

## OPPORTUNITIES FOR REDUCING PESTICIDE USE IN MANAGEMENT OF LEAFHOPPERS, CUTWORMS AND THRIPS

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Grape entomology research at WSU-Prosser is focused on understanding the biology of grape pests and their natural enemies so that biological and cultural strategies may be used in addition to chemical strategies, to manage them more effectively with less pesticide and less cost. In the three years since this program began, we have improved our knowledge of grape pest/natural enemy biology and are beginning to formulate better management strategies based on this knowledge. Here, I outline some of these advancements with respect to three important grape pests, leafhoppers, cutworms and thrips.

### Grape Leafhoppers

Washington grapes are host to two leafhopper species, the Western Grape Leafhopper (WGLH), *Erythroneura elegantula*, and the Virginia Creeper Leafhopper (VCLH) *Erythroneura ziczac*. Despite a wealth of information on egg parasitism of WGLH in California and its incorporation into leafhopper management programs there, very little was known until recently about egg parasitism of WGLH and VCLH in Washington. Previously, it was thought that a single species of parasitic wasp (*Anagrus epos*) was responsible for parasitism of WGLH and VCLH eggs in Washington. Research since 1999 has shown that there are three species of *Anagrus* (*A. erythroneurae*, *A. daanei* and *A. tretiakovae*) responsible for parasitizing grape leafhoppers in Washington. *Anagrus erythroneurae* and *A. tretiakovae* appear to be the most important biocontrol agents of WGLH, while *A. daanei* seems to be the most important species for VCLH. The incidence, distribution, seasonality, alternate leafhopper hosts and rates of parasitism of these *Anagrus* spp. have been studied in all eastern Washington grape regions during the past two seasons. Consequently, we now have a good understanding of their importance in natural regulation of grape leafhoppers and their value to grape growers in leafhopper management. Our research also identified the existence of additional, significant egg mortality of leafhoppers produced by an as yet unknown cause or causes. A complex of general predators (e.g. whirligig mites, predatory bugs, lacewings, lady beetles, spiders) has also been identified as an important source of mortality for leafhopper nymphs and adults on Washington grapes.

*Anagrus* egg parasitoids are capable of causing substantial mortality (up to 100% parasitism) to leafhopper populations during August and September. However, this biological control is invariably too late to be of practical use for managing WGLH and VCLH. Parasitism of the first leafhopper egg generation in spring is rarely greater than 10-15%, regardless of pesticide input. A key feature of the biology of *Anagrus* spp. is their need to overwinter as immature stages within leafhopper eggs. Unfortunately WGLH and VCLH overwinter as adults, thus *Anagrus* parasitoids must leave vineyards in autumn to find alternate

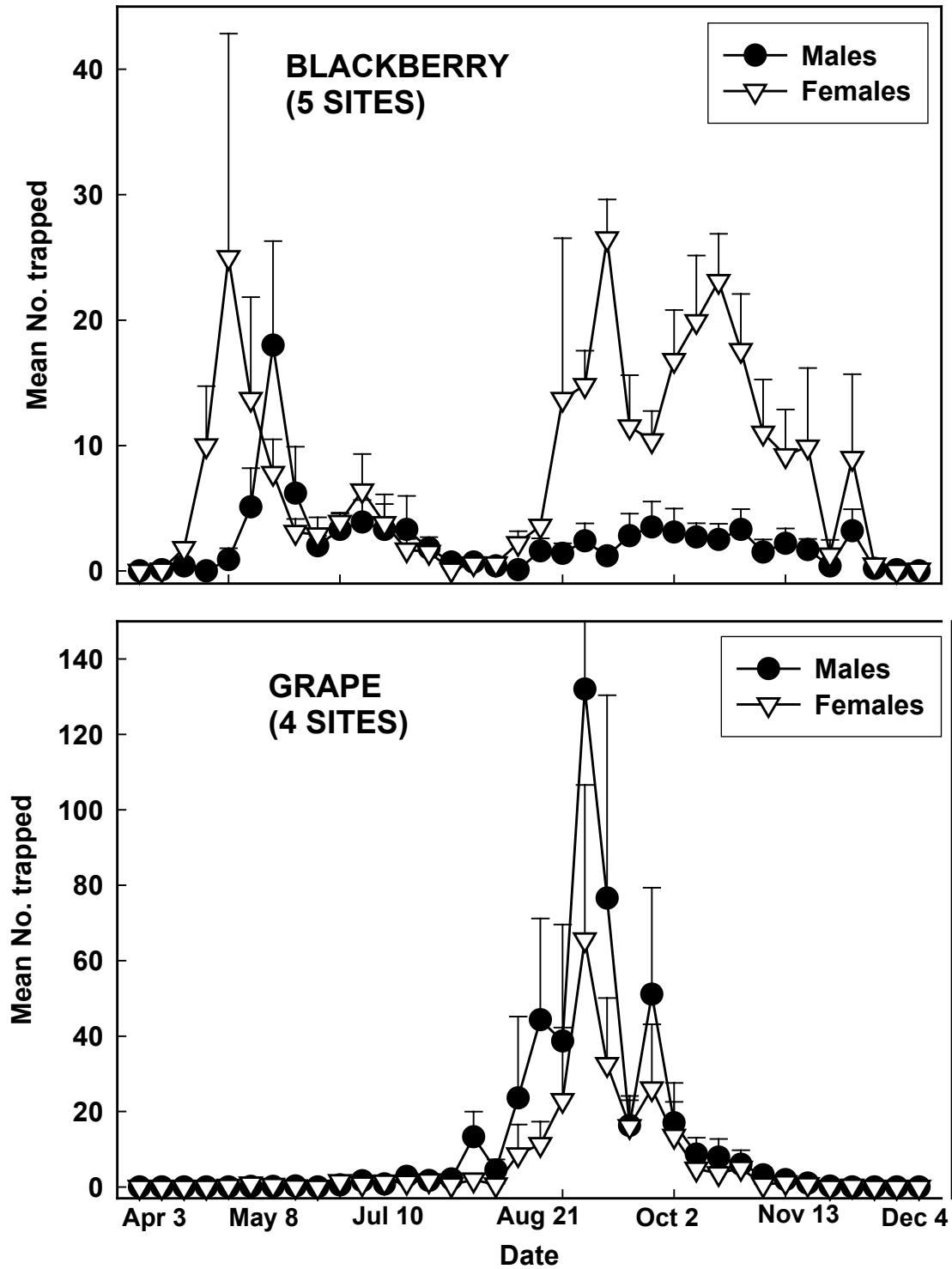


Fig. 1. Phenology of *Anagrus* spp. populations in blackberry and grape in 2001 as determined by mean weekly sticky trap captures.

leafhopper hosts which overwinter as eggs. Our work has shown that in eastern Washington, rose leafhoppers (RLH), *Edwardsiana rosae*, and white apple leafhoppers, *Typhlocyba pomaria*, overwintering as eggs on blackberry or roses (wild or domesticated), are important alternate hosts for *Anagrus* spp. *Anagrus* are common in blackberries and wild roses during spring but rare in vineyards at this time (Fig. 1). The proximity of blackberry and rose to vineyards is likely to be a significant factor influencing dispersal of *Anagrus* to vineyards during spring. *Anagrus* wasps complete their development in leafhopper eggs within a week or so and are able to produce three or four generations within the time it takes WGLH and VCLH to produce one generation. Consequently, *Anagrus* populations expand rapidly once established in vineyards. Parasitism of 30% in the first generation of leafhopper eggs in May/June is sufficient in California to prevent subsequent generations from becoming damaging. If parasitism of leafhopper eggs can be increased in the first generation from 10-15% to 30%, then chemical control of the second generation of nymphs may not be necessary.

Roses have been cultivated in and around vineyards in Europe and Australia for many years and for many reasons including signifying ownership and as an indicator for powdery mildew. I propose a further reason for growing roses near to vineyards in Washington: to provide an overwintering resource for *Anagrus* wasps and an enhancement for biological control of grape leafhoppers.



We are currently looking closely at the potential for roses planted adjacent to vineyards to recruit autumn populations of RLH and *Anagrus* and to determine how effectively this increases the rate of parasitism in spring populations of grape leafhoppers.

RLH populations during summer occur on a wide variety of crop and ornamental hosts but appear to overwinter only on roses and closely-related plants. Consequently, domestic roses in the Columbia Basin at least, attract large numbers of RLH during autumn. It is anticipated that *Anagrus* wasps follow RLH to roses from summer hosts as well as from vineyards. Data collected during autumn 2002 indicate that this is the case with all three species important for WGLH and VCLH parasitism trapped on sticky cards placed in rose bushes in back yards and adjacent to vineyards. Further sampling during winter and spring 2003 will reveal how successful the rose strategy is for enhancing spring colonization of grapes by *Anagrus* and subsequent parasitism of leafhoppers. If you decide to try this strategy for yourself, remember that the roses must not be pruned until after leafhopper and *Anagrus* emergence, which usually occurs in April. Overwintering RLH eggs are inserted into rose canes, so normal winter pruning would remove most of the leafhopper and *Anagrus* populations.

The use of broad-spectrum insecticides like Provado, Admire or Dimethoate for grape leafhoppers increases the chances of mites, mealybugs and thrips becoming pest problems later in the season increasing pesticide use and costs. Up until now, no 'soft chemical' option, that is, an insecticide which kills leafhoppers but does not kill beneficial insects and mites, has been available for leafhopper control. Fortunately, this has now changed and there is a good insecticide available for effective leafhopper control that also has minimal impact on predators and parasitoids. It is an insect growth regulator, buprofezin, marketed by Nichino America as APPLAUD. I strongly recommend the use of this product when it becomes necessary to spray for leafhoppers. We are currently conducting tests with Applaud against beneficials but already we know that it is safe to predatory mites, the mite-eating lady beetle, *Stethorus* and the minute pirate bug, *Orius tristicolor*, a predator of leafhopper nymphs, thrips and mealybugs. I also expect it to be harmless to *Anagrus* wasps. Applaud also possesses activity against mealybugs. Registered for use on grapes in spring 2002, Applaud represents a significant advancement in grape IPM in Washington, by providing a chemical tool largely compatible with IPM and biological control. Its use will lead to reduced overall pesticide inputs by not inducing outbreaks of secondary pests like spider mites.

### **Cutworms**

Cutworms are the larvae of a large group of brown/gray moths that generally feed on broad-leaved weeds and other low-growing plants. However, some species are prone to climb a little higher in their search for food and young foliage and buds of grapes during spring are vulnerable to cutworm attack. Cutworms are often a local and sporadic problem with some vineyards or parts of vineyards more prone to damage than others. We know little about the identity and biology of cutworm species damaging grapes. It has been thought that two species, the spotted cutworm and the redbacked cutworm are the only damaging species, but recent observations indicate that other species are involved as well. Cutworms overwinter as either eggs or young larvae and are very difficult to monitor during early spring because of their small size and cryptic/nocturnal behavior.



Control is usually achieved by applying broad-spectrum insecticides. No chemical effective against cutworms, but ‘soft’ on beneficials is available, but minimization of disruption by broad-spectrum insecticides can be achieved by directing sprays to the ground and lower trunk instead of to the entire vine architecture. Treating only areas of vineyards with significant cutworm infestations is also suggested. Encouraging and maintaining a vineyard ground cover during spring that has a large component of broad-leaved weeds will, in many instances, minimize cutworm movement onto vines. Ground covers will also attract and provide residence for predators like ground beetles and parasitic wasps. Removing weed-dominated ground covers during spring is often followed by major damage to grapes by food-deprived cutworms. Other non-chemical strategies for preventing/reducing damage by cutworms include the use of sticky trunk bands and using an air blast sprayer to blow cutworms off of vines at night into collection buckets. More research is needed on the identity and biology/ecology of cutworm species that damage grapes. A promising area of research is the use of attractants or sex pheromones to monitor the vineyard abundance of adult cutworms during late summer and autumn, to identify ‘hot spots’ of moth activity that may represent potential locations of cutworm abundance and vine damage in the following spring.

### **Thrips**

Thrips, like cutworms, are usually a local and sporadic pest of grapes in Washington and do not require treatment in every vineyard in every season. There are two species of thrips that damage grapes, the Western Flower Thrips, *Frankliniella occidentalis* and the Grape Thrips, *Drepanothrips reuteri*. The western flower thrips is also a minor predator

of mite eggs and mealybug crawlers. Although precise thresholds have not been established for thrips on grapes in Washington, it is clear that relatively large numbers need to be present to cause stunting damage to buds and shoots. In addition, there is usually a relatively small window of opportunity for significant damage to occur in early spring just after bud burst. This window is prolonged if conditions are cool but if conditions are warm, vine growth is rapid and susceptibility to thrips damage is minimized. Thrips will often migrate into vineyards from adjacent weedy areas or sagebrush and outside rows are most often affected

Dimethoate applied for thrips control kills most beneficial insects and mites and should be avoided if possible. Minimize adverse impacts by spraying only outside rows, 'hot spots' or alternate rows. A new insecticide, Surround, is now registered for thrips control on grapes. This product has kaolin as the active ingredient and forms a mineral-based white particle film on sprayed leaves. Surround only suppresses thrips populations but this may be sufficient to avoid economic damage. It is unclear how harmful Surround is to predators and parasitoids but it is likely to be less disruptive to biological control than Dimethoate.

### **Conclusions**

The early season use of broad-spectrum insecticides for control of leafhoppers, cutworms, thrips and mealybugs, represents the greatest barrier to development of integrated pest management (IPM) in Washington grapes. The use of insecticides like Lorsban, Carbaryl, Dimethoate, Provado and Admire during April-June has a dramatic suppressive effect on natural enemy populations which extends through the rest of the season. Consequently, secondary pests like spider mites, normally held in check by predators, can reach outbreak levels, requiring treatment. Avoidance of the use of these insecticides or substitution with more targeted chemicals like Applaud, is the single biggest step which can be made towards development of IPM. Once predators and parasitoids become part of overall pest management programs in grapes, the need for pesticide inputs will decline. Better pest management will be based on limited use of selective insecticides and miticides that will complement the activities of predators and parasitoids. As outlined here, these activities may be enhanced by cultural strategies such as growing roses as an overwintering habitat for leafhopper parasitoids and allowing broad-leaved weeds to serve as a food source for cutworms.

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