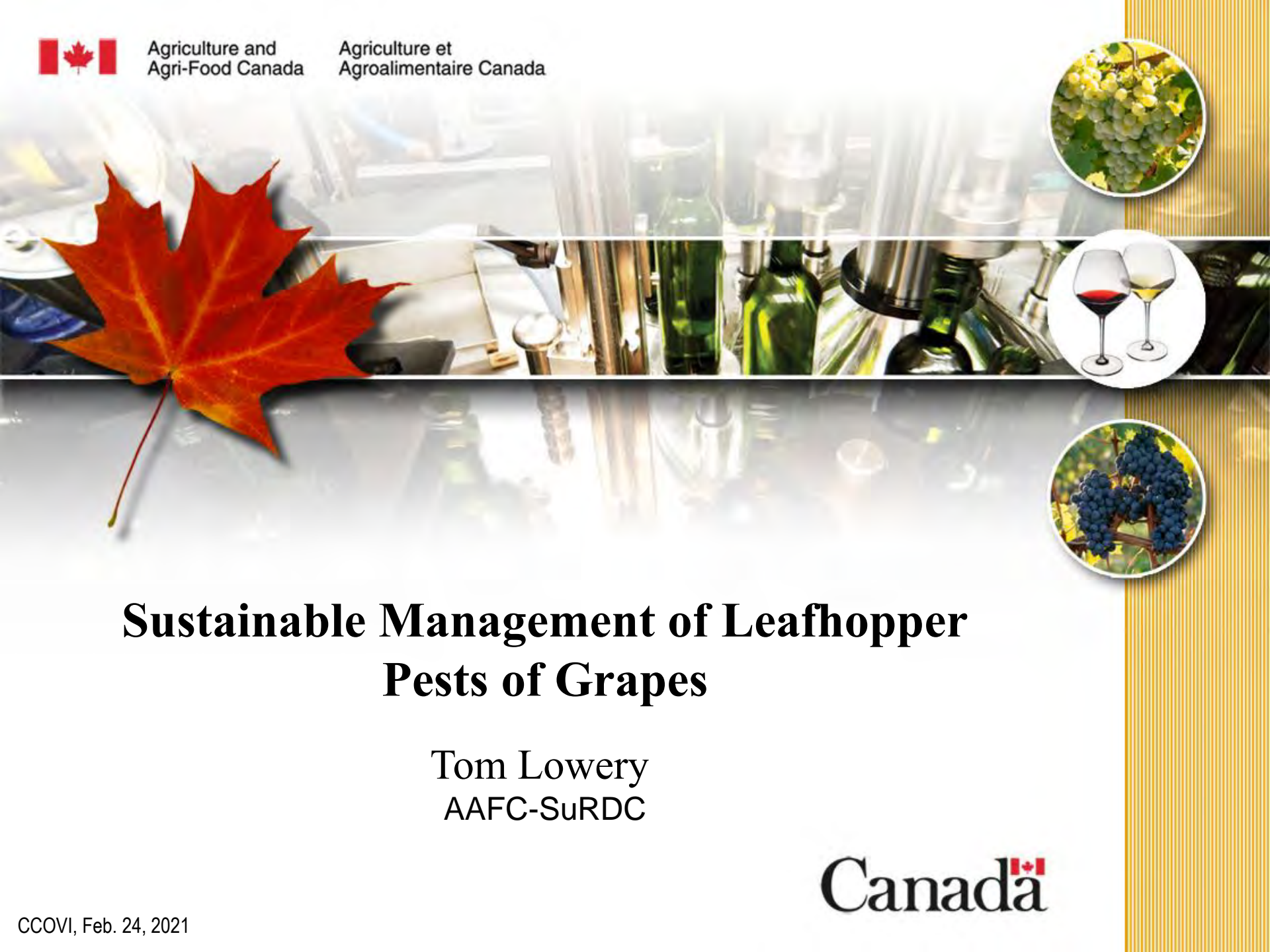




Agriculture and  
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# Sustainable Management of Leafhopper Pests of Grapes

Tom Lowery  
AAFC-SuRDC

Canada 

# **Lowery research program: 3 related areas.**

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- **Integrated grape pest management.**
  - *Economically important crop with many and diverse pest and disease problems.*
- **Epidemiology and management of insect-borne plant diseases.**
  - *More viruses recorded from grapes than from any other plant.*
- **Biology and management of homopteran insects (aphids, leafhoppers, scale, mealybug, and the like).**
  - *Homopteran insects are important vectors of plant viruses.*
  - *Grapes are host to many economically important homopteran pests, including several species of leafhopper.*



# ASC-12 Grape & Wine Activity 17 - Grape & Wine CGCN Development of Sustainable Management Practices for Leafhoppers on Grapes; 2018-2023.

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## Research Participants

- Dr. Tom Lowery**, Project Lead, AAFC-Summerland, BC (entomology, grape pest management)
- Dr. Paul Abram**, AAFC-Agassiz, BC (entomology, biological control)
- Dr. Pat Bowen and Carl Bogdanoff** (plant physiology/viticulture), **D. Nield** (minor use program), AAFC-Summerland
- Dr. Tara Gariepy**, AAFC-London ON (insect molecular taxonomy)
- Dr. Joel Kits**, AAFC-Ottawa, ON (taxonomy of homopteran insects)
- Dr. Justin Renkema** (J-P. Parent), AAFC-Vineland, ON (entomology)
- Dr. Serguei Triapitsyn**, UC-Riverside, CA (*Anagrus* wasp taxonomy)

# *Erythroneura* leafhopper pests of grapes in Canada



Virginia creeper leafhopper, *E. ziczac*



Western grape leafhopper, *E. elegantula*



*E. vulnerata*

Numbered photos by K.G.A. Hamilton, AAFC, in: Saguez et al, 2014. Diversity and abundance of leafhoppers in Canadian vineyards. J. Insect Sci. Vol. 14, Article 73.

Eastern grape leafhopper, *E. comes*



Three-banded leafhopper, *E. tricincta*



Grapevine leafhopper, *E. vitis*



*E. bistrata*/  
*E. vitifex*



The **potato leafhopper**, *Empoasca fabae*, feeds from phloem and injects a toxin causing leaf and shoot distortion and ‘hopper burn’.

- Damage threshold very low (for the **grape leafhopper**, *Empoasca vitis*, of Europe, it is 0.5 nymphs or eggs per leaf).
- Does not winter in Ontario; rarely occurs in BC.



**Potato leafhopper,**  
*Empoasca fabae*



Photo credit: Ont. Min. Agr. Food

## Sharpshooter Pests of Grapes.

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**Willow sharpshooter,**  
*Neokolla confluens*



**Poplar sharpshooter,**  
*N. hieroglyphica*



Accidentally introduced to Europe from NA, the **vine leafhopper**, *Scaphoideus titanus*, is the primary vector there of grapevine yellows disease (Flavescence dorée phytoplasma).

# Will the pest status of treehoppers change?

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Using an artificial diet system, graduate student Dieter Kahl (SuRDC) has shown that **buffalo treehoppers**, *Stictocephala bisonia* and *S. basalis* are capable of transmitting Grapevine red blotch virus.

It is a close relative of the **three-cornered alfalfa treehopper**, *Spissistilus festinus*, that is thought to be a vector of GRBV based on research by Bahder *et al.* 2016. (Phytopathology, 106: 1223-1230)

# Control of Buffalo Treehoppers

- There are no insecticides currently registered for the control of treehoppers on grapes in Canada.
- Legumes such as alfalfa are preferred hosts.
- Research on legumes for vineyard groundcovers should include their suitability as hosts for treehoppers.

Birdsfoot Trefoil



White clover



Sainfoin



Photo credits: AAFC



# Biology of *Erythroneura* Leafhopper Pests of Grapes in Canada.

- Native to N.A. – certain species invasive in other areas/countries.
- Small size (~3 mm) – very fecund – 2 gen./yr – winter as adults.
- Nymphs often pale, marked with yellow, orange, red, or brown – 5 nymphal instars.
- For most species, eggs are deposited in the leaf mesophyll.
- Grapes (*Vitis* sp.) and closely related plants (i.e. Virginia creeper vine) the only or the preferred hosts for most pest species.



Photo: AAFC

Nymphs of Virginia creeper leafhopper, left, and western grape leafhopper, right.



Photo: AAFC

# Leafhopper Damage to Grapevines.

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- Puncture leaf mesophyll cells and remove the fluids, reducing photosynthesis, carbohydrate accumulation, and ripening of fruit.
- Foul leaves and fruit with cast skins, feces, honeydew, and sooty mold fungus.
- Annoyance to vineyard workers.
- No documented field transmission of grapevine viruses or phytoplasma diseases by *Erythroneura* species.



Photo: AAFC



Photo: AAFC

## Pest Status Differs Between Regions

### Leafhoppers in Ontario:

- >7 species
- Native to the region
- Large *Anagrus* parasitoid populations (?)
- *V. vinifera* and hybrids
- Several major grape pests
- Lower % organic
- **Minor pest status**

### Leafhoppers in BC:

- 2 species
- Invasive pests
- Small *Anagrus* population
- Mostly *V. vinifera*
- Few major grape pests
- Higher % organic or sustainable
- **Major pest status!**

## Chemical Control:

- Leafhoppers controlled mostly with insecticides.
- Resistance of the **western grape leafhopper** to DDT in 1953 (Stafford & Jensen) and to carbaryl and endosulfan in 1984 (Flaherty).
- There are concerns regarding:
  - human health
  - environmental impacts
  - damage to non-target organisms
  - vineyard/housing interface
- Lack of effective organic materials in Canada.
- Sustainable and organic grape pest management programs focus more on non-chemical approaches.



## **New and Alternative Spray Materials:**

Research is required to evaluate the effectiveness of 'softer' materials and to assist in their registration:

- Insect growth regulators
- Microbial insecticides
- Horticultural summer oils
- New insecticide chemistries

### **Three major impediments!**

- Winegrapes are considered a 'minor crop'.
- Requires efficacy and other data.
- Unable to register neem-based organic materials.



Photo: AAFC



Photo: P. Abram AAFC

## **Biological Control:**

Leafhoppers have many natural enemies, including European earwigs, *Forficula auricularia*, that scrape eggs from the leaves, but the most effective natural control agents are species of *Anagrus* wasps (family: Mymaridae) that parasitize leafhopper eggs.

- There are various ways to preserve and enhance leafhopper natural enemies, including increased vineyard plant species diversity and the choice of spray materials.

## Parasitism of WGL eggs by the wasp *Anagrus erythroneuræ* in BC

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- ❖ Effectively controls the WGL in most vineyards except when certain insecticides are used for leafhopper control.
- ❖ Large numbers winter in eggs of the **rose leafhopper**, *Edwardsiana rosae*, on roses, plums, apple, blackberry, etc.
- ❖ The **mint leafhopper**, *Eupteryx melissae*, on garden sage, lavender, catmint, etc., is another important host.



Photo credits: AAFC

## Parasitism of VCL eggs by *Anagrus daanei* in BC

- Native to eastern NA.
- Mostly ineffective except near riparian areas late in the season.
- Few winter hosts (what are they?).
- Leafhoppers on red osier dogwood perhaps a summer host.
- Leafhopper project includes studying *Anagrus*/leafhopper host relationships in Ontario.



Photo credits: AAFC



**The current CGCN-AAFC leafhopper project includes collection of leafhoppers and *Anagrus* parasitoids from dormant winter and summer hosts in BC and ON.**

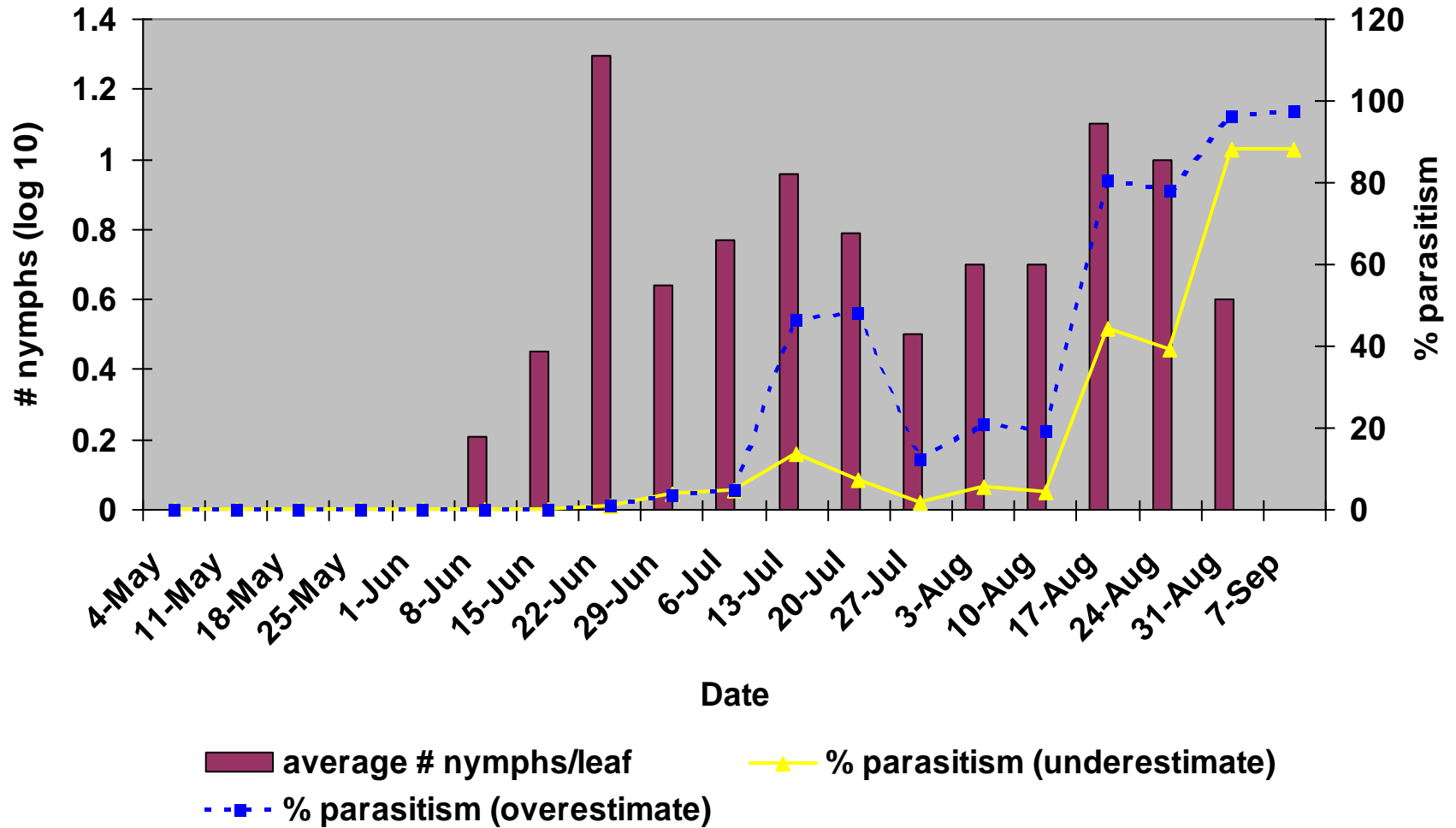
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In collaboration with taxonomists S. Triapitsyn and J. Kits, T. Gariepy is able to utilize molecular diagnostic techniques to directly identify and associate the *Anagrus* wasp species with the species of leafhopper host egg.



Photo: AAFC

Average number of leafhopper (*Erythroneura ziczac*) nymphs per leaf and percent parasitism of leafhopper eggs, Oliver, B.C., 1998.



## Preserving and Enhancing Parasitism of Leafhopper Eggs.

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- Increasing vineyard groundcover species diversity.
- Providing plants for alternate winter or spring hosts.
- Possible transfer of another species, *Anagrus tretiakovae*, from ON to BC.
- Softer, selective insecticides.

Dwarf catmint





Photo credits: AAFC

- Application of yellow sticky tape is effective for the control of leafhoppers, reducing numbers by 90-96%.
- Effect largely limited to the taped row.
- Expensive and difficult to apply.

**Recommend using yellow sticky tape only on outer edges or 'hot spots' when leafhopper numbers are very high.**

## Cultural Control: Canopy Management

- Removal of basal leaves in June can be effective for the control of leafhoppers. It also reduces disease incidence and improves fruit quality. There is little impact on vine growth or yield.

A multi-year trial involving 4 treatments applied to 2 cultivars at each of 2 vineyards showed an average ~ 70% reduction in leafhopper numbers with removal of basal leaves.



Photo: AAFC

# Cultural Control: Managing Vine Vigour

A study in CA of the effects of deficit irrigation (25% or 50%) between berry set and veraison on populations of WGL and **variegated grape leafhopper**, *Erythroneura variabilis*, found:

- Reduced oviposition
- Increased nymphal mortality
- A reduction in numbers of nymphs ranging from 30-54%

Costello, M.J. 2008. Regulated deficit irrigation and density of *Erythroneura* spp. (Hemiptera: Cicadellidae) on grape. J. Econ. Entomol. 101(4): 1287-1294.



Photo: P. Bowen, AAFC

# Leafhopper Feeding and Oviposition Deterrents

24 hr. laboratory feeding choice test bioassays with leafhopper nymphs to evaluate the deterrent effects of:

- Fungicides
- Surfactants
- Plant essential oils
- Formulated plant essential oil products

Several organosilicone surfactants and strobilurin fungicides are highly deterrent!



## Materials Repellent to Leafhoppers

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- Certain neonicotinoid insecticides are repellent to adult leafhoppers.
- The organic fungicide Grandevo® with the active ingredient *Chromobacterium subtsugae* (Marrone Bio Innovations) registered also for leafhopper control in the US reportedly has repellent action.
- Organosilicone surfactants, some of which are labelled organic, became widely used around the time that the new strobilurin fungicides and neonicotinoids came on the market.



## Summary:

- Leafhoppers and their close relatives are important pests of grapes in BC and are of increasing concern in Ontario.
- There is a desire for spray materials with different modes of action and in the development of non-chemical controls.
- The effectiveness of individual non-chemical control practices has been demonstrated. These can be used in combination with the selective use of insecticides and preservation or enhancement of *Anagrus* parasitoids in a sustainable leafhopper management program.
- A leafhopper management program suitable for other regions requires additional research, but many of the practices can be transferred or adapted (e.g. early season leaf removal).

# Leafhopper Action Plan Summary:

Beneficial plants and/or Sticky tape

Oviposition deterrent

Basal leaf removal, or feeding deterrent

Foliar oil (or insecticide)

Oviposition deterrent

Models based on temperature or plant developmental stages would assist with timing of the various control actions.

Feeding deterrent

Foliar oil (or insecticide)

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THANK YOU!

