

SURVEY AND MONITORING OF THE INCIDENCE AND ABUNDANCE OF A NEW LEAFMINING PEST OF WINE GRAPES IN EASTERN WASHINGTON

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Final Report 2021- 2022 Washington State Grape and Wine Research Program



1. Summary:

Leafminer damage on wine grapes was first reported from vineyards in the Tri-Cities area in September 2020. We determined that the damage was caused by a new, undescribed species of leafmining moth in the genus *Phyllocnistis*. This species is the first leafminer pest to be recorded damaging commercial wine grapes in North America.

The commercially available pheromone for the Citrus leafminer, surprisingly, was found to be an effective lure for the Grape leafminer and facilitated our surveying and monitoring in 2021. We deployed pheromone-baited white sticky traps in single vineyards in eleven eastern WA AVA's during July-September 2021. Grape leafminers were detected in six AVA's (Walla Walla, Candy Mountain, Horse Heaven Hills, Columbia Valley, Red Mountain and Snipes Mountain). Most of these detections comprised low numbers (1-20) except Columbia Valley (208) which is the AVA where the original detection of this insect occurred in 2020. These results suggest that the center of Grape leafminer distribution and abundance in eastern Washington viticulture in 2021 was focused on the Tri-Cities area within the Columbia Valley.

Two vineyards in the Tri-Cities area that harbored substantial populations of Grape leafminers in 2020, were selected for regular monitoring in 2021. Leafminers were far more abundant at one vineyard in 2021 with hundreds of leafminer adults trapped weekly during the season, with a maximum of almost 1500 (3 traps) in late June. In both vineyards numbers of adult leafminers increased rapidly in June (maximum of 1481 in one trap on June 22), before falling quickly at the end of the month into July. The decline in leafminer numbers may have been associated with the historically high temperatures that occurred in eastern WA in late June 2021. Leafminer larvae living between the upper and lower leaf epidermis likely were 'cooked' in the sun.

Our research has shown that the Grape Leafminer, a new, undescribed species, can occur in large populations in eastern Washington vineyards with much visible evidence of leaf damage. However, as of 2021, it was only abundant in a few vineyards in the Tri-Cities area in the Columbia Valley AVA. It is possible or even likely that this pest will spread in the future and for populations to increase region-wide. However, it seems likely that Grape leafminer will principally be a cosmetic leaf pest issue. Affected leaves look unsightly, but economic damage to mature grapevines is unlikely. The impact of Grape Leafminer on nursery and newly-established young grapevines could be more significant, however, and needs further study.

2. Final Report

SURVEY AND MONITORING OF THE INCIDENCE AND ABUNDANCE OF A NEW LEAFMINING PEST OF WINE GRAPES IN EASTERN WASHINGTON

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4. Objective(s) of Research

To provide information on the distribution, abundance and damage potential of a newly-discovered Grape leafminer species in commercial vineyards in eastern Washington.

To determine the seasonality of Grape leafminers in eastern Washington vineyards.

To identify and assess the incidence and abundance of parasitic wasps impacting Grape leafminer populations in eastern Washington commercial vineyards

5. Summary of Major Research Accomplishments and Results by Objective:

1. *Information on the Distribution, Abundance and Damage Potential of a Newly-Discovered Grape Leafminer Species in Commercial Vineyards in Eastern Washington*

Initial Discovery

In September 2020, we became aware of the presence of leafminer-type damage to leaves in vineyards or on backyard grapes in a few locations in the Tri-Cities area. These leaves showed serpentine-like ‘scribbles’ on primarily upper leaf surfaces, although some leaves also had lower surfaces with ‘scribbles’ (Fig. 1). This damage is usually made by dipterous (flies) or lepidopterous (moth) larvae and is common on many other plants but it is rarely seen on US grapevines and there are no known leafmining pests of grapes in North America.

Samples were collected of scribble-damaged leaves, examined, then held in the laboratory for emergence of leafminer adults. Development of the larva (which creates a mine between the upper and lower leaf surfaces by tunneling and feeding), took 7-10 days before a pupa was formed at the end of the mine (Figs. 2-3). After a further week or so, a tiny (3mm in length) adult moth emerges, confirming that it was a moth caterpillar that formed the mine and caused the scribble leaf damage.



Figure 1. Leaves damaged by leafminer in a Tri-Cities area vineyard in autumn 2020



Figure 2. A leafminer larva lives its entire life within a single mine that snakes across a leaf terminating in the formation of a chrysalis



Figure 3. The chrysalis produces an adult leafminer after a few days

A New Species

Initial investigations indicated that this leafminer moth was a species in the genus *Phyllocnistis* which contains at least two species that attack grape (*P. vitifoliella*, *P. vitigenella*). Ancestral host plants of these species appear to be wild grapes (*Vitis* spp.), but *P. vitigenella* (American Grape Leafminer) has been introduced into Europe where it has become a pest of cultivated grapes.

However, the *Phyllocnistis* species in Washington is neither of the known grape-feeding species. According to Dr Charley Eiseman, it appears to be an undescribed and unknown species (Fig. 4). Different species of leafminers usually produce unique trails on leaves and the trails can often be used to identify species. The mines produced by Washington leafminers on grapes differ significantly from those produced by *P. vitifoliella* and *P. vitigenella* on grapes.

In October 2020, I sent samples of Washington leafminer larvae, pupae and adults to Dr Eiseman. Subsequently, he sent some of this material to Dr Erik van Nieukerken in the Netherlands, who conducted genetic analyses. DNA barcoding results from these analyses confirmed that Washington Grape leafminers are a unique species of *Phyllocnistis*, separate from *P. vitifoliella* and *P. vitigenella*. Interestingly, our species has also been found damaging ornamental *Parthenocissus* (Virginia Creeper) in Nevada.



Figure 4: Undescribed adult *Phyllocnistis* Grape leafminer reared from infested leaves collected from a Tri-Cities vineyard during autumn 2020

2021 Survey

Media alerts targeted at wine grape growers were broadcast during March-April 2020 providing information on the autumn 2020 discovery of *Phyllocnistis* leafminers on grapes in eastern Washington. We encouraged growers to be watchful, examine early season shoots in spring 2021 and report to us any leafminer infestations found. We followed up all reports with on-site visits and sampling of infested leaves. Infested leaves were examined under a stereomicroscope in the laboratory for leafminers and associated parasitoids. Follow-up visits in mid and late season were made to selected infested sites to assess abundance and distribution of leafminers within vineyards and the extent of leaf damage.

In response to our publicity, we received reports of leafminer occurrence in one AVA (Walla Walla) aside from the Columbia Valley AVA in which our original infestations of leafminer were seen in 2020. Two vineyards in the Walla Walla AVA reported a ‘few’ leaves with leafminer scribbles found in 2020.

Discovery of an Effective Pheromone for Monitoring Grape Leafminer

The Citrus Leafminer (*Phyllocnistis citrella*), an important pest of citrus in the US and Australia, and in the same genus as our undescribed Grape leafminer, has a commercial pheromone available for population monitoring (Citrus Leafminer Lure: Evergreen Growers Supply).

In April 2021 we tested this pheromone in the vineyard that had most evidence of leafminer damage in autumn 2020, to see if it had activity towards grape leafminer. We used three white sticky traps each baited with a single pheromone lure. Surprisingly, it worked immediately and was very effective, trapping almost 600 adult leafminers in three traps in seven days.

Presence of Grape Leafminer in Eastern Washington Viticultural Areas

Armed with an effective attractant and monitoring tool for the undescribed Grape leafminer, we deployed pheromone-baited white sticky traps in single vineyards in eleven eastern WA AVA's during July-September 2021. Results on the incidence of Grape leafminer in these AVAs are shown in Fig. 5.

Grape leafminers were detected in six AVA's (Walla Walla, Candy Mountain, Horse Heaven Hills, Columbia Valley, Red Mountain and Snipes Mountain). Most of these detections comprised low numbers (1-20) except Columbia Valley (208) which is the AVA where the original detection of this insect occurred in 2020.

These results suggest that the center of Grape leafminer distribution and abundance in eastern Washington viticulture in 2021 was focused on the Tri-Cities area within the Columbia Valley appellation. Although the presence of Grape leafminer was detected in five additional AVA's, the numbers were small. The presence of leafminer-damaged leaves was not reported from any appellation except for Columbia Valley and Walla Walla.

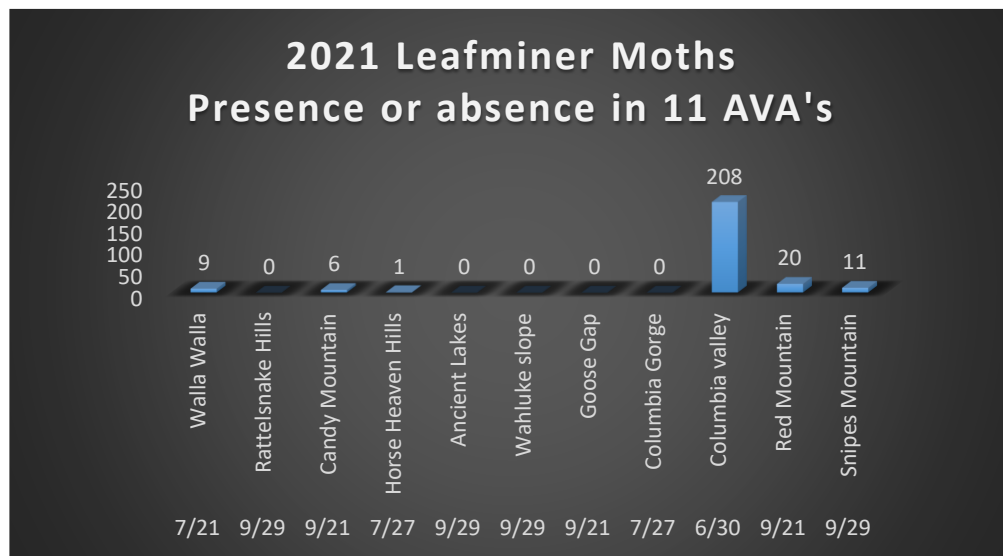


Figure 5. Incidence of adult grape leafminers in pheromone-baited sticky traps deployed for 7-14 days in a single vineyard in eleven AVA's in eastern Washington July-September 2021

The presence of very high numbers of adult leafminers in traps (Fig. 6) as well as a high density of damaged leaves in 2 vineyards in the Tri-Cities area in 2020 and 2021, suggests that this region is where the insect originated. It also appears to not be spreading very rapidly to other vineyards, but this may change in the future.



Figure 6. Adult grape leafminers on a pheromone-baited sticky trap

2. *Determine the Seasonality of Grape Leafminers in Eastern Washington Vineyards*

The two vineyards (K and W) that harbored significant populations of Grape leafminers in 2020, as judged by the incidence of damaged leaves, were selected for regular monitoring in 2021. K is located near Candy Mountain and W is in Richland. Both sites are in the Tri-Cities area.

Three pheromone-baited white sticky traps were placed in each vineyard separated by at least 50 meters. They were tied to the canopy at approximately 1.75 m above the ground and replaced weekly from April 26-September 21 2021. Retrieved traps were taken to the laboratory and stored until examined under a stereomicroscope and the number of trapped Grape leafminers was recorded.

Vines in a 30 feet length of row in two rows (at least 10 vines in total), were examined weekly for Grape leafminer damage and the number of damaged leaves were recorded.

Data on the abundance of Grape leafminers trapped during May-September 2021 at the two vineyards are shown in Fig. 7.

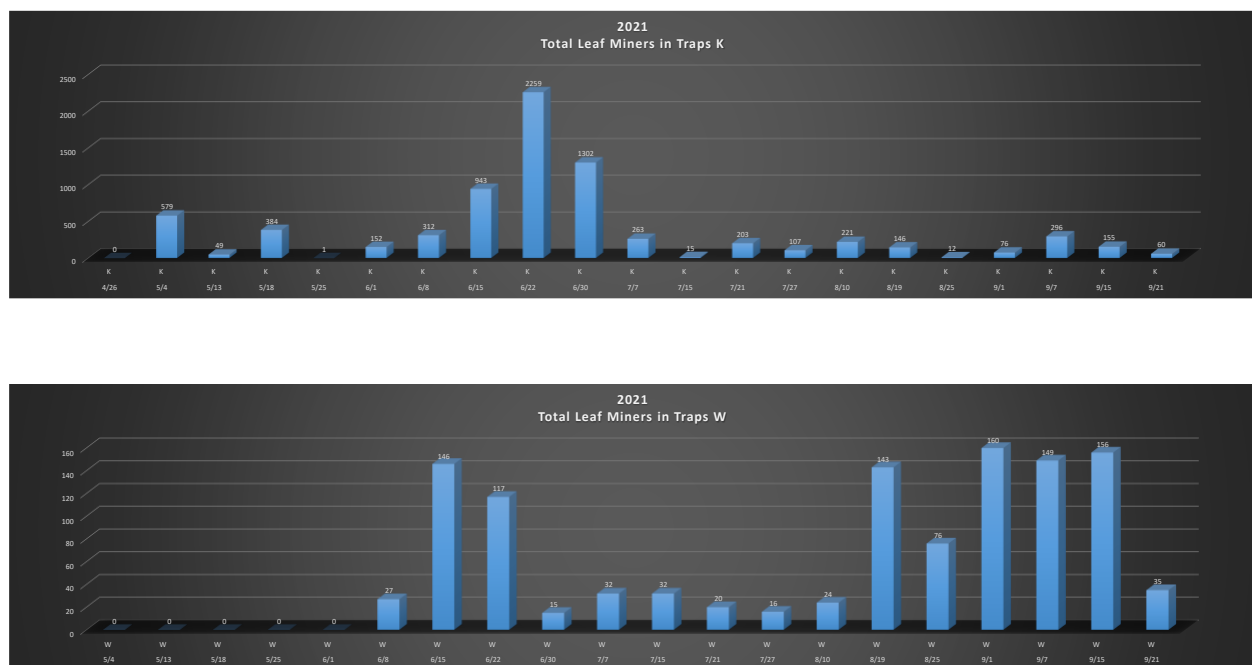


Figure 7. Total number of Grape leafminers trapped May-September 2021 at 2 vineyards (K, W) in the Tri-Cities area (note different scale for each graph).

Leafminers were far more abundant at Vineyard K than Vineyard W. At Vineyard K, traps routinely caught hundreds of leafminer adults every week during the season, with a maximum of almost 1500 in late June. In contrast, numbers at Vineyard W peaked at 160 and were sometimes

less than 50. Leafminers were present at vineyard K (May 4) a full month before they appeared at vineyard K (June 8). In both vineyards numbers of adult leafminers increased rapidly in June (maximum of 1481 in one trap at K on June 22), before falling quickly at the end of the month into July.

The late June decline in leafminer numbers which lasted for the rest of the season at Vineyard K, may have been associated with the historically high temperatures that occurred at that time when there were multiple days of temperatures exceeding 110 F in eastern Washington, peaking at almost 120 F. Under these extremely high temperatures, some grape leaves were scorched and it is easy to imagine that leafminer larvae living between the upper and lower leaf epidermis would be fried! However, studies are needed to confirm this.

In a season with seasonally average temperatures, there may not be the substantial reduction in leafminer populations as occurred in 2021 (Fig. 8).

Examination of the trap data and observations on development of leafminer larvae in the laboratory, indicate that this species goes through a generation (egg to adult) in as little as 14 days. Thus, there may be 10 generations of leafminers in vineyards during May-September. This would explain the very high numbers seen at Vineyard K in autumn 2020 and adds weight to the idea that excessive heat inhibited populations in 2021.



Figure 8. Adult Grape leafminers trapped May-September (combined data from vineyards K and W).

Despite the very large population of adult leafminers in Vineyard K, the number of mined leaves remained fairly low, never exceeding 12 per sampling (10 vines). Interestingly, even though adult leafminer numbers were substantially smaller at Vineyard W, a similar number of mined leaves were found compared to Vineyard K (Fig. 9). No mined leaves were seen at Vineyard W until early July, reflecting the lower numbers of adult leafminers. This is in contrast to Vineyard K, where a larger population of adults resulted in mined leaves being found all season from May onwards.

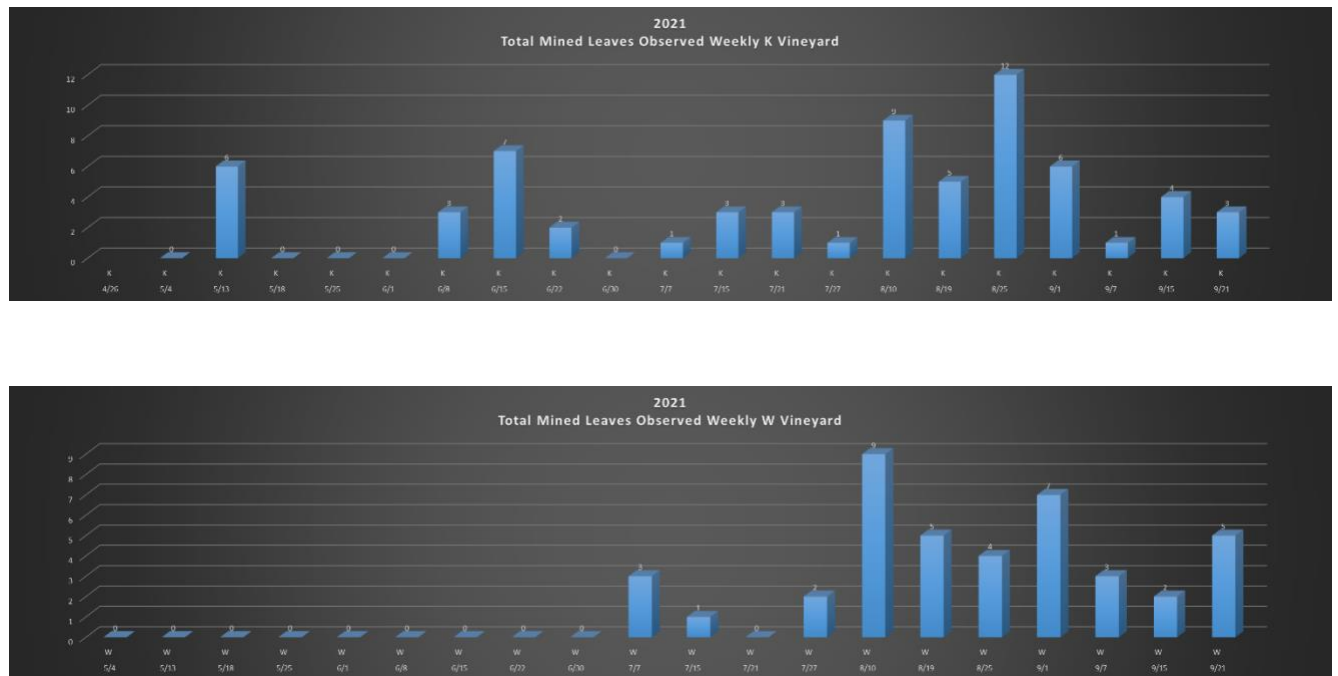


Figure 9. Number of leafminer-mined grape leaves at Vineyards K and W during May-September 2021

3. Identify and Assess the Incidence and Abundance of Parasitic Wasps Impacting Grape Leafminer Populations in Eastern Washington Vineyards

Samples of leafminer-infested leaves collected during May-September 2021 from Vineyards K and W, did not reveal any parasitoids. This is in contrast to limited samples taken in autumn 2020 from Vineyard K which showed the presence of a parasitoid species (Fig. 10).

This is a wasp in the genus *Closterocerus* in the family Eulophidae, members of which specialize in attacking concealed larvae like those of leafminers. Further work is needed to determine the importance of this wasp in regulating Grape leafminer populations. It is possible that this parasitoid like the Grape leafminer, is also an undescribed species.



Figure 10. A wasp parasitoid (*Closterocerus* sp. (Eulophidae)) parasitizing Grape leafminer in the Tri-Cities, WA (2020).

Conclusions and Prognosis

The Grape leafminer, a new, undescribed species in the genus *Phyllocnistis*, is capable of producing large populations in eastern Washington vineyards. However, as of 2021, it is only abundant in a few vineyards in the Tri-Cities area in the Columbia Valley AVA. Small populations were also found in other nearby AVAs (Walla Walla, Snipes Mountain) and also AVAs within the area of the Columbia Valley AVA (Red Mountain, Candy Mountain, Horse Heaven Hills).

It is possible or even likely that this pest will spread to other AVAs in the future and for populations to increase. It seems likely that Grape leafminer will principally be a cosmetic leaf pest issue. Damaged leaves look unsightly, but economic damage to mature grapevines is unlikely.

However, the impact of Grape leafminer on nursery and newly-established young grapevines could be more significant. Heavy infestations could cause stunting and poor growth of vines. There is also the possibility that Grape leafminers could transmit bacterial and viral diseases. There is some precedent to this with the related species, *Phyllocnistis citrella*, known to exacerbate some citrus diseases.

Importantly, this study has demonstrated that Citrus leafminer pheromone is an effective lure for monitoring *Phyllocnistis* Grape Leafminer. Thus, pheromone-baited sticky traps will provide an effective tool for monitoring the distribution, abundance and phenology of Grape leafminer in the future.

4. Outreach and Education Efforts - Presentations of Research:

To date, outreach and education has primarily involved the publication of an article in the WSU Viticulture and Enology Newsletter and communications with individual growers in eastern Washington. Collaboration and cooperation with these growers was instrumental and key to our success in achieving a good outcome to this research.

James, D. G. (2020). Leafminers: A new insect in Washington vineyards. Washington State University Viticultural and Enology Extension News Fall p. 3.

5. Research Success Statements

This research benefits the viticulture industry in Washington by ensuring growers are well-prepared for understanding and managing a new and potentially important leafminer pest of wine grapes. Our research has achieved its aim of providing information on this newly-discovered potential pest of WA grapes, including data on distribution and abundance. We also determined seasonality of the pest along with the important discovery of an effective tool for future monitoring.

6. Funds Status

Fully expended, in the manner outlined in the proposal budget.