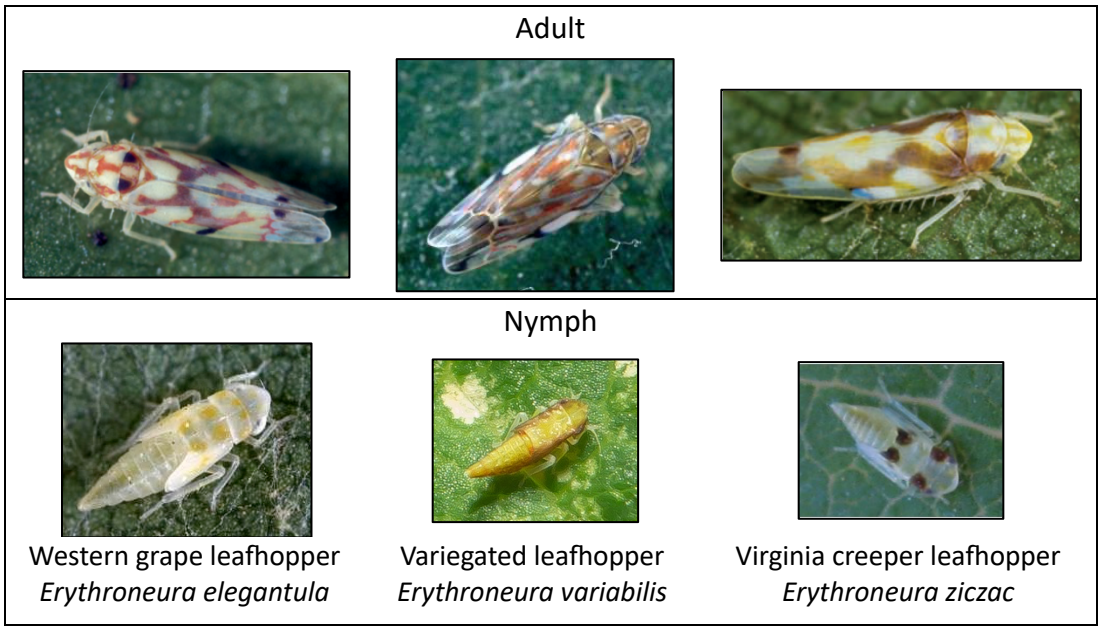
Managing invasive leafhoppers in organically farmed vineyards

Monica L. Cooper, ANR Advisor-Viticulture

Two invasive species, variegated leafhopper (*Erythroneura variabilis*) and Virginia creeper leafhopper (*Erythronuera ziczac*) have become more prevalent in Napa County. In some instances, they have become an entrenched issue, particularly in organically farmed vineyards.



Unlike western grape leafhopper (*Erythroneura elegantula*), which is native to California, the invasive leafhoppers are poorly controlled by resident natural enemies, principally *Anagrus* spp. wasps that parasitize leafhopper eggs. For variegated leafhoppers, parasitism is reduced because of the location of eggs within the leaf tissue. In the North Coast, *Anagrus* spp. have not adapted to recognize Virginia creeper eggs as a potential host.

In the absence of sufficient biological control, management of variegated and Virginia creeper leafhopper relies on other tools. Historically, pyrethroid-based insecticides have been the principal control option in organically farmed vineyards. However, concerns about their broad-spectrum activity and toxicity to natural enemies precipitated the search for alternatives.

Leafhoppers feed in leaf mesophyll and are active on grapevines during the growing season. They overwinter as adults, seeking shelter in leaf litter on the vineyard floor. During the winter, variegated and western grape leafhoppers are in a reproductive diapause. The diapause is broken when they feed on grape tissue in the spring. In contrast, Virginia creeper leafhopper does not have a reproductive diapause. This is an important biological distinction, because it means that Virginia creeper leafhopper lays eggs *earlier* in the growing season than western grape or variegated. This also means that the Virginia creeper eggs laid in the spring begin hatching 10 to 14 days earlier than variegated or western grape eggs.

For western grape leafhopper, parasitism rates of 10-30% of 1st generation eggs by *Anagrus* spp. may result in suppression of 2nd and 3rd generations, reducing the reliance on chemical interventions. Thus, the historical practice for western grape leafhopper was to monitor first-

generation eggs for parasitism and determine whether further action was needed. Limited parasitism of the invasive leafhopper species has necessitated a shift in strategy, particularly in organically farmed vineyards, where interventions must now target the 1st generation nymphs to reduce subsequent generations. Failure to reduce the 1st generation nymphs can lead to large population outbreaks and late-season defoliation at a critical time in the ripening cycle. Late-season interventions are less successful mainly because leafhopper generations are overlapping, making it more difficult to target the correct life stage.

Research trials conducted in Mendocino County vineyards by emeritus IPM Advisor, Lucia Varela, demonstrated the potential for crop oils for leafhopper management, targeting nymphs of the 1st generation. These oil applications were most effective against young-instar nymphs.

In 2021 and 2022, we had similarly positive results with crop oils in demonstration trials in Napa County. In early May, we started weekly monitoring of grape leaves. Detection of the first nymphs triggered the first oil application. In 2021 and 2022, we found the first Virginia creeper nymphs in mid-May, just before bloom. In 2023, we found our first Virginia creeper nymphs in late May; although a later calendar date, phenologically this still coincided with bloom. We found the first variegated and western grape nymphs at the end of May in 2021 and 2022, and in early June in 2023, approximately 14 days later. In vineyards with all three leafhopper species, egg hatch continued from mid-May through the end of June in 2021 and 2022. During the period that eggs were hatching, we made three applications of crop oil at roughly 14-day intervals, targeting young-instar nymphs.

Egg hatch is closely tied to vine phenology because leafhoppers feed and lay eggs on leaves. Within a ranch, leafhopper phenology follows vine phenology: nymphs are found earlier in blocks with early budbreak, and later in blocks with later budbreak. Therefore, vine phenology guides monitoring efforts for egg hatch and treatment timing should follow leafhopper biology.

In addition to timing, the other important consideration when using crop oils is rate. Although it is widely believed that anoxia (suffocation) is the primary mode of action of crop oils, studies have shown that it is more likely to be a nerve toxin[1]. The lipophilic properties of oil allow the molecules to rapidly penetrate the insect cuticle and accumulate in the lipid-containing tissues, mainly of the nerve ganglia. Toxicity symptoms include loss of mobility, abdominal contractions, and dehydration. At lower rates, oils can be detoxified in the insect's fat bodies; younger nymphs have smaller fat bodies than older nymphs and adults. Thus, an application rate of at least 2% oil is required to obtain toxicity, and young instars are the most susceptible stages.

In summary, crop oils are a tool for leafhopper nymph suppression. They must be used at the appropriate timing for the 1st generation: in spring, as nymphs are hatching from eggs. And at the appropriate rate: at least 2% concentration[2]. Monitoring and application timing should consider vine phenology and recognize differences between cultivars. Multiple applications are typically needed to obtain sufficient suppression. Good application practices should be followed to ensure accurate and thorough coverage. Access additional educational resources on the UCCE-Napa Viticulture website: https://ucceviticulturenapa.wixsite.com/uccevitnapa

[1]Najar-Rodriguez et al. 2008. Food and Chem. Tox. 46: 3003-3014

[2]Nile et al. 2019. 10.1007/s11356-019-05509-z