PFR SPTS No. 14591

Outdoor lettuce virus disease project 2016-2018 Year 1 report

Fletcher J, Walker M, Davidson M, Paull S, Palmer A

April 2017















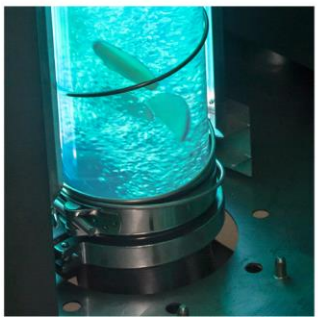


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CONTENTS

EXECUTIVE SUMMARY

Outdoor lettuce virus disease project 2016-2018 Year 1

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April 2019

Over the past three seasons, lettuce (*Lactuca sativa*) growers in the lower North Island, Nelson and Mid Canterbury have been concerned about poorly performing outdoor lettuce crops. In particular, those growing iceberg /crisp head lettuce types have noticed seasonal crop collapses with losses as high as 50%.

From specimens submitted from the lower North Island and Canterbury, in the last two seasons *Lettuce necrotic yellows virus* (LNYV) was identified in some plants. LNYV is usually transmitted by the blackcurrant-sow thistle aphid (*Hyperomyzus lactucae*). LNYV was not detected in Canterbury in the 2002–3 virus surveys; *Mirafiori lettuce big-vein virus* (MLBVV) and *Lettuce big-vein associated virus* (LBVaV) were detected at 10–20%, and *Turnip mosaic virus* (TuMV) at 10%. In addition, in 2002 a serious new pest of lettuces arrived in the form of *Nasonovia ribisnigri*, the blackcurrant-lettuce aphid, which has been managed using insecticides and aphid-resistant cultivars.

A joint grower researcher meeting held on 17 August 2016 expressed concern that:

- A more virulent strain of LNYV virus has arrived from Australia (two virus strains exist)
- A new aphid, able to transmit the virus has arrived in New Zealand
- Recent warm winters/summers in New Zealand have changed some dynamic with the behaviour of the sow thistle aphid
- Some interaction with other lettuce viruses and/or insects was occurring

In order to explore these possibilities, lettuce crops at two sites: Marshland and Southbridge in Mid Canterbury were monitored weekly from November2016 to mid-April 2017 for aphid vector activity over the spring, summer and autumn periods using field scouting and a wind trap.

Scouts from FruitFed Supplies also inspected lettuce plants weekly by examining them for the presence of aphids and any virus-like symptoms. Mature adult specimens were collected to confirm species identity. Collection tubes from the nearby wind trap were replaced weekly and collected specimens were conveyed to The New Zealand Institute for Plant & Food Research Limited (PFR), Lincoln for identification and counting. Three crop surveys were undertaken at the sites to determine the incidence of disease symptoms and identity of any associated viruses. Collected data was analysed and compared with existing recorded data held by PFR.

Our work found LNYV and *Cucumber mosaic virus* (CMV) were strongly associated with necrosis symptoms of iceberg lettuce heads. Both viruses were found in *Sonchus* and *Lactuca*

weed hosts near the monitored sites. Similarly *N. ribisnigri* was the most abundant aphid species found present on lettuce heads examined throughout the season at Marshland and Southbridge. Published literature and personal communications indicate there is strong evidence of *N. ribisnigri* transmitting *LNYV,* and some evidence of it transmitting CMV along with many of the other aphid species collected on lettuce heads. Along with this we found reservoirs of LNYV and CMV were commonly found in *Sonchus* and *Lactuca* weeds associated with both monitored sites.

From this work we recommend:

- Zero tolerance of weed hosts of LNYV and CMV in and around lettuce plantings
- Rapid removal/ploughing-under of harvested crops adjacent to growing crops
- An expansion of the area of suitable Nasonovia-resistant crisp head plantings over the critical infection periods
- An examination of the efficacy of currently registered insecticides against *N. ribisnigri, Myzus persicae* and *H. lactucae***.**
- Development of more sensitive and faster diagnostic tools such as isothermal amplification in order to determine field detection system for LNYV and CMV in lettuce and to determine that *N. ribisnigri* is indeed another vector of LNYV and CMV.

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1 INTRODUCTION

Over the past three seasons, lettuce *Lactuca sativa*) growers in the lower North Island, Nelson and Mid Canterbury have been concerned about poorly performing outdoor lettuce crops. In particular, those growing iceberg/crisp head types have noticed seasonal crop collapses with losses as high as 50%. Outdoor fancy lettuce varieties grown in the same field and fancy lettuce grown in plastic tunnel houses in the same areas do not seem to be affected to the same degree. Disease symptoms expressed include: plant stunting, leathery leaves, vein thickening, some head misshaping and in particular internal veinal necrosis leading to head rotting and plant collapse (Figure 1). Symptoms often show up just before or at harvest over January/February. The field pattern of infection appears to be random with nothing suggesting a source of infection.

Lettuce necrotic yellows virus (LNYV) was identified from some plant specimens submitted from the lower North Island and Canterbury in the last two seasons (2014-16). LNYV is transmitted by the blackcurrant-sow thistle aphid (*Hyperomyzus lactucae*). Sow thistle aphids usually overwinter on black currants, move onto sow thistle (S*onchus oleraceus*) and related species, then to lettuce to probe and feed but not usually to colonise. LNYV has been recognised in New Zealand for well over 60 years (Fry et al 1973) and while observed to cause some serious losses on occasion in the 1960's it has subsequently occurred only sporadically with few reported losses.

Further to this, in 2002 a serious new pest of lettuces arrived in the form of *Nasonovia ribisnigri*, the blackcurrant-lettuce aphid. *N. ribisnigri* overwinters on blackcurrant or gooseberry then emerges to colonise lettuce crops or weeds such as hawksbeard (*Crepis capillaris*) and chicory (*Cichorum intybus*). In 2002 this pest colonised and infested lettuce heads initially causing serious damage and economic loss to the lettuce industry until largely controlled using targeted insecticides and aphid-resistant cultivars. *N. ribisnigri* was recorded as a vector of *Cucumber mosaic virus* (CMV) (Blackman & Eastop 2000).

In addition, a virus survey of lettuce crops undertaken 2002–2004 (Fletcher et al. 2005) which concluded that *Lettuce big-vein disease* (LBVD), caused by *Mirafiori lettuce big-vein virus* (MLBVV) usually in combination with *Lettuce big-vein associated virus* (LBVaV), was the most widespread virus disease of lettuce over the survey period. Other viruses present included LNYV, *Beet western yellows virus* (BWYV), CMV and *Lettuce mosaic virus* (LMV).

In 2016, a grower meeting organised by FruitFed Supplies Christchurch was held on 17 August 2016 in Kaiapoi to discuss the iceberg lettuce issue. The consensus of the meeting was that there might be a number of possibilities regarding what might be happening and these included:

1. A more virulent strain of *Lettuce necrotic yellows virus* (LNYV) has arrived from Australia (two virus strains exist)
2. A new aphid, able to transmit the virus had arrived in New Zealand
3. Recent warm winters/summers in New Zealand have changed some dynamic with the behaviour of the sow thistle aphid
4. Some interaction with other lettuce viruses and/or insects was occurring

In order to gather sufficient information to be able to propose control measures, it was suggested that lettuce crops be inspected for visual symptoms of viruses. Samples could then be collected to confirm the visual symptoms by laboratory analysis and The New Zealand Institute for Plant & Food Research Limited (PFR) entomologists could then identify the aphid/ insect species on the lettuce. In order to fund this work a proposal for funding was put to Vegetables New Zealand Incorporated which agreed to fund a two-year project summarised in Appendix 9.1.This report summarises the first year of activities under Objective 1: Aphid vector monitoring and Objective 2: Virus disease survey.

2 MATERIALS AND METHODS

2.1 Objective 1: Aphid vector monitoring

Lettuce crops at two sites at Marshland & Southbridge were monitored weekly from November to mid-April for aphid vector activity over the spring, summer of 2016 and autumn of 2017 period using field scouting and a wind trap (Figure 1). Scouts from FruitFed Supplies also inspected 20 random lettuce plants weekly, examining them for the presence of aphids and any virus-like symptoms. Mature adult specimens were collected to confirm species identity. Collection tubes from the nearby wind trap were replaced weekly and collected specimens were conveyed to PFR, Lincoln for identification and counting. Three crop surveys were undertaken to determine the incidence of disease symptoms and the identity of any associated viruses.

Collected data were analysed and compared with existing recorded data held by PFR.

A

B

C

Figure 1A. Wind trap used to monitor aphid flight patterns adjacent to lettuce crops at Southbridge, November 2016–March 2017. Figure 1B. *Sonchus asper* and other weeds adjacent to lettuce crops at Southbridge, November 2016–March 2017. Figure 1C. *Sonchus asper* and *Lactuca serriola* at Marshland.

2.2 Objective 2: Virus disease survey.

2.2.1 Surveys

The monitored properties at Marshland and Southbridge were surveyed for the presence of *Sonchus* spp. and other potential virus hosts. Lettuce crops were monitored for the development of virus symptoms, specimens were collected in spring, summer and autumn, symptoms recorded and virus identities confirmed using enzyme-linked immunosorbent assay (ELISA). Further submitted lettuce specimens collected by project collaborators and colleagues were also examined and tested. Four specimens with typical necrosis symptoms were also examined by Mark Braithwaite of Plant Diagnostics Ltd, Templeton for any fungal or bacterial pathogens. Three lettuce surveys were undertaken around Marshland, Southbridge and Chertsey Mid Canterbury and a lettuce seedling nursery at Kaiapoi was also visited. Specimens were also received from a crop in Styx Mill Road near Marshland. During the survey, observations and comments by Dr Heiko Ziebell from the Julius Kühne Institute, Braunschweig, Germany indicated that other viruses transmitted by soil fungi such as *Olpidium brassicae* may be implicated in causing the necrosis symptom. Antibodies to these viruses were kindly donated and included in our assays. Comments from Mr Mike Titley, a lettuce consultant from Australia that in his view the symptoms were caused by LNYV were also helpful. A review of literature associated with aphid transmission of LNYV was also undertaken.

2.2.2 Virus assays

Virus assays were completed for CMV and Tomato spotted wilt virus (TSWV) using DAS ELISA. TAS ELISA was completed for Mirafiori lettuce big-vein virus (MiLBVV), Lettuce big-vein associated virus (LBVaV), Lettuce ring necrosis virus (LRNV), Ranunculus white spot mottle virus (RWSMV), Impatiens necrotic spot virus (INSV), potyvirus and BWYV. Indirect ELISA was completed for LNYV. And a confirmation polymerase chain reaction (PCR) for LNYV was also completed at PFR, Lincoln for examples from various survey sites. Eight isolates of LNYV from all survey sites were further examined using sub group specific PCR by Colleen Higgins (Auckland University of Technology; Higgins et al. 2016).

2.2.3 Literature review

LNYV has been recorded in Australia and New Zealand (Fry et al. 1973; Dietzgen et al. 2007) as well as Great Britain, Spain and Italy (Higgins et al. 2016). An initial literature search on the vector propensity of *N. ribisnigri* found very few records for virus transmission apart from CMV (Blackman & Eastop 2000) and BWYV (Schliephake et al. 2000). After discussions with Zeger van Herwijnen of Rijk Zwaan Breeding revealed that *N. ribisnigri* was used to maintain their isolate of LNYV, a further literature search was undertaken to see if European or other records of LNYV infections of lettuce associated with *N. ribisnigri* were available.

2A

2B

2C

2D

Figure 3A and 3B. Viral necrosis and damage from *Sclerotina sclerotiorum* in lettuce crops at Southbridge and Marshland, Mid Canterbury. Figure C and D. Viral necrosis symptom from lettuce crops at Southbridge.

Collected data analysed and will be compared with existing recorded data held by PFR from previous surveys in 2002–4 (Fletcher et al. 2005).

3 RESULTS

3.1 Objective 1: Aphid vector monitoring

Aphid species and numbers collected and identified from the wind trap over the period November 2016 to March 2017 are summarised in Figure 3.

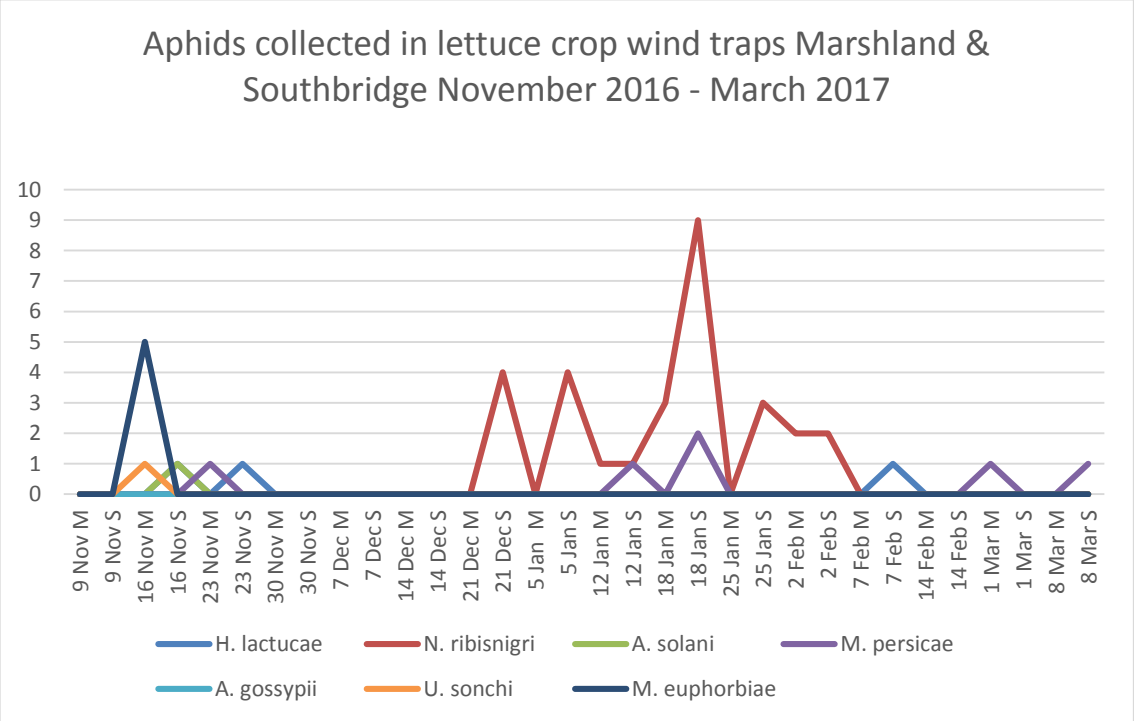


Figure 3. Aphids collected in wind traps located in two lettuce crops at Marshland and Southbridge, Mid Canterbury, November 2016–March 2017. *Hyperomyzus lactucae, Nasonovia ribisnigri, Aulacorthum solani, Aphis gossypii, Uroleucon sonchi, Macrosiphum euphorbiae, Myzus persicae.*

From our wind trap monitoring *H. lactucae* was trapped only during November, whereas *N. ribisnigri* was trapped from December through to February. In both cases trapped numbers were below 10/week. Virus vectors including *Myzus persicae* were trapped occasionally from November through to March. 'Other' aphids also includes possible virus vectors such as *Rhopalosiphum padi* (cereal aphid), *Macrosiphum rosae* (rose aphid) and *Brachycaudus rumexicolens* (dock aphid).

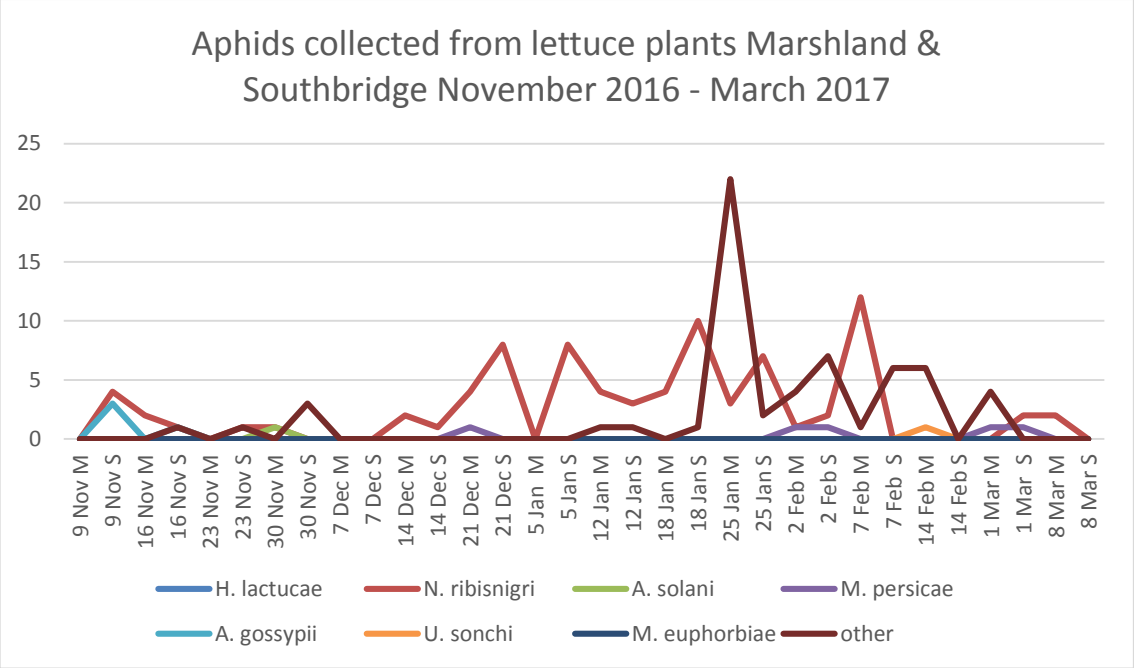
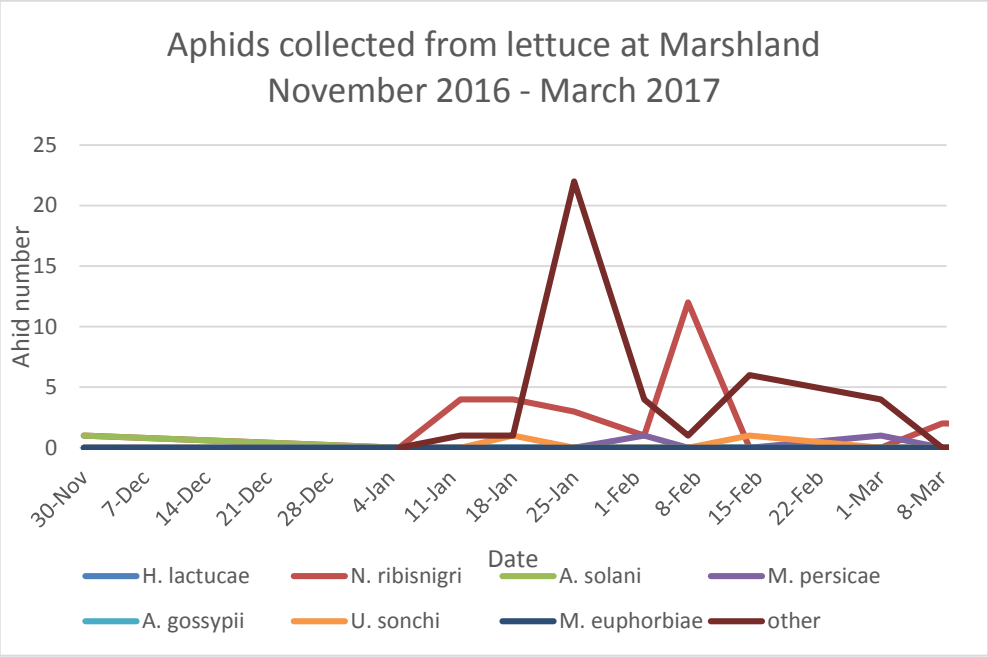


Figure 4. Aphids collected from individual lettuces located in two lettuce crops at Marshland and Southbridge, Mid Canterbury November 2016 –March 2017. ***Hyperomyzus lactucae, Nasonovia ribisnigri, Aulacorthum solani, Aphis gossypii, Uroleucon sonchi, Macrosiphum euphorbiae, Myzus persicae.***

Aphid species and numbers collected and identified from individual lettuces sampled and examined over the period November 2016 to March 2017 are summarised in Figure 4. Numbers individually for Marshland and Southbridge are summarised in Figure 5A & B.

Figure 5A



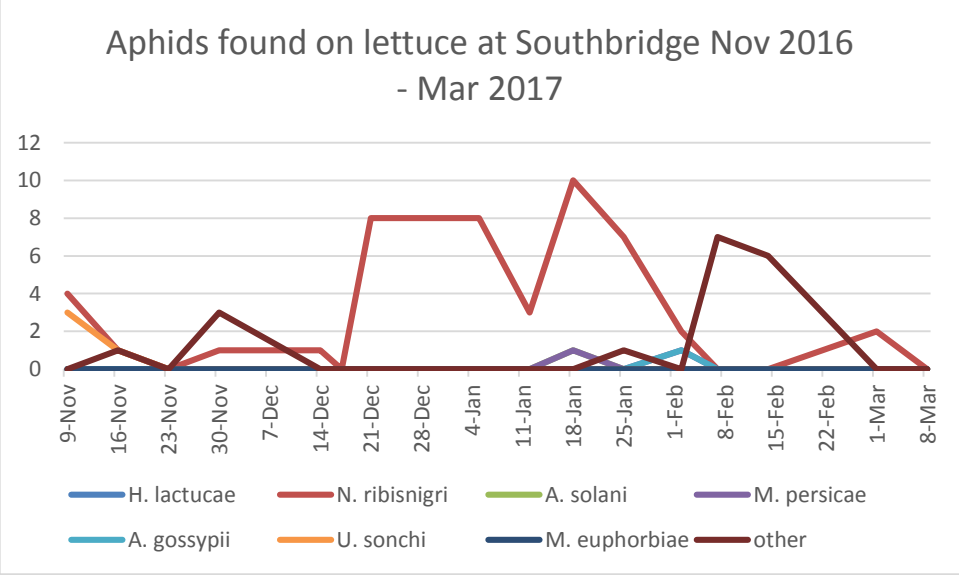


Figure 5B

Figure 5A & B. Aphid species and numbers collected and identified from individual lettuces sampled and examined over the period November 2016 to March 2017 for Marshland and Southbridge, Mid-Canterbury. *Hyperomyzus lactucae, Nasonovia ribisnigri, Aulacorthum solani, Aphis gossypii, Uroleucon sonchi, Macrosiphum euphorbiae, Myzus persicae.*

From our lettuce plant monitoring, *H. lactucae* was not trapped during November, whereas *N. ribisnigri* was trapped from December through to February at both sites. Peak numbers of *N. ribisnigri* were in January concurring with most previous records at PFR Lincoln (Figure 8 Appendix 9.2). More aphids were found at Marshland than Southbridge. Virus vectors including *M. persicae* were collected occasionally from November through to March. 'Other' aphids also include possible virus vectors such as *Rhopalosiphum padi* (cereal aphid), *Macrosiphum rosae* (rose aphid) and *Brachycaudus rumexicolens* (dock aphid).

3.2 Objective 2: Virus disease survey.

3.2.1 Surveys

Crop survey observations

Table 1. Visual estimates of virus symptoms observed from November 2016 to March 2017 in lettuce crops at Marshland, Southbridge and Chertsey, Mid Canterbury. *Lettuce necrotic yellows virus* (LNYV), *Cucumber mosaic virus* (CMV), *Mirafiori lettuce big-vein virus* (MLBVV), *Lettuce big-vein associated virus* (LBVaV, Lettuce big-vein disease (LBVD).

Lettuce crop virus Survey observations						
	Marshland		Southbridge		Chertsey	
	Symptom	Viruses		Viruses		Viruses
9-Nov	0 necrosis LBVD 5%		LBVD 10%			
21-Nov	0 necrosis LBVD 5%				0 necrosis	
16-Dec			5 % nec	LNYV, MiLBVV, CMV		
23-Dec	10% nec	LNYV, LBVD, CMV				
20-Jan	10-35% nec	LNYV, LBVD, CMV	30% nec	LNYV, LBVaV, CMV, BWYV		
31-Jan			70-100% nec	LNYV, LBVaV, CMV,	4% nec	LNYV, LBVaV, MiLBVV, CMV,
1-Mar	5-10%	LNYV, LBVD, CMV	20% nec	LNYV, LBVaV, CMV,		
Cultivars	Albanos, Oriola		Abanas, Alpinas , Casino		Oriola, Siberinas , Albanas and Pedrola	

From our observations from November 2016 through to March 2017 (Table 2), lettuce head necrosis was first detected at Southbridge in early November and in Marshland in late December. Significant necrosis developed through January (up to 100%) into February

(10–20%) diminishing in March. Chertsey had very low levels of necrosis detected in their crops. LNYV, CMV and LBVD were the main viruses observed. Virus incidence is discussed in more detail below.

Weed hosts

Results of virus assays from 23 specimens from two sites are summarised in Table 1. The associated aphid species collected from *Lactuca serriola* and *Sonchus asper* weeds are summarised in Table 2.

Table 2. Virus assays detecting *Lettuce necrotic yellows virus* (LNYV) and *Cucumber mosaic virus* (CMV) in weed species collected from Marshland and Southbridge, Mid Canterbury, December 2016.

Host		LNYV	CMV
Lactuca serriola- prickly lettuce	Marshlands	8/9 plants	2/9 plants
Sonchus asper - prickly sow thistle 30/1/17 shed at Ryan K	Marshlands	1/7 plants	2/7 plants
Sonchus asper - prickly sow thistle 30/1/17 shed at Ryan K	Southbridge	2/6 plants	0
Trifolium pratense red clover		0/1	0/1

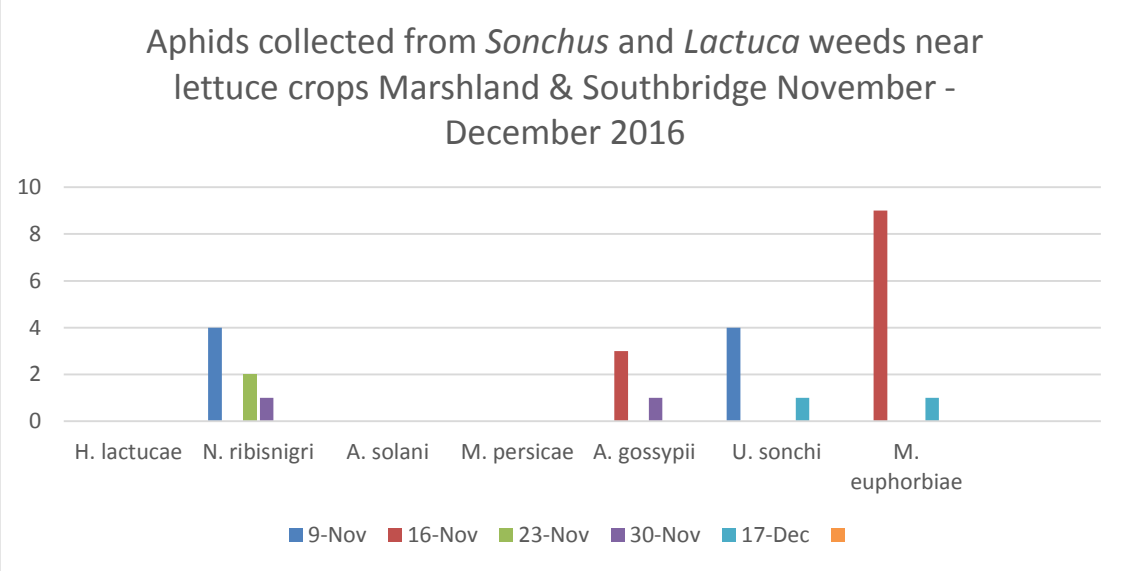


Figure 6. Aphid species collected from Lactuca & Sonchus at Marshland & Southbridge, Mid Canterbury, from November to December 2016. Hyperomyzus lactucae, Nasonovia ribisnigri, Aulacorthum solani, Myzus persicae,Aphis gossypii, Uroleucon sonchi, Macrosiphum euphorbiae

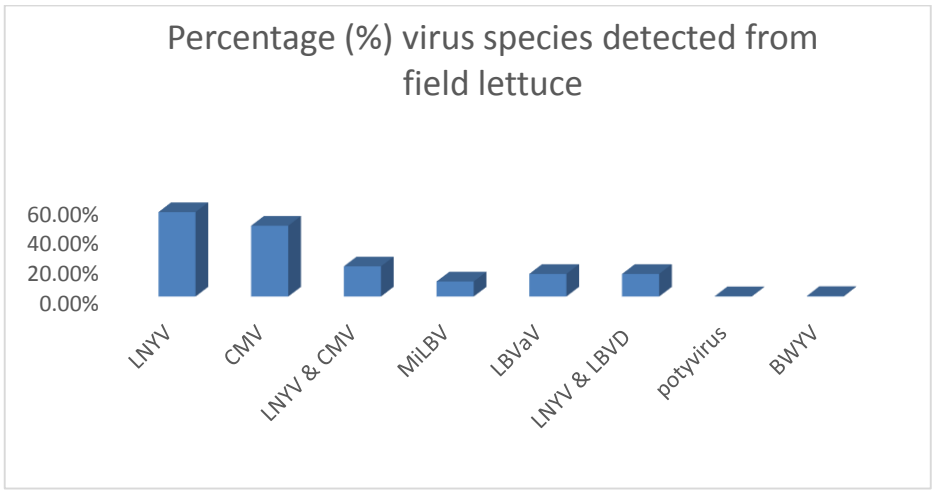
From our observations both prickly lettuce and prickly sow thistle (Figure 1B and C) were hosts of both LNYV and CMV particularly at Marshland and were visited by various aphid species including: *Hyperomyzus lactucae, Nasonovia ribisnigri, Aulacorthum solani, Myzus persicae*, *Aphis gossypii, Uroleucon sonchi, Macrosiphum euphorbiae*.

This appears to be the first detection of LNYV and CMV in *Sonchus asper* and *Lactuca serriola* in New Zealand.

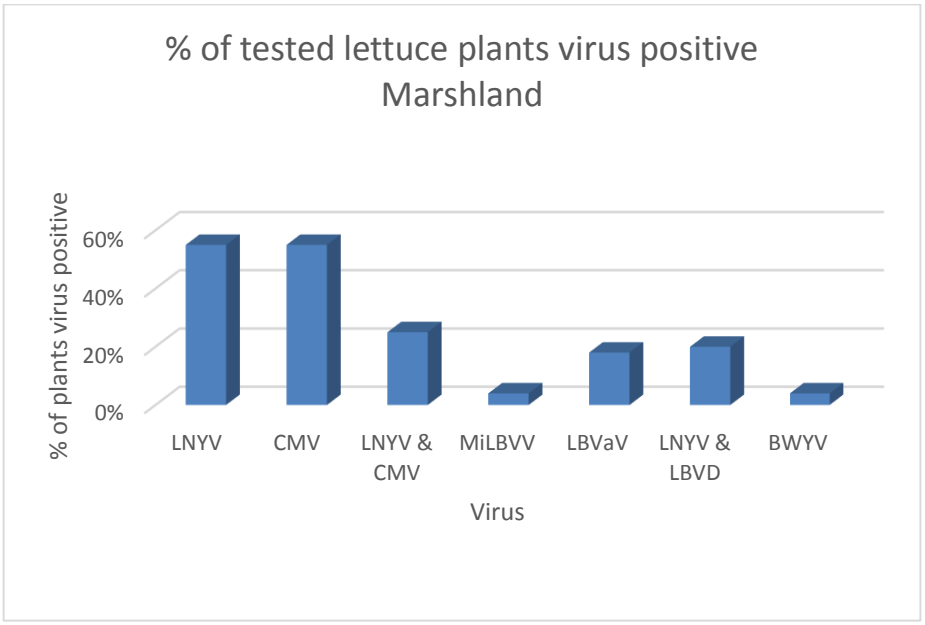
3.2.2 Virus assays

Virus incidences in the surveyed crops

Results of virus assays from 55 specimens from the lettuce crops surveys are summarised in Figure 6. No TSWV, INSV, RWSMV or LRNV was detected during the surveys.



A)



B)

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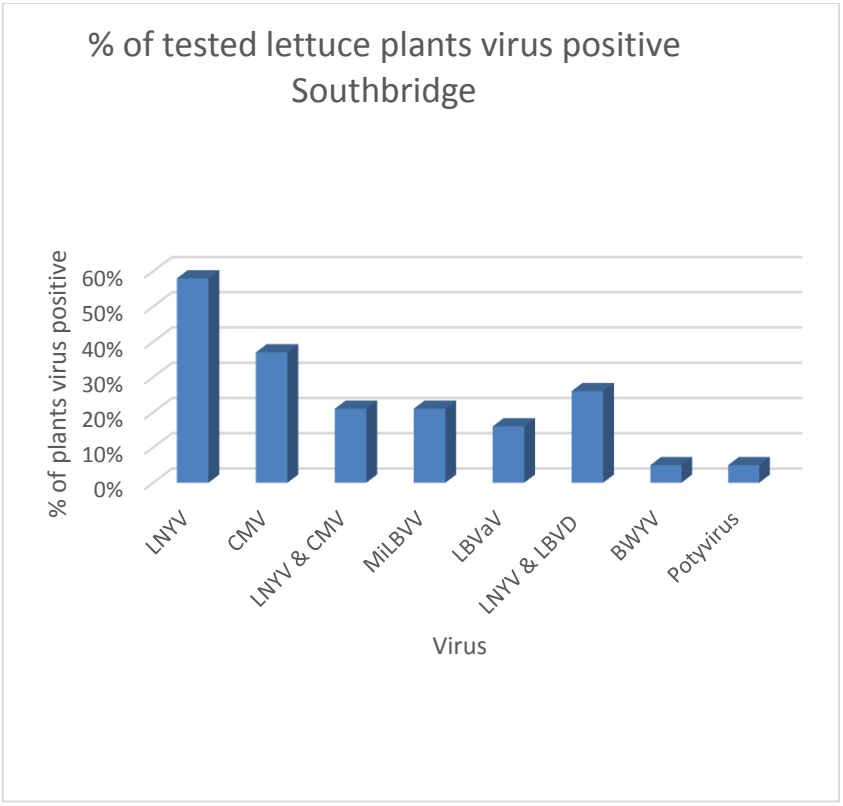

C)

Figure 7A. Percentage of different virus species detected by enzyme-linked immunosorbent assay (ELISA) A) in all 56 plants collected in surveys from lettuce crops at Marshland (including Styx Mill Road), Southbridge (including Chertsey), Mid Canterbury, February 2017, B) Marshland and C) Southbridge. *Lettuce necrotic yellows virus* (LNYV), *Cucumber mosaic virus* (CMV), *Mirafiori lettuce big-vein virus* (MLBVV), *Lettuce big-vein associated virus* (LBVaV), Potyvirus (*Lettuce mosaic virus or Turnip mosaic virus*), *and Beet western yellows virus* (BWYV).

From our assays both LNYV and CMV were strongly associated with necrosis symptoms of iceberg lettuce heads. LNYV was detected in 56% of symptomatic heads and CMV in 47% of heads. LNYV was more prevalent in Southbridge with 58 % and 37% CMV than in Marshland where LNYV and CMV were each 55%. Both sites had lower incidences of mixed LNYV and CMV; 21% Southbridge and 25% at Marshland. Other viruses while present but were below 20% in incidence. A selection of isolates were further tested by Dr Colleen Higgins (AUT) PCR to determine which LNYV subgroups may be present (Table 3). Both subgroups appear to be present at Marshland with only subgroup 2 at Southbridge.

Table 3. Seven isolates of Lettuce necrotic yellows virus (LNYV) from Marshland and Southbridge, Mid Canterbury, tested for subgroup 1 and 2. *Lettuce necrotic yellows virus* (LNYV), *Cucumber mosaic virus* (CMV), *Lettuce big-vein associated virus* (LBVaV).

Lettuce virus dried isolate collection Canterbury, February 2017		ELISA positive	Subgroup 1	Subgroup 2	Location
W 4	yellowing some vein & margin necrosis	LNYS		+	Marshlands
S 11	internal vein necrosis LBVD symptom whole plant	LNYV, CMV	0	+	Southbridge
S 13	internal vein necrosis LBVD split plant 2	LNYV	0	+	Southbridge
S 14	internal vein necrosis LBVD whole plant	LNYV	0	+	Southbridge
K 9	yellow stunted plant	LNYV, LBaV	+	0	Marshlands
L 2	stunting, yellow leaves, some necrosis	LNYV, CMV, LBaV	0	+	Chertsey

3.2.3 Literature review

This search revealed that in Italy *N. ribisnigri* was recorded as a vector of both CMV and LMV (Micieli de Biase & Ragozzino 1977) and that it was also a vector of LNYV associated with disease outbreaks in Campania (Ragozzino et al.1985). We also discovered recent work by Diaz at al. (2012) showing the dispersal potential of *N. ribisnigri* species independent of their population size, especially wingless adults who may walk an average of 25–47 cm and colonise up to 20% of neighboring plants. It was also noted that from 10 to 21 days after aphid release, dispersion of aphids within the experimental plot was higher in spring (reaching 95–100% of plants infested) than in autumn (72–88% of plants infested).

4 DISCUSSION

From our observations from November 2016 through to March 2017, both LNYV and CMV were strongly associated with necrosis symptoms of iceberg lettuce heads. Similarly *N. ribisnigri* was the most abundant aphid species found present on lettuce heads examined throughout the season at Marshland and Southbridge. Published literature and personal communications indicate there is strong evidence of *N. ribisnigri* transmitting LNYV and some evidence of it transmitting CMV along with many of the other aphid species collected on lettuce heads. Lettuce aphis (*H. lactucae*) only seemed to appear in November trap catches and was not detected on lettuce heads. LNYV was not detected in Canterbury in the 2002–3 surveys, with LBVD (LBVaV and MiLBVV) detected at 10–20% and TuMV at 10%. LBVD was detected at 10–15% in our recent surveys.

Reservoirs of LNYV and CMV were commonly found in *Sonchus* and *Lactuca* weeds associated with both monitored sites. This appears to be the first detection of LNYV and CMV in *S. asper* and *L. serriola* in New Zealand. Many other crop and weed hosts of CMV are recorded in New Zealand (Veerakone et al. 2015) and further work might be useful to confirm these hosts in the Marshland area.

We hypothesise that LNYV is moving into lettuce crops by early season transmission by *H. lactucae* then further transmitted by movement within the crop by *N. ribisnigri* walking between plants. *N. ribisnigri* is also likely to be transmitting CMV along with many of the other visiting aphid species. Indeed it is also possible that other aphid species might also be contributing to the spread of LNYV within the crop. We believe that rapid removal/ploughing-under of harvested crops adjacent to growing crops may reduce the within –crop sources of virus infection.

We believe it is important further work to determine if *N. ribisnigri* is transmitting LNYV and CMV is undertaken and suggest further refining of current PCR techniques to examine aphids.

We believe an expansion of the area of Nasonovia-resistant crisp head plantings over the critical infection period from around Christmas may reduce the resident aphid population in successive lettuce plantings. At the moment only Albanas and Alpinas are being planted in some cases. We also understand that the use of *N. ribisnigri*-resistance iceberg type lettuces are not always favoured by growers as they do not pack out as well as the traditional varieties. We suggest some closer examination of available or new cultivars as to their suitability as supplement or replacement options.

5 CONCLUSIONS/ RECOMMENDATIONS

LNYV and CMV were strongly associated with necrosis symptoms of iceberg lettuce heads. Both viruses were found in *Sonchus* and *Lactuca* weed hosts near the monitored sites. Similarly *N. ribisnigri* was the most abundant aphid species found present on lettuce heads examined throughout the season at Marshland and Southbridge. Published literature and personal communications indicate there is strong evidence of *N. ribisnigri* transmitting LNYV and some evidence of it transmitting CMV along with many of the other aphid species collected on lettuce heads. Along with this we found reservoirs of LNYV and CMV were commonly found in *Sonchus* and *Lactuca* weeds associated with both monitored sites.

From this work we recommend:

- Zero tolerance of weed hosts of LNYV and CMV in and around lettuce plantings
- Rapid removal/ploughing-under of harvested crops adjacent to growing crops
- An expansion of the area of suitable Nasonovia-resistant crisp head plantings over the critical infection period
- An examination of the efficacy of currently registered insecticides against *N. ribisnigri, M. persicae* and *H. lactucae*
- Development of more sensitive and faster diagnostic tools, such as isothermal amplification, in order to determine field detection systems for LNYV and CMV in lettuce and to confirm that *N. ribisnigri* is indeed another vector of LNYV and CMV

6 ACKNOWLEDGEMENTS

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APPENDICES

Appendix 1. Research Proposal

Outdoor lettuce virus disease project 2016–2018

Background

- There is continuing grower concern about poorly performing outdoor lettuce crops in a number of provinces in both the North and South Islands.
- The problem seems to have started some 3 years ago and was first noticed in Marshland near Christchurch.
- Similar problems have been observed in the Lower North Island, Nelson and Southbridge but not in Pukekohe, Hawke's Bay, Conway Flat, Chertsey, Oamaru or Outram.
- Cut out losses can be as high as 50% in iceberg lettuce.
- All varieties of iceberg lettuce seem to be affected.
- Fancy lettuce grown in plastic tunnel houses in the same areas do not seem to affected.
- Outdoor fancy lettuce varieties grown in the same field are not affected to the same degree as iceberg lettuces.
- *Lettuce Necrotic Yellows Virus* (LNYV) was identified in a number of specimens over the last two seasons.
- The field pattern of infection appeared to be random with nothing suggesting a source of infection. LNYV is transmitted by the black currant-sow thistle aphid (*Hyperomyzus lactucae*). Sow thistle aphid usually overwinter on black currants, move onto sow thistle (*Sonchus oleraceus* and related species), then to lettuce.
- A grower meeting organised by FruitFed Supplies, Christchurch was held on 17 August in Kaiapoi to discuss the issues.

The consensus of the meeting was that there were a number of possibilities regarding what is happening;

1. A more virulent strain of the virus has arrived from Australia (two virus strains exist)
2. A new aphid, able to transmit the virus, has arrived in New Zealand.
3. The recent warm winters/ summers in New Zealand have changed some dynamic with the behaviour of the sow thistle aphid.
4. Or that there is some interaction with other lettuce viruses and/or insects occurring.

A proposal to apply for funding to study the problem was agreed by Vegetables NZ Inc. The estimated cost would be $10,000 +GST per season.

To gather sufficient information in order to propose control measures, it is suggested that lettuce crops be inspected for visual symptoms of viruses. Samples may then be collected to confirm

the visual symptoms by laboratory analysis and also have The New Zealand Institute for Plant & Food Research Limited (PFR) entomologists identify the aphid/ insect species on the lettuce.

Objective 1: Aphid vector monitoring.

Year 1

Lettuce crops at two sites at Marshlands & Southbridge will be monitored weekly for aphid vector activity over the spring, summer and autumn period using field scouting and a wind trap.

Scouts from Fruit Fed Supplies will inspect 20 random lettuce plants weekly examining them for the presence of aphids and any virus-like symptoms. Mature adult specimens will be collected to confirm species identity.

Collection tubes from the nearby wind trap will be replaced weekly and species confirmed.

Collected specimens will be conveyed to PFR, Lincoln for identification and counting.

Collected data analysed and will be compared with existing recorded data held by PFR.

Control measures proposed. This will be based on aphid species found through the field surveys to assist with timing of agrichemical applications.

Year 2

Subject to previous seasonal results monitoring will be repeated at another regional site to confirm that aphid vector activity is consistent with Christchurch data.

Control measures refined from the Year 1 programme.

Objective 2: Virus disease survey

Year 1

The monitored property will be surveyed for the presence of *Sonchus* spp. and nearby black currant plants. Lettuce crops will also be monitored for the development of virus symptoms. Virus identity will be confirmed using enzyme-linked immunosorbent assay (ELISA). At least three surveys will be undertaken in spring, summer and autumn.

A survey of lettuce crops in Canterbury (Marshland, Southbridge and Chertsey) will be undertaken particularly when growers start to observe typical symptoms of poor performance in their crops.

Collected specimens will be examined and any virus disease or other observations (such as grower management practices, disease/symptom intensity) will be recorded.

Collected data analysed and will be compared with existing recorded data held by PFR from previous surveys in 2002–4 (Fletcher et al. 2005).

Year 2

Further close property monitoring will need to be confirmed subject to previous seasonal results. The scope of this monitoring will be determined prior to the Year 2 surveys commencing.

A wider survey of lettuce crops in lower North Island, Nelson, Marshland, Southbridge and Chertsey will be undertaken as in the previous season when growers start to observe typical symptoms of poor performance in their crops.

Collected specimens will be examined and any virus disease or other observations will be recorded.

Collected data analysed and will be compared with existing recorded data held by PFR previous surveys in 2002–4 (Fletcher et al. 2005), and the previous season's monitoring.

A research summary will be prepared for growers by 1 May each season outlining observations and making any appropriate recommendations.

Reference

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Appendix 2. Lincoln suction trap records 2004—2009

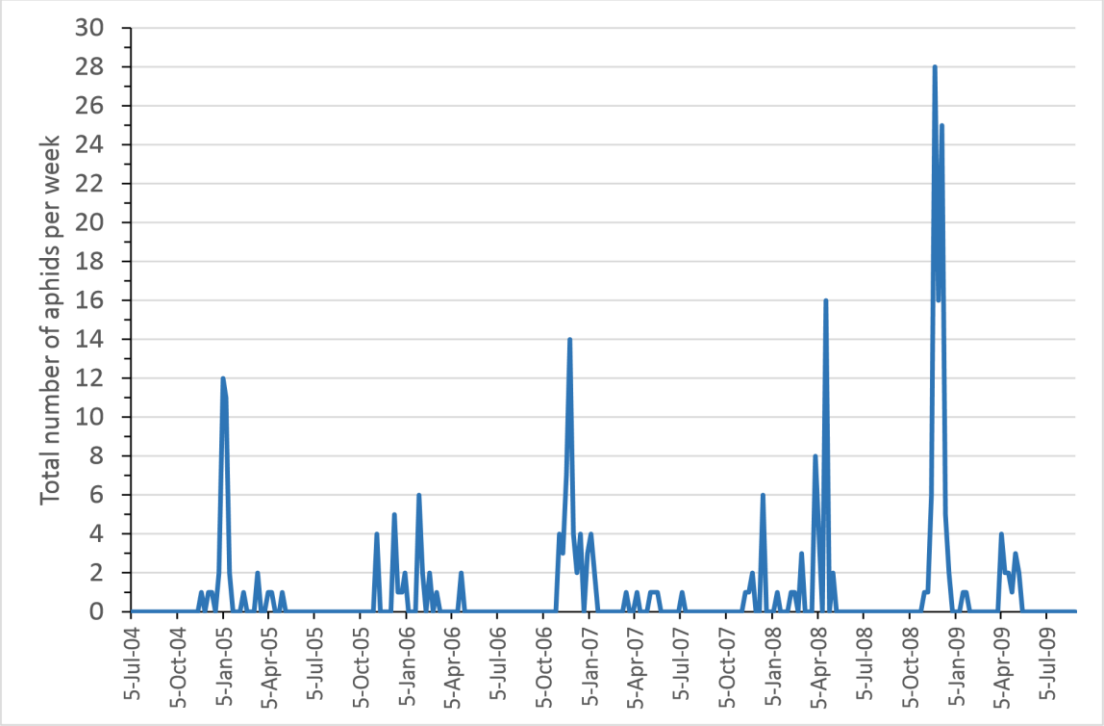

Figure 8. The total number of blackcurrant sow thistle aphid (*Hyperomyzus lactucae*) from weekly Lincoln Suction trap samples, July 2004 to August 2009

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