PERENNIA **Interim Report (Year 2 of project)**

Aphid monitoring and virus testing in strawberries – 2015 growing season

Date: February 10, 2016

Background:

This project has three primary activities – 1) to conduct aphid monitoring for improved management of aphid vectored strawberries viruses in the province, 2) to conduct late season virus testing of newly planted commercial fields as a measure of recovery success, and 3) to conduct virus testing of certified nursery stock to ensure G4 stock is free of virus disease.

A fourth objective emerged mid-way through Year 1 of the project with the verification of two additional insect vectored diseases in raspberry and highbush blueberry crops respectively. As such, some project funds for scouting and laboratory testing for verification and distribution of these diseases, a two-virus complex in raspberry and blueberry stunt phytoplasma, were allocated.

Project objectives:

The main objective of the project is to aid in the management of the primary virus vector (ie. the strawberry aphid, *Chitosiphon spp.)* and to ensure that nursery stock produced in the province meets the recovery strategy requirements for commercial fruit growers. To meet this objective the following activities were conducted:

1. Monitor for strawberry aphid (SA) on representative farms across the province and provide the monitoring results to cooperating growers and the industry as a whole on a timely basis for optimum vector management,
2. Execute the 'virus testing protocol' as outlined in the "Guidelines for growing and inspecting strawberry plants in Nova Scotia".
3. Conduct a late summer virus survey of all newly planted strawberry fields to assess the progress of virus management efforts in the province. (A similar survey was conducted in 2013 and data from this survey is a suitable benchmark for comparison).

Secondary objectives were to add to our knowledge about the disease and its vectors for even greater management success in future. These activities included the following:

1. Begin collecting degree day data for the development of a degree-day prediction model for the initiation of the spring flight of the SA,
2. Include monitoring for secondary vectors for virus transmission (eg. *Myzus* and *Aphis* species) and their regional distribution within the main strawberry aphid monitoring program,
3. Begin analysis of relative tolerance of local strawberry varieties to virus disease,
4. Expand testing for other aphid vectored viruses (eg. strawberry vein-banding virus and strawberry crinkle virus) in G3 nursery plant stock.

2015 results:

1) Due to prolonged snow cover in the spring of 2015, monitoring plots were established about one week later than in 2013 and 2014. Twenty-nine plots in all were set-up in early May on 23 farms across the province with three aphid forms being monitored – eggs, wingless (apterae), and winged (alatae) forms. In addition two plots were set-up to monitor for raspberry aphid and sharp-nosed leafhopper respectively, on two additional farms.

Aphid egg counts from 30 leaf samples collected at plot set-up indicated that like 2014 the overwintering population in 2015 was again very low compared to 2013, the first year that monitoring was conducted for SA in the province. However, there were a number of farms where eggs were identified and a management plan for control was activated once confirmation of strawberry aphid was made at hatch 1-2 weeks later.

Consistent with the egg scouting data, leaf counts of wingless apterae were again very low in 2015, particularly in the central/eastern region of the province. However, some farms were found to have resident populations of SA and growers were able to manage these populations to minimize the flight stage of this species.

Perhaps not surprisingly, counts of winged SA were even lower in 2015 than in 2014 as one would expect with the low egg counts and wingless apterae counts leading up to the flight period (Table 1). However, the importance of non-resident flight participants arriving by jet stream from the midwest U.S., into southern Ontario and Quebec before moving into Nova Scotia was unknown and so it was thought a large flight could still be possible. Fortunately, the extremely low numbers of winged SA catches in 2015 suggest that the contributions to the population from outside the province are negligible.

The high risk aphid flight period for SA began in the western/Valley region on the week of June 15-19th, a week later than the previous two years, and was essentially complete by the last week of July, lasting roughly 7 weeks. This was very similar to 2013 only shifted one week later. The 2014 season was unique in that the flight period was short and intense, lasting only 5 weeks.

In the central/eastern study area, the flight period for strawberry aphid could not be deduced in 2015 as monitoring counts were insufficient to clearly identify its initiation and termination. Clearly there was a flight as there were low levels of infections found in newly planted fields but the yellow sticky traps used for monitoring the winged form of SA appear to be extremely conservative, so much so that coupled with a very light flight they were unreliable as a scouting tool.

Table 1. Total seasonal winged aphid counts in the western Nova/Valley region in 2013 to 2015 growing seasons in Nova Scotia

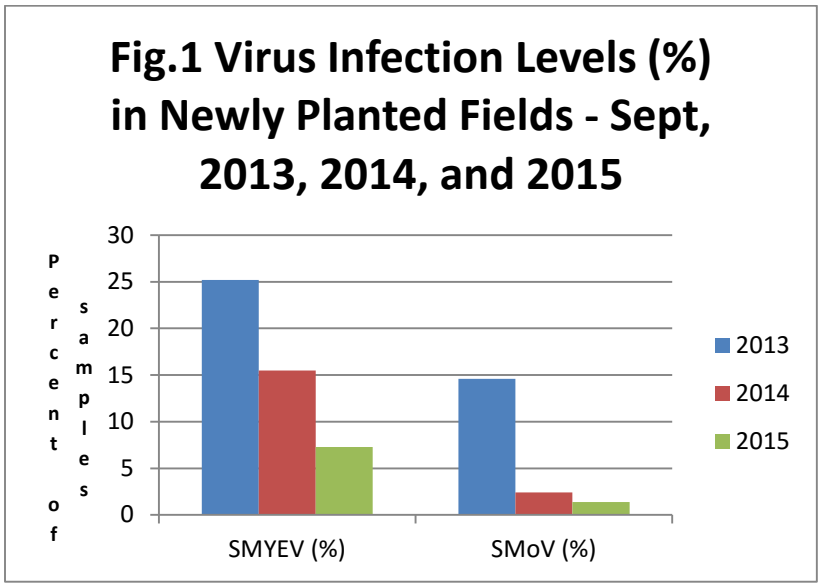
Monitoring fraction	**Year**		
	2013	**2014**	**2015**
Total winged SA catches	493 (4.6 % of total)	24 (0.1% of total)	15 (0.05% of total)
Total winged aphid catches	10774	28045	27160 (incomplete)

The melon aphid (*Aphis gossypii*) is a secondary vector for one of the two viruses, the strawberry mottle virus, and scouting in 2014 suggested that this vector is distributed across the province in numbers comparable to that of the primary vector SA. However, further study in 2015 indicated that this species is very difficult to distinguish from other Aphis species and that the 2014 results may have overestimated the importance of this species as a contributor to the epidemic. Due to the difficulty of confidently identifying this vector it was decided to focus only on the primary vector, the strawberry aphid, as was done in 2013.

Regular monitoring updates were communicated by email to the general industry and other stakeholders with 7 updates distributed noting aphid flight initiation as well as flight peak and collapse information. Moreover, individual monitoring results were communicated to the 25 cooperating farms on a weekly basis to optimize their aphid management.

2) Benchmark virus testing of newly plant fields

Benchmark testing of newly planted strawberry fields was conducted in late summer of 2013 and at the same time in 2014 and 2015 to monitor virus level trends and the recovery progress. In 2013 the levels of the two viruses, strawberry mild yellow edge virus (SMYEV) and strawberry mottle virus (SMoV), were 25 and 15% respectively but dropped to 15% and 2.5% respectively in 2014. This trend continued in 2015 with a further drop of SMYEV infections to 7.3% and SMoV to only 1.4% of total samples collected (Figure 1). This is excellent evidence of the success of the recovery program and is further supported by the exceptional crop reported for the 2015 growing season.



3) Virus testing of G4 nursery stock

Testing of G4 strawberry nursery stock, previously referred to as “certified” stock, was conducted on the four Nova Scotia strawberry plant nurseries in late August for ‘southern’ stock and mid-October for ‘northern stock. A testing protocol with low tolerances for strawberry mild yellow edge virus and zero tolerance for strawberry mottle virus was executed successfully again in 2015.

Additionally, certified raspberry stock was tested in fall for the two raspberry viruses identified in commercial fruiting fields in 2014 and found to be clean. As such, Nova Scotia raspberry fruit growers can be assured that like strawberries their raspberry nursery stock does not carry virus disease.

4) Status of raspberry virus complex and blueberry stunt phytoplasma

Several additional farms were tested in 2015 for these new insect vectored diseases and confirmed that they are both relatively widespread in the Annapolis Valley but have not been confirmed outside the Valley as of yet. Additionally, they do not appear to be at serious levels outside of the two respective farms where they were identified in 2014. The key to avoiding spread and increase in future will be the execution of competent monitoring programs for the vectors as has been successfully demonstrated for the strawberry viruses. To this end, one monitoring plot for each of the two vectors, was established in 2015 to help optimize management on the respective farms and also to add to our knowledge for the broader industry.

Summary:

Monitoring results clearly indicated that numbers of the primary disease vector, the strawberry aphid, remained very low again in 2015, after relatively high fluxes were observed in 2013 (Table 1). We can only speculate the reasons for this but intensive management over the previous two growing seasons and perhaps two difficult winters for this species are the most probable explanations. Also, extra-provincial contributions to the SA population during the high risk flight period, via jet stream, appear to be minimal. The latter is also good news because several additional viruses are being reported in provinces to the west and there has been concern that they might move into Nova Scotia by in-flying alatae.

It is also good news that the assessment in 2014 of the significance of the secondary vector, the melon aphid, was likely exaggerated due to the difficulty of distinguishing between the many species of the 'Aphis' genus to which the melon aphid belongs. As noted above, this vector is capable of transmitting strawberry mottle virus (SMoV) and yet levels of this virus are lower than the other virus and continue to drop (Fig.1). Clearly this would not be the case if this species was a significant contributor to the epidemic. As such, it is our conclusion that monitoring for strawberry aphid alone is satisfactory for the successful management of Nova Scotia's two-virus complex.

Virus testing of newly planted fields was conducted in late summer and fall of 2015 and showed a significant drop in new infections from 2014 season (Fig.1), to the extent that a normal crop forecast is again being made for the coming growing season. Strawberry mild yellow edge virus, the more common of the two viruses causing the epidemic of 2012/2013, still remains at a level above the 5% target threshold and efforts will continue in 2016 to further reduce levels of this virus. Although strawberry mottle virus is at very low levels overall, it persists in pockets on several farms and efforts will be made to reduce it further by targeted monitoring and management in the coming growing season.

Finally, efforts will be continued to assess and monitor for the two new insect-vectored diseases, a two-virus complex in raspberries spread by the large raspberry aphid, and a phytoplasma disease in highbush blueberries spread by the sharp-nosed leaf hopper. Although two farms have been impacted significantly by these two respective diseases, they do not appear to be at epidemic levels for the respective industries as a whole and it is our hope that the information gained through this project will help forestall a possible epidemic such as seen with the virus crisis that crippled the strawberry industry in 2012/2013.