final 2017

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**Project title:** Understanding the scale and importance of *Raspberry leaf blotch virus* and its association with raspberry leaf and bud mite

**Project number:** SF 148

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**Date project commenced:** 1<sup>st</sup> March 2014

**Date project completed  
(or expected completion date):** 28<sup>th</sup> February 2017

# GROWER SUMMARY

## Headline

- Raspberry leaf blotch virus is transmitted and proliferated by the raspberry leaf and bud mite with Glen Ample and Octavia found to be the most susceptible varieties.

## Background and expected deliverables

Crop damage to raspberry caused by raspberry leaf and bud mite (RLBM) feeding is an increasing problem around the UK. The damage, which was previously thought to be associated purely with the mite, is now also known to involve infection with *raspberry leaf blotch virus* (RLBV). It particularly affects Glen Ample but symptoms are increasingly being seen on other varieties (Figures 1 and 2). There is also a suggestion (preliminary results: J. Allen/S. MacFarlane) that the recently identified growth decline in certain varieties such as Octavia displaying poor lateral development, die back, blotchy leaves and malformed fruit (Figures 3 and 4), could be associated with this pest and/or virus. The association between the mite and RLBV has been proven. Increasingly however, damage symptoms are being observed without the mite being seen in the field.

This project aimed to carry out a UK-wide sampling of plantations and to conduct experiments to elucidate the links between the mites, the virus, plantation age, variety, yield loss and plant source, to inform strategies for control.

## Symptoms



**Figure 1.** Minor leaf blotch symptom - primocane leaf



**Figure 2.** Moderate to severe infection to floricanes lateral; blotches to primocane leaves



**Figures 3 & 4.** Severe infection - curled twisted chlorotic leaves and malformed fruit

## **Summary of the project and main conclusions**

The project work was divided into six distinct objectives:

**Objective 1** - To determine how widespread RLBV is in UK floricane and primocane raspberry plantations

**Objective 2** - To confirm preliminary observations that RLBV is associated with plantation decline

**Objective 3** - To identify the cropping situations where RLBV occurs

**Objective 4** - To identify whether RLBV infection is associated with mite numbers infesting plants and/or the levels of damage caused to infected plants by the mites feeding

**Objective 5** - To monitor how RLBV develops and spreads within a plantation

**Objective 6** - To monitor varietal susceptibility to mite and RLBV

### ***Objective 1 - To determine how widespread RLBV is in UK floricane and primocane raspberry plantations***

In the first two years of the project, raspberry samples were collected from a range of raspberry plantations, spanning both new and old plantations and including 29 different varieties as well as different cropping systems. Of the 158 plantations sampled, 19% were positive for RLBV. This accounted for samples taken on 38% of the holdings tested and 38% of the varieties sampled. Of the varieties sampled, Glen Ample and Octavia were most commonly infected.

Mites were detected on 18% of samples, 82% of which were positive for RLBV. Both the mite and virus were detected in all of the key fruit growing regions of the UK on both small and large holdings and in both protected and containerised production. These results suggest that the mites and the virus are closely associated and widely distributed around the UK.

### ***Objective 2 - To confirm preliminary observations that RLBV is associated with***

### ***plantation decline***

Where plantations were found to be positive for RLBV, the average proportion of the whole field showing RLBV symptoms was up to 50%. In some extreme cases this value was as high as 100% of the plantation showing symptoms, with several plantations being grubbed after they were surveyed.

Overall, very few asymptomatic plants were positive for the virus. In susceptible varieties, such as Glen Ample, there was clear association between characteristic symptoms of yellow leaf blotching and presence of the mite and or virus. Overall, however, 46% of samples showing typical yellowing symptoms tested negative for the virus, but in the newer plantations a greater proportion of ambiguous symptoms did yield positive virus results.

In this study the virus was rarely found in the absence of the mite, which is promising as there is a much greater potential to control the mite on farm than the virus. Careful monitoring and virus testing of plantations is important to identify the mite and virus early and to thereby avoid a build-up of the mite over time.

### ***Objective 3 - To identify the cropping situations where RLBV occurs***

On the sites surveyed in 2014 and 2015, the method of spawn management appeared to have some effect on levels of the mite and virus. Where mechanical methods were employed, such as strimming, greater levels of the mite and virus were apparent. This could be linked to seasonal carryover of mites. Mechanical methods tend to leave part of the spawn canopy behind and the presence and proximity of young primocane foliage to infested florican leaves allows mites to migrate onto next year's canes. There is also the risk of mites spreading through the debris created by mechanical spawn control.

Both RLBM and RLBV can be found on wild raspberry hosts. Presence of wild raspberry in close proximity to raspberry plantations seemed to increase the proportion of plantations affected. Mites were detected at harvest on some plantations that had not previously been identified as having mites at any earlier stage in the season. These particular plantations were noted as having wild raspberry on the site, which may act as a mite host. These results indicate the proximity of infested wild raspberry to commercial raspberry plantations is one pathway by which infection may be introduced to new plantations. Plantations of modern varieties, which were generally not found to be infected, were found to have the virus when in close proximity to an infected plantation.

The mites are unable to crawl far, so would have to be carried on the wind or by humans or animals to a new plantation. The infected raspberry plant may act as a host for the mite and

virus, from where they can colonise healthy raspberry plantations or re-infect those that have been cleared of the mite.

Sites which used acaricides such as abamectin and/or releases of predatory mites appeared to have a lower level of RLBV and RLBM suggesting use of these agents could provide incidental control of the mite, and therefore reduce levels of the virus. However, it is likely that other factors are also important in determining the virus levels, such as variety, cropping system and proximity to wild raspberries.

***Objective 4 - To identify whether RLBV infection is associated with mite numbers infesting plants and/or the levels of damage caused to infected plants by the mites feeding***

The numbers of mites recorded on bud and leaf samples from the raspberries ranged from one or two mites to over 30. When tested, it was found that any level of mite infestation could lead to a positive result for RLBV.

Where mites were recorded on buds in the dormant season, they were recorded more frequently throughout the whole season on those plants. The presence of over wintering mites on the floricanes did not necessarily lead to mites being present at bud burst. However, where there were high mite counts at dormancy, the floricanes were infested at bud burst. This suggests that the mites are able to survive over winter and this would give the mites a base from which to build up the population in the following year.

The majority of mites were only first detected on the primocane at harvest and generally on plantations that had already had the mite during the season on the floricanes. It is possible that during picking, the mites are knocked off and then spread from the floricanes to the primocane, or when a worker moves from an infested plantation they may spread the mite to another plantation.

The initially small number of mites needed to cause infection and symptoms was confirmed in the transmission trials held at JHI, where mites and virus were transferred to healthy plants by clipping infested, symptomatic leaves to healthy plants. These plants were successfully infected with RLBV without high population bursts of mites being noted.

***Objective 5 - To monitor how RLBV develops and spreads within a plantation***

The results from both the field and at JHI indicate that the virus is very strongly linked to the presence of the mite. The virus was generally detected in the plants at the same sampling assessment that the mites were detected. On a few plantations there was a lag time in virus detection, from when the mites were detected. In these cases the virus was not present until

the next sampling assessment. Mites tested during the dormant season were found to be positive for the virus even when the leaf bud they were on was negative for RLBV. This suggests that the mite introduces the virus to the part of the plant it is feeding on, but that it may take time for the virus to develop in the leaf.

The virus was not found on the primocane unless the mite was present, except in two plantations. Here the virus was found at bud burst. Both of these plantations had previously had mites present on the plant that were carrying the virus. The presence of the virus in the apparent absence of the mite may be due to: 1) a transient infective mite population, which was controlled or declined naturally, or 2) very low mite occurrence at sampling which was not possible to detect.

During the transmission experiments at JHI, RLBV was sporadically able to move across the graft junction into upper leaves but a productive infection was not maintained in the plants. Similarly, in the stem-taping experiment RLBV was initially able to move up to the top of the mite-inoculated plant but after two months virus could no longer be detected in these leaves.

When taken together with the previous grafting experiments in 2014 and 2015 it has been determined that RLBV only has a very limited ability to move via the vasculature from lower to upper leaves. However, in the absence of mites the virus infection does not persist. This suggests that repeated treatment to kill mites will prevent RLBV infection and disease symptoms from spreading through the plant. Whether the virus can spread within a single leaf after inoculation by one or a few mites, and in doing so cause disease symptoms, is not yet known.

#### ***Objective 6 - To monitor varietal susceptibility to mite and RLBV***

The surveys and subsequent testing for RLBV performed on samples from the field, suggested that there was potentially some differential varietal susceptibility to the virus. Of the 29 varieties tested, Glen Ample, Octavia and older florican varieties were the most commonly affected by the disease. However, more modern varieties including the coded variety CV-C and primocane varieties (previously considered less susceptible) were also found to be affected. The modern coded variety CV-A was the most sampled variety during the two year survey, with none of the samples testing positive for the virus.

Variety transmission tests at JHI confirm results from the field in Years 1 and 2 of this project, indicating that there is differential varietal susceptibility of raspberry cultivars to RLBV. Glen Ample has been shown repeatedly to be highly susceptible, showing the highest incidence of the virus on infected plants, with 100% of plants becoming infected. Under these experimental conditions, some varieties were noted as having extremely low incidence of the virus after being infected by mites, whilst others were more intermediate in their susceptibility. It is likely



that the extreme susceptibility of Glen Ample to leaf blotch disease is a major factor in the emergence of this disease over the last ten years.

In some tests, disease symptoms were observed and virus was detected by RT-PCR even though mites were not seen. It is possible that in these instances the mites were able to transmit the virus to the plant but then failed to become established themselves.

The variety experiments do not unequivocally show whether lack of susceptibility (failure to develop the disease) is due to effects on the mite or on the virus. To answer this question, in depth studies to look at the establishment and proliferation of mites on different varieties would be needed.

### **Main conclusions**

Overall, RLBV and its associated vector are widespread across the country. However, at present one of the industry's primary varieties (referred to as CV-A in this report) appears to have tolerance to the mite and/or the virus, although direct challenge experiments using this variety were not carried out. This could change in the future, as the mite and virus are well established in wild raspberry populations in main cane fruit growing areas, for example in hedgerows. This residual population could easily allow the mite and virus to re-establish within plantations and cause severe damage very quickly. This is particularly a concern if a new variety adopted by the industry in the UK proved to be susceptible.

The current production practice of growing raspberries under polythene tunnels with plants and rows in close proximity to each other, with relatively high relative humidity and little wind movement, has created ideal conditions for RLBM. Although the use of acaricides and predatory mites seemed to confer some incidental control of the raspberry leaf and bud mite, there are currently no acaricides approved for providing control in outdoor crops. There is also a very limited choice of effective acaricides currently available. Abamectin (Dynamec) is the only option for use and this is only approved for use on protected crops or those in propagation. Predatory mites such as *Amblyseius andersoni* and *A. californicus* can provide some control but it is unlikely to completely clear an infestation. It is therefore difficult to eradicate the mite from infested propagation and commercial fruiting plantations.

### **Financial benefits**

The total average cost of the disease to the UK raspberry industry can be calculated using the average figures for the industry from the DEFRA Horticulture Statistics. The current total raspberry area recorded in 2015 was 1,538 ha. Of this, the area occupied by the most susceptible varieties (such as Glen Ample and Octavia) is approximately 20 % (312 ha). The average raspberry yield across all varieties is 11.5 tonnes/ha and the average value across

the year is £7,209. The total average value of this crop is therefore approximately £26m ( $312 \times 11.5 \times 7209 = £25,865,892$ ). If we use the figures from this study that on average up to 50% of a plantation is subjected to the RLBV symptoms, this puts nearly £13m of crop at risk in the UK from the virus per annum. This is likely to be an underestimate of the cost of RLBV to the industry, as it is using averages across all varieties (for example Glen Ample and Octavia yields of 15 tonnes/ha are achievable when grown well under protection).

A number of key actions have been identified during this project, including growers being vigilant for symptoms, particularly in susceptible varieties. The project has also identified a benefit of being able to screen material at the breeding stage using a molecular test for RLBV. This ensures that highly susceptible varieties can be removed from breeding programmes.

### **Action points for growers**

- Growers should be vigilant for symptoms and mites, although it can be hard to identify as occasionally symptoms are not linked to virus presence.
- If symptoms and mites are suspected, careful crop management is recommended to reduce the spread of mites. The use of acaricides and/or predatory mites will aid management of mites, but with no outdoor approval for acaricides such as abamectin, and limited choice for protected crops and propagation, complete control may be difficult to achieve.
- Future raspberry breeding should take the susceptibility of a new variety into account when selections are made. The susceptibility of a new variety can be determined relatively simply as demonstrated by the experiments performed by JHI as part of this project and the use of the molecular test for RLBV diagnosis will make the selection process faster and more robust.