Area-wide IPM Program for Virginia Creeper Leafhopper in northern California vineyards

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Erythronoeura Leafhoppers in California Distribution, Biology and Key Natural Enemies
Western grape
*E. elegantula*

Variegated
*E. variabilis*
Virginia creeper
Erythroneura ziczac

Western grape
E. elegantula

Variegated
E. variabilis
Virginia creeper
*Erythronoeura ziczac*

Western grape
*E. elegantula*

Variegated
*E. variabilis*
Erythroneura Leafhoppers in California

Virginia creeper
(E. ziczac)

Western grape
(E. elegantula)

Variegated
(E. variabilis)

Four red/brown spots

No spots

“Race stripes”
Virginia creeper (*E. ziczac*)

Western grape (*E. elegantula*)

Variegated (*E. variabilis*)

1\(^{st}/2^{nd}\) instars are difficult to distinguish!

Four red/brown spots

No spots

“Race stripes”
Erythroneura Leafhoppers in California
Leaf Stippling Impacts Yield/Quality
Plus a Nuisance at Harvest
Erythroneura Leafhoppers in California

Key Parasitoids

*Anagrus* spp. (Mymaridae)

- *Anagrus daanei*
- *Anagrus erythroneurae*
- *Anagrus tretiakovae*
**Erythroneura** Leafhoppers in California

**Key Parasitoids**

**Anagrus** spp. (Mymaridae)

<table>
<thead>
<tr>
<th>Leafhopper</th>
<th>Anagrus parasitoids</th>
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</thead>
</table>
| Virginia creeper    | • *A. tretiakovae*  
                      | • *A. daanei*                  |
| Western grape       | • *A. daanei*                  
                      | • *A. erythroneurae*           |
| Variegated          | • *A. erythroneurae*           
                      | • *A. tretiakovae*             |
Erythronoeura Leafhoppers in California

Overwintering Biology

Summer
Erythroneura Leafhoppers in California

Overwintering Biology

Fall

Alternate Host/Habitat

Anagrus spp. migrates out of the vineyard

Leafhopper stays in the vineyard as adult
Erythroneura Leafhoppers in California
Overwintering Biology
Winter

Overwintering Anagrus spp.

Overwintering Leafhoppers
Overwintering *Erythroneura* Leafhoppers in California

Overwintering Biology

Spring

Overwintering *Anagrus* spp.

*Anagrus* spp. migrates back into vineyard

Active Leafhoppers
**Erythronoeura** Leafhoppers in California

**Anagrus** Overwintering Habitat

Natural Habitats

Erythroneura Leafhoppers in California

Anagrus Overwintering Habitat

Gardens, Hedgerows

Erythroneura Leafhoppers in California

• Three species
  • Western grape
  • Variegated
  • Virginia creeper

• Anagrus spp. are key parasitoids

• Overwintering habitat is critical for Anagrus
  • Blackberry, coyote brush, roses, mints

• Leafhoppers prefer vigorous vines
  • Elevated nitrogen content + irrigation levels
Virginia Creeper Leafhopper Area-wide IPM Program in the North Coast
Virginia creeper
*Erythroleuera ziczac*

Western grape
*E. elegantula*
VCLH Area-wide IPM Project
Initial Outbreaks in Mendocino/Lake County
2011-2012
**VCLH Area-wide IPM Project**

**Differences in VCLH + WGLH Biology**

**VCLH Preference for Glabrous Leaves**

<table>
<thead>
<tr>
<th></th>
<th>Tannat</th>
<th>Amarela</th>
<th>Tinta Francisca</th>
<th>WGLH</th>
<th>Tannat</th>
<th>Amarela</th>
<th>Tinta Francisca</th>
<th>VCLH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean No. Eggs / g leaf</td>
<td><img src="chart.png" alt="Bar chart" /></td>
<td>a</td>
<td><img src="chart.png" alt="Bar chart" /></td>
<td>a</td>
<td><img src="chart.png" alt="Bar chart" /></td>
<td>a</td>
<td><img src="chart.png" alt="Bar chart" /></td>
<td>C</td>
</tr>
</tbody>
</table>

*Note: The graph shows the mean number of eggs per gram of leaf for Tannat, Amarela, and Tinta Francisca for both WGLH and VCLH. The letters (a, A, B, C) indicate statistical significance among the treatments. The VCLH preference for glabrous leaves is highlighted.*
VCLH Area-wide IPM Project

Differences in VCLH + WGLH Biology

Earlier Egg Deposition + Nymph Emergence

Leafhopper Adults

VCLH Area-wide IPM Project

Differences in VCLH + WGLH Biology

Earlier Egg Deposition + Nymph Emergence

Leafhopper Adults
VCLH Area-wide IPM Project
Differences in VCLH + WGLH Biology
Earlier Egg Deposition + Nymph Emergence

Leafhopper Eggs

- VCLH
- WGLH
VCLH Area-wide IPM Project

Differences in VCLH + WGLH Biology

Earlier Egg Deposition + Nymph Emergence

Leafhopper Nymphs

VCLH

WGLH
VCLH Area-wide IPM Project

Differences in VCLH + WGLH Biology

Lack of VCLH Parasitism

Leaves with Parasitized Eggs (%)

![Graph showing comparison between WGLH and VCLH leaves with parasitized eggs. The graph indicates a significantly higher percentage of parasitized leaves in WGLH compared to VCLH.]

- **WGLH**: About 80% parasitized leaves
- **VCLH**: Slightly above 10% parasitized leaves
VCLH Area-wide IPM Project

Key Differences in VCLH + WGLH Biology

Standard Focus is on Late Season Densities
VCLH Area-wide IPM Project

Key Differences in VCLH + WGLH Biology

Absence of Biocontrol $\rightarrow$ Spray Timing Adjustments

- Spray? -

Graph showing the number of Adults, Eggs, and Nymphs per trap and leaf from March to October. The graph indicates the timing of spray adjustments based on the differences in biology.
VCLH Area-wide IPM Project

Key Differences in VCLH + WGLH Biology

Absence of Biocontrol $\rightarrow$ Spray Timing Adjustments

Key Differences in VCLH + WGLH Biology

Absence of Biocontrol $\rightarrow$ Spray Timing Adjustments

<table>
<thead>
<tr>
<th>Month</th>
<th>Adults per Trap</th>
<th>Eggs per Leaf</th>
<th>Nymphs per Leaf</th>
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<tbody>
<tr>
<td>Mar</td>
<td></td>
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</tr>
<tr>
<td>Apr</td>
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<td>May</td>
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<td>Sep</td>
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<td>Oct</td>
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</tbody>
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VCLH Area-wide IPM Project

Key Differences in VCLH + WGLH Biology

Absence of Biocontrol $\rightarrow$ Spray Timing Adjustments

Graph showing:
- Adults per Trap
- Eggs per Leaf
- Nymphs per Leaf

Spray? Arrows indicate the timing of spraying in relation to the peaks of different life stages.
# VCLH Area-wide IPM Project

## Spray Trials with OMRI Material

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<tr>
<td>PyGanic</td>
<td>pyrethrin</td>
<td>Nymphs</td>
<td>Nymphs</td>
<td>Nymphs</td>
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<tr>
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<td><em>Chromobacterium</em> sp.</td>
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<td>Mycotrol</td>
<td><em>Beauveria bassiana</em></td>
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<tr>
<td>Stylet Oil</td>
<td>oil</td>
<td>-</td>
<td>Nymphs</td>
<td>-</td>
<td>-</td>
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<tr>
<td>DeBug Turbo</td>
<td>azadirachtin</td>
<td>-</td>
<td>Nymphs</td>
<td>Eggs</td>
<td>Eggs</td>
</tr>
<tr>
<td>PureAg</td>
<td>oil (colloidal)</td>
<td>-</td>
<td>-</td>
<td>Nymphs</td>
<td>-</td>
</tr>
<tr>
<td>DeBug Tres</td>
<td>azadirachtin</td>
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<td>-</td>
<td>-</td>
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VCLH Area-wide IPM Project
Establish Biological Control
VCLH Area-wide IPM Project

Establish Biological Control

Parasitism Survey - 2013

Leaves with Parasitized Eggs (%)

![Bar Graph]

- WGLH
- VCLH
Establish Biological Control
Parasitism Survey - 2013

VCLH Area-wide IPM Project

Leaves with Parasitized Eggs (%)

A. daanei
A. erythroneurae

WGLH

VCLH
VCLH Area-wide IPM Project

Establish Biological Control

Parasitism Survey - 2013

Leaves with Parasitized Eggs (%)

A. daanei
A. erythroneurae

Parasitoid is present in North Coast – but not attacking VCLH!
Mendocino
Napa
Yolo
El Dorado

Egg Parasitism (%)

VCLH Area-wide IPM Project
Establish Biological Control
Expanded Parasitism Survey - 2014

Grape leafhopper
Virginia creeper leafhopper

A. daanei
A. erythronoeurae
A. tretiakovae

A. daanei
A. erythronoeurae

A. daanei

A. daanei

A. daanei

A. daanei
VCLH Area-wide IPM Project
Establish Biological Control
*Anagrus daanei* Rear-Release Program – 2015

1. Collect from Abandoned Vineyards in Sacramento Valley
2. Rear + Aggregate Parasitoids in Greenhouse
3. Release Near Hopland
A. daanei Rear-Release Program – 2015-2017
Field Release and Follow-up Evaluation
Paired release with a no-release control site
Pre- and post-release evaluation
VCLH Area-wide IPM Project
Establish Biological Control
Success of Initial Release – 2015

Parasitism Rate

- Release Point
- No Release Control

Graph showing the parasitism rate at different release points:
- July 29: Low parasitism rate
- Aug 21: Low parasitism rate
- Sept 4: Moderate parasitism rate
- Sept 25: High parasitism rate
VCLH Area-wide IPM Project
Establish Biological Control
Multiple Colonies at UC Berkeley – 2016
VCLH Area-wide IPM Project
Establish Biological Control
Mass Rearing in Greenhouse – 2016
VCLH Area-wide IPM Project
Establish Biological Control
Multiple Releases in Mendocino/Lake – 2016
15,000+ parasitoids across 9 sites
VCLH Area-wide IPM Project
Establish Biological Control
Release Impacts on Parasitism Rate – 2016

- Consistent parasitism – 1 site
- Some parasitism – 3 sites
- Low/no parasitism – 5 sites
VCLH Area-wide IPM Project
Establish Biological Control
Releases are Early, Frequent and Abundant

Parasitism Rate (%)

Total Parasitoids Released

- Anagrus daanei
- Release Point
- Control

Parasitism Rate (%)

Total Parasitoids Released

Release Point

Control

Establish Biological Control

Releases are Early, Frequent and Abundant
VCLH Area-wide IPM Project
Establish Biological Control

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Anagrus daanei

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- VCLH Area - wide IPM Project
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VCLH Area-wide IPM Project
Establish Biological Control
Releases are Early, Frequent and Abundant

- Anagrus daanei
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- Control

Parasitism Rate (%)

Total Parasitoids Released

1-Apr 1-May 1-Jun 1-Jul 1-Aug 1-Sep 1-Oct
Short-term Goal – Triage Outbreaks
• Pest ID, ecology, varietal preferences, regional hot spots
• Monitoring, spray timing, product selection

Long-term Goal – Establish Biological Control
• Identified and evaluated novel population of *A. daanei*
• Mass rear-release program now in progress

Plans for 2017
• Continue Regional Monitoring + Rear-Release Program
• Developing Pest ID posters (Spanish/English)
VCLH Area-wide IPM Project
Key Take-Aways – VCLH in Sierra Foothills

Monitoring

• Know Your Leafhoppers!
• Monitor Early in the Season
• Know Where to Look
  • Preference for Glabrous Leaves (Grenache, Chard. SB)
  • Preference for Vigorous Vines
• Earlier Egg Deposition = Earlier Nymphs

Management

• Limited Biological Control
• Overwintering Parasitoid Habitat = Blackberry
• Early Season Sprays are Critical – 1st generation nymphs
Virginia Creeper Leafhopper Areawide Project

Improving Control of the Virginia Creeper Leafhopper

Our Mission

This website provides information and resources related to on-going efforts by UC Cooperative Extension to improve biological control of the Virginia Creeper Leafhopper (*Erythronoeura ziczac* Walsh) in Mendocino and Lake County wine grape vineyards.

Current VCLH Outbreaks in the North Coast

Since 2011, organic grape growers in Mendocino and Lake County have been experiencing severe outbreaks of the Virginia creeper leafhopper (*Erythronoeura ziczac* Walsh) [Hemiptera: Cicadellidae]. Feeding by *E. ziczac* causes stippling of grape leaves which can reduce vine productivity and ultimately effect crop yield and fruit quality. Large adult populations of this pest can also be a nuisance to workers at harvest.
Egg Deposition Continues, First VCLH Nymphs

Author: Houston Wilson  
Published on: May 15, 2017

Leafhopper egg deposition continues on both white and red varieties. Eggs of western grape leafhopper (WGLH) are now present at all of the monitoring sites.

Eggs of Virginia creeper leafhopper (VCLH) on white varieties are close to full maturity (eye spot is present) and we observed our first VCLH nymphs (1st instars) last week at the "Hopland" and "Ukiah/Talmage" sites (both are Chardonnay).

Nymph emergence will continue to increase in the coming weeks, so now is the time to start thinking about monitoring nymph populations in your vineyard. Leafhopper nymph identification guidelines are available [here](video) and [here](text version).

Due to the lack of biological control, effective early-season control of VCLH is critical. Based on
How to Manage Pests
UC Pest Management Guidelines

Grape

Leafhoppers

Scientific names:
Western grape leafhopper: *Erythroneura elegantula*
Variegated leafhopper: *Erythroneura variabilis*
Virginia creeper leafhopper: *Erythroneura zigzag*

(Reviewed 7/15, corrected 12/16)

In this Guideline:
- Description of the pests
- Damage
- Management
- Important links
- Publication
- Glossary

**DESCRIPTION OF THE PESTS**

The grape leafhopper is a pest of grapes north of the Tehachapi Mountains, especially in the San Joaquin, Sacramento, and North Coast valleys. It is also a problem in warmer, interior Central Coastal valleys. The variegated leafhopper is the major pest of grapes in southern California and in the Central Valley as far north as San Joaquin County. Variegated
Acknowledgements:

[Funding] CA Department of Pesticide Regulation, American Vineyard Foundation;
[UCCE] Lucia Varela, Kent Daane, Glenn McGourty, Monica Cooper, Lynn Wunderlich;
[UCR] Serguei Triapitsyn, Richard Stouthamer, Paul Rugman-Jones; [Growers/PCAs]
Numerous growers/PCAs throughout the North Coast.