

Management of Grape Insect and mite pests-2009

Greg Loeb
Department of Entomology
Cornell University
New York State Agricultural Experiment Station
Geneva, NY 14456

The 2008 field season was an average year with respect to insect and mite pests in the Finger Lakes and Lake Erie regions. Japanese beetles were abundant again but serious defoliation was variable from site to site. A similar story for grape berry moth and spider mites; treatable damage at some sites but overall not particularly serious. Leafhoppers, including potato leafhopper, were generally not at sufficient densities to warrant insecticide treatment. The 2009 field season has now started and as I am writing this (12 May) I have noticed some of the usual early-season suspects: grape plum moth and plant bugs. Prospects for the remainder of the field season are always somewhat of an open question. With insect and mite pests, anyway, it pays to monitor and only apply pesticides when necessary. For some sites, you may not need to apply any insecticides saving you money and potentially reducing disruption of natural control agents.

In preparation for the 2009 growing season, in this article I review the major arthropod pests of grapes, providing a brief summary of their biology and the damage they cause, including any new information that is available, and then a discussion of control options. This information is similar to past spring updates with some modifications due to new research or changes in pesticide availability (e.g. sections on mealybugs and soft scale, grape berry moth, Japanese beetle). You may want to skip to the end where I provide some bottom line thoughts focused on our key pests. The material I present is based on the work of many people at Cornell and elsewhere. I work closely with Rick Dunst and Ted Taft Jr. and the rest of the crew at the Fredonia Vineyard Lab, Tim Weigle of the NY IPM Program, Hans Walter-Peterson, Alice Wise, and Dan Gilrein from Cornell Cooperative Extension, Peter Jentsch from the Hudson Valley, Andy Muza from Penn State Cooperative Extension and Steve Hesler (my research support specialist here at Geneva). Before reviewing the pests I want to briefly provide an update on insecticide and miticide news.

Insecticide and miticide news

There are a few additional insecticides to be aware of that are becoming available for control of grape pests. Lets start with a new group of insecticides termed anthranilic diamides that have a novel mode of action affecting a part of the insect nervous system involving calcium channels leading to muscular paralysis. This class of insecticide is typically selective against Lepidopteran insects (e.g. grape berry moth) but also have some efficacy against other insect orders. Three companies are marketing insecticides based on anthranilic diamides:

Dupont has Altacore [chloranthraniliprole] (EPA # 352-730, Signal Word = Caution, REI = 4 hours, DTH = 14 d). It currently has grape berry moth and climbing

cutworm on the label, although some of our tests indicate some efficacy against Japanese beetle. We will get more information on this during the 2009 season. *Altacore has a federal label so is available for PA but has yet to receive NY approval.* Altacore is relatively easy on beneficials.

Bayer has Belt SC [flubendiamide] (EPA # 264-1025, Signal Word = Caution, REI = 12 hours, DTH = 7 d). Belt currently does not have grape berry moth on its label although our trials indicate good efficacy and I expect grape berry moth will be added. *Belt is currently not labeled in NY.* Belt is relatively easy on beneficials.

Finally Syngenta has Voliam flexi [chlorantraniliprole as in Altacore and thiamethoxam] (EPA # 100-1319, Signal Word = Caution, REI = 12 hours, DTH = 14 d). Voliam flexi combines an anthranilic diamide for control of Lepidoptera with a neonicotinoid that provides good control of sucking insects and some beetles. The label includes grape berry moth, leafhoppers, mealybugs, phylloxera, and Japanese beetle. *Voliam flexi currently is not labeled in NY.* Voliam flexi is relatively easy on beneficials.

There are a couple of other new insecticides that have recently received labels worth mentioning here. Delegate WG [spinetoram] (EPA # 62719-541, Signal Word = Caution, REI = 4 hours, DTH = 7 d), is a next generation material related to Spintor [spinosad] that is selective against Lepidoptera like grape berry moth as well as thrips. It is easy on beneficial arthropods. It is reported to have longer residual activity than Spintor, which would be a nice improvement. In our insecticide trial in 2008 Delegate performed well, although pressure was not high.

I also wanted to mention another insecticide, Leverage 2.7 (EPA # 264-770, Signal Word = Warning signal word, REI = 12 hrs, DTH = 3, Restricted use) that combines two insecticides: a neonicotinoid imidacloprid and a pyrethroid cyfluthrin. Imidacloprid (same active ingredient as in Provado or Admire) is effective against sucking insects and some beetles and cyfluthrin (same active ingredient as in Baythroid) is a broad-spectrum pyrethroid effective against many orders of insects. Hence the label includes grape berry moth, cutworm, flea beetle, and mealybugs among others. The broad-spectrum activity also means it will be hard on beneficials.

Finally, there is one other interesting new insecticide that is coming on the market called Movento [spirotetramat, EPA # 264-1050, Signal Word = Caution, REI = 24 hours, DTH = 7]. Movento is systemic in activity, being applied to the foliage and then translocated throughout the plant, including the roots. It has a novel mode of action and seems particularly effective against some sucking insects such as mealybugs and phylloxera. Movento works best when an adjuvant is used to aid in leaf penetration. Stylet oil is probably the most effective adjuvant (0.25% V:V) with Movento but you must be careful using this in combination or near use of captan and/or sulfur as this will lead to phytotoxicity. The adjuvant Induce is prohibited with Movento when fruit is present due to adverse plant compatibility. Consult labels for more information. *Movento is not yet labeled in NY.*

Review of key arthropod pests

There are over 30 insect and mite pests that attack grapes in New York, although many of these are rarely abundant enough to be of economic concern. In this review I will focus on the key grape pests that have a moderate to large pest potential. Where pertinent, I will indicate if there is variation in pest potential for different parts of the state or for particular cultivars. I will briefly go over basic biology and symptoms of damage and then discuss some of the control options available. More details on control measures can be found in the New York and Pennsylvania Pest Management Guidelines for Grapes: 2009 now on line [<http://ipmguidelines.org/grapes>]. And of course, before applying any chemical control measure make sure to read the label, taking into account things like potential for phytotoxicity, labeled pests, re-entry and days to harvest intervals, effects of pH, and compatibility with other pesticides. I will present pests in the order they tend to show up in the vineyard during the season (budbreak, pre bloom, post bloom, and mid-season). Because arthropods are generally detectable in the field before they cause economic injury and insecticides and miticides mostly work as eradicants and can be costly, it is advisable to monitor pest densities and only apply control measures when economically justified. To aid in correct identification of pests in the field, consider purchasing a handy pocket-sized guidebook put out by Michigan State University that covers many of the arthropod pests (and diseases as well) that can be problematic here in NY and Pennsylvania. Find out more at <http://www.ipm.msu.edu/GrapePocket.htm> or call 517-353-6740.

Budswell to Bloom

Grape Cane Borer. In the fall the adults of this beetle bore tunnels into live 1 and 2-year old canes to create a place to spend the winter. Although this damage doesn't generally kill canes, they may be weakened and break during the growing season. In addition, experimental results indicate tunnels may reduce yield on a cane for some cultivars. In many cases damaged canes can be removed at pruning, although this adds time to the process. Historically, grape cane borer (GCB) problems have been most severe around Keuka Lake in the Finger Lakes Region, although we are finding more GCB evidence around some of the other Finger Lakes and also in the Lake Erie Region. The larva of GCB develops in dead wood and does not cause economic damage. However, since larvae grow into adults it makes sense to try and limit reproduction. Dead wood in the grape canopy, on the vineyard floor, or in burn piles are all good food sources for GCB larvae. My sense is that destroying as much of this dead wood as possible through chopping in the vineyard or burning before larvae have a chance to mature (end of July) helps reduce GCB adult populations in the fall, although we do not have a lot of data yet to back this up. Adults become active in the spring as temperatures warm up, especially evening temperatures, and sap begins to flow (probably as early as budswell). Egg laying gets started about budbreak and continues well into June. The eggs are placed under bark and appear well protected. Our current approach to controlling GCB is to target an insecticide (Imidan 70W is the only material labeled right now) against the spring adults in order to reduce reproduction and overall population levels. Generally speaking, our small plot trials have not found Imidan or other insecticides applied in the spring to be

particularly effective at reducing damage in the fall/winter. Hence, we are still searching for a more effective chemical control option. It is possible that vineyard wide application of Imidan in the spring, over time, could be beneficial, but we have not been able to conduct such large-scale trials to verify this. Note that a fact sheet on GCB is available via a pdf file on the web [<http://nysipm.cornell.edu/factsheets/grapes/pests/gcb.pdf>].

Steely Beetle (grape flea beetle) and Climbing Cutworm. The adult steely beetle (shiny black or dark blue in color) overwinter as adults and become active as temperatures increase in the spring. They feed on swollen buds prior to budbreak with the potential of causing considerable damage under the right conditions; specifically when we get a prolonged swollen bud stage. Look for damage from steely beetle along the edges of the vineyard. Climbing cutworm refers to larvae of several species of Noctuid moths that cause a similar type of damage as steely beetle. Larvae hide during the day in the leaf litter or grass below the vine and then climb up into vine to feed on buds on warm evenings. Grass under the vine may increase problems from cutworms. Use about 2% bud damage from either species as a threshold for treatment. Some hybrids with fruitful secondary buds and that tend to overcrop can probably handle higher damage levels. Note that shortly after budbreak, steely beetles and cutworms do not cause damage. Later in the season steely beetles lay eggs that hatch into larvae that do feed on grape leaves but this damage is not economically important. There are several effective, broad-spectrum, insecticides labeled for steely beetle in grapes including Sevin, Imidan, and Danitol. Sevin, Danitol and Capture are labeled for use against cutworms.

Soft scales and Mealybugs. Soft scales and mealybugs are sucking insects that spend part of their life-cycle on the canes or the trunk and part out on leaves or fruit. At high densities they can reduce vine vigor or contaminate grape clusters with their sugary excrement, which supports the development of sooty mold. However, the major concern with soft scales and mealybugs in our area relates to their potential to vector leafroll virus, a serious disease of grapevines (a fact sheet on leafroll virus is available at http://nysipm.cornell.edu/factsheets/grapes/diseases/grape_leafroll.pdf . Soft scales in our area overwinter on canes as large immatures or young adults. At this stage they vary in shape and color but are typically brown or gray and look like bumps or large scales on the canes. They have limited ability to move at this stage. As the spring progresses they complete development and begin laying eggs (mid-May to mid-June), often many hundreds to over a thousand per female. The eggs hatch into mobile crawlers that disperse out on to the foliage to feed. Most of the scale insects in our area have just one generation per year. As they mature during the season they move back to the canes to overwinter. The grape mealybug overwinters on canes or trunks as a small immature, initially moving out from trunk wood to first or second year wood in spring (at budswell). These crawlers like to hide under loose or cracked bark; look where one-year canes have been bent over trellis wire. As they become adults they move back to the trunk region to lay eggs. The cycle is repeated a second time during the season for two generations per year. They are oval-shaped with a white waxy covering that extends beyond the body all around as filaments. They also have a pair of extra long filaments that extend at the rear. Mealybugs and soft scales, but particularly mealybugs, are often tended by ants. Mealybugs are able to move around the vine more than soft scales, although they are

slow movers.

From the standpoint of reduced vigor, we do not believe most growers have sufficient soft scale or mealybug pressure to warrant control with insecticides. Their role as vectors of grapevine leafroll associated viruses is less clear. Marc Fuchs, virologist at NYSAES, has quantified some cases where virus has increased within a vineyard and vectors may be responsible. With this caveat, there are two times during the season to control soft scale and mealybugs: the dormant period prior to budbreak and during the growing season when crawlers are hatching and actively moving around. Oil during the dormant period smothers the overwintering stage of the soft scale or mealybug. During the growing season carbaryl is labeled for European fruit lecanium, a species of soft scale on grapes, and an insect growth regulator called Applaud [buprofezin] is labeled for both soft scale and mealybugs. *Note that Applaud is not legal to use on Long Island.* A number of additional insecticides are labeled for mealybugs but not soft scales including Provado [imidacloprid], Assail [acetamiprid] and Imidan [phosmet]. Timing these foliar applications is difficult. For the scale insects, crawlers are active after bloom (around July 4th in 2006). For mealybugs, first generation eggs hatch in the middle or later part of July. Egg hatch for the second generation is in late summer. It is important to note that we do not have good data either on the effectiveness of these insecticides and more importantly, whether controlling them will help stop spread of the virus. We are initiating a new study this season to examine both these issues.

Banded Grape Bug and Lygocoris Bug. Both species overwinter as eggs in grape canes, emerging as nymphs shortly after budbreak to 5 inch shoot growth. The banded grape bug (BGB) nymph is greenish to brown in color with black and white banded antennae. Nymphs of Lygocoris are pale green with thin antennae and about half the size of BGB. Nymphs of both species can cause economic damage by feeding on young clusters (buds, pedicel and rachis) prior to flowering. Adults, which appear close to bloom, do not cause economic damage and for at least one of the species (BGB), become predaceous on small arthropods. There is only one generation per season. Monitor for nymphs at about 5 inch shoot stage by examining flower buds on approximately 100 shoots along the edge and interior of vineyard blocks. These plant bugs are sporadic from year to year and from vineyard to vineyard; most vineyards will not require treatment. But if present at sufficient numbers (1 nymph per 10 shoots), they can cause significant yield reductions and hence it is worth the time to check. Pay particular attention to vineyard edges. There are several insecticides labeled for use against plant bugs (Imidan, Danitol, and Assail [only BGB on label]).

Grape Plume Moth. This is another potential pest of grapes that overwinters as eggs in canes and emerges shortly after budbreak. Larvae typically web together young leaves or shoot tips and leaves to form a protective chamber from which they feed. Sometimes the flower buds get caught up in the webbing and get fed on and this is where the potential for damage occurs. Research indicates 1) that damage tends to be concentrated on the vineyard edge near woods and 2) that it takes quite a few plume moth larvae to cause economic damage. For Niagara grapes we were unable to detect a statistical effect on vines with 20% infested shoots compared to control vines where plume moth was killed

with an insecticide. Nevertheless, the trend was for reduced yield associated with high plume moth infestations (>20%). For higher value cultivars a somewhat lower threshold would be appropriate. Treatment of plume moth can be tricky for several reasons. First, the larvae develop very quickly and often have reached the pupal stage before you even recognize there is a problem. Second, larvae inside their leaf shelters are protected from insecticides. For these reasons, it's important to monitor and treat for plume moth early in the season (before 10 inch shoot stage) using sufficient water to achieve good coverage. Danitol is the only insecticide labeled for use against grape plume moth in NY.

Bloom to Mid-season

Grape Berry Moth. Grape berry moth is familiar to most grape growers in the eastern US. It is considered our most important arthropod pest in Lake Erie and the Finger Lakes and much of our current IPM strategy centers around its control. Grape berry moth is typically not abundant on Long Island, although has been more of a problem the last few years. Grape berry moth (GBM) overwinters as a pupa in the leaf litter, emerging as adults in May and June to initiate the first generation of larvae that feed directly on young fruit clusters of wild and cultivated grapes. Depending on temperature, there can be one to three additional generations produced during the season. The larvae cause damage in three ways. First, they can reduce yield by 1) directly feeding on the flower clusters, 2) hollowing out the grape berry and 3) causing premature berry drop. Second, they contaminate the juice that can lead to rejection of entire loads at the processing plant. This is mainly a serious problem for native grapes grown for sweet juice. Third, their feeding activity on flowers/young berries (first generation) and green or ripe fruit (later generations) create good conditions for the development of bunch rots. This is particularly a serious problem for wine grapes, especially those with tight clusters.

GBM has been effectively managed over the past 15 years, while at the same time reducing overall pesticide use, through 1) the recognition that vineyards vary in risk to GBM, 2) the use of a reliable monitoring plan, and 3) judicious use of broad-spectrum insecticides. Note that this approach to GBM management was developed for native grapes and although it can provide a useful guideline for wine grapes, more research needs to be done for these grape varieties. Categorizing vineyard blocks according to risk is a good place to start. High Risk vineyard blocks are characterized by having at least one side bordered by woods, being prone to heavy snow accumulation, and a history of GBM problems. In the past we have recommended treating these high risk sites shortly after bloom (first generation larvae) and in July (second generation) and then scouting for damage in mid to late August to see if a third insecticide application is required. Our recent research indicates that the first postbloom spray has little impact on end of season damage by GBM and can probably be skipped for low to moderate-value varieties. Extremely high risk sites, regardless of crop value, probably will still benefit from the postbloom spray.

Determining the exact timing of the later insecticide applications (July and August) has proven tricky. We are currently testing a temperature-based phenology model that looks promising, using bloom time of wild grape as the starting point. For example, our old

method recommended a second-generation spray for high risk sites at the end of July or early August. However, during the 2008 growing season the model recommended a treatment in early to mid-July. Damage at the end of the season was lower in vines treated according to the model compared to the standard timing. If the model continues to perform well we hope to have it available to growers via the web by next field season. Timing is becoming increasingly important for maximizing efficacy of newer generation insecticides such as Intrepid, Avaunt, and Delegate.

Note that much of the problems with GBM stem from late-season egg-laying. Too often growers put their sprayers away after early August and do not check for GBM. Pay attention to email crop updates for alerts on GBM (and other pests). For Low Risk vineyard blocks (lack of woods, low amounts of snow, little history of GBM problems) you can probably safely ignore GBM for the first generation but remember to scout in July and it may even make sense to scout in late August as well. For vineyard blocks that fall in between high and low risk (Intermediate Risk) we recommend skipping the postbloom spray and to scout for GBM in July and August. The current thresholds for juice grapes are 6% cluster damage for late-July and 15% at the end of August. Thresholds for vinifera are probably less due to the additional risk of bunch rots associated with GBM feeding injury and their higher value.

There are several options available for chemical control of GBM. The most commonly used products are Danitol and Sevin. Other broad-spectrum pyrethroids (e.g. Capture and Baythroid) are also effective. Leverage includes both a pyrethroid that would provide control of GBM and a neonicotinoid that would provide good control of sucking insects like leafhoppers (see below). Imidan is also an effective broad-spectrum material but it is not quite as effective against leafhoppers as the pyrethroids. Moreover, the new label for Imidan has a 14 REI, which makes its use problematic. There has been some evidence of control failures with Sevin in the Lake Erie area due to resistance. Although such problems have not been documented in the Finger Lakes or Long Island, it is something to pay attention to and rotation among pesticides with different modes of action is usually a good idea. The pyrethroids are effective materials as noted above, but I have concerns about their overuse leading to spider mite problems.

There are some additional, more narrow-spectrum, materials registered for use against GBM. Dipel is one option that has been around for a number of years. The toxin produced by the *Bacillus thuringiensis* (Bt) bacteria is specific to Lepidoptera. In our trials it has been less effective than the broad-spectrum insecticides but has the advantage that it conserves predators and parasitoids in the system. We have found that 2 applications of Dipel per GBM generation (immediate post bloom and mid-July), improves efficacy. Use sufficient water to achieve good coverage of fruit since the larvae must consume the Bt as they enter the berry for it to be effective. Good coverage is an issue for all the GBM materials. Mating disruption, using large releases of the GBM sex pheromone, is another control option to consider. The idea is to prevent mating by artificially releasing so much sex pheromone that males have difficulty locating the female moths. This technique has been around for a number of years and is being used by a small percentage of growers. It is probably most effective for intermediate and low risk vineyards or in years where berry

moth densities are low. However, these are the areas that often times do not require an insecticide application for GBM every year. Plastic twist ties impregnated with sex pheromone is now the main method for releasing pheromone. The older version of the Isomate GBM twist tie releaser is no longer being sold. However, there is a new product called Isomate-GBM Plus, which lasts the entire growing season. The insect growth regulator Intrepid from Dow Corporation has an EPA label for use on grapes and is available in Pennsylvania and most other states and has proven quite effective in trials in NY, Michigan and Pennsylvania. It has not received DEC approval for New York and we don't expect it to happen this field season. Intrepid is a selective material active against the larvae and eggs of many species of Lepidoptera including GBM. We are still learning how to best use this new material but it seems it needs to be applied a bit earlier than other insecticides. Intrepid has fairly long residual activity and is an excellent choice for the second generation treatment in July as it may provide some control of the overlapping third generation as well. Finally, as noted under chemical news above, for PA there are the anthranilic amides insecticides available for grape berry moth (Altacore and Voliam Flexi).

Grape Leafhoppers. There is actually a suite of leafhoppers that feed on grapes. The Eastern grape leafhopper *Erythroneura comes* (pale white in summer) mainly feeds on native cultivars like Concord while several additional species feed on *V. vinifera* and hybrids including *E. bistrata/vitifex*, *E. vitis*, *E. vulnerata*, and *E. tricinta*. All these *Erythroneura* leafhoppers have similar life-cycles. They overwinter as adults and become active as temperatures warm up in the spring. They move on to grapes after budbreak, mate and begin laying eggs around bloom. There is one full generation during the summer and a partial second. In warm years there is a potential for a nearly full second generation of nymphs and adults. Both nymphs and adults cause similar damage; removal of leaf cell contents using sucking mouthparts. Hence, moderate densities can reduce photosynthesis, ripening and yields. Severity of damage is increased in dry years, assuming irrigation is not available. The last few years have been low grape leafhopper years, probably due to cold winters and cool temperatures during spring and early summer.

Sampling for leafhoppers corresponds to sampling for grape berry moth. At the immediate post bloom period sucker shoots should be examined for evidence of stippling (white dots on leaves caused by leafhopper feeding). If you see stippling throughout the vineyard block an insecticide treatment is recommended. Note that for vineyards at high risk of GBM damage, you may already be applying an insecticide at this time (10 day postbloom). If you use a broad-spectrum material such as Sevin or Danitol you will also control leafhoppers. The next sampling period for leafhoppers is mid July and focuses on abundance of first generation nymphs. At this time check leaves at the basal part of shoots (leaves 3 through 7) for leafhopper nymphs or damage, on multiple shoots and multiple vines located in the exterior and interior of the vineyard. Use a threshold of 5 nymphs per leaf or 10% of leaves with at least moderate stippling to determine need for treatment. The third time for sampling for leafhoppers should occur in late August. This focuses on nymphs of the second generation. Follow a similar sampling protocol as used at the end of July, using a threshold of 10 nymphs per leaf. Note if you have made

previous applications of broad-spectrum insecticides for leafhopper or GBM it is very unlikely that it will be necessary to treat for leafhoppers in late August. If you do not observe much stippling it is not necessary to more carefully sample for leafhopper nymphs.

There are several choices of pesticides to use against leafhoppers. Sevin, or other carbaryl products, has been a standard for many years and is still effective except in isolated pockets of Concord and other native grapes around the Finger Lakes where we have observed control failures suggesting emergence of resistance. There are several effective alternatives to Sevin including Danitol, Capture, Baythroid, Lannate [methomyl], and the neonicotinoids Provado, Pasada (generic version of Provado) and Assail. Lannate is in the same chemical class as Sevin so there is potential for cross-resistance. The carbamates (Sevin and Lannate) and pyrethroids are hard on predatory mites. The neonicotinoids are mainly effective against sucking insects like leafhoppers and not as hard on natural enemies as the broad-spectrum insecticides. Note that a half label rate of Provado WP (0.5 oz.) was as effective as the full rate in controlling leafhoppers in our trials.

Potato Leafhopper. The potato leafhopper is quite distinct from grape leafhoppers discussed above. One big difference is that potato leafhopper originates each year from the southeastern US (it can not successfully overwinter in upstate NY or PA) while grape leafhoppers are indigenous to our area. The overwintered, winged adults ride north on warm fronts and usually arrive in our area sometime after bloom. When and where they arrive is not very predictable and some years are worse than others. However, they tend to arrive on Long Island before the Finger Lakes or Lake Erie region. Vineyards adjacent to alfalfa sometimes get an infestation of potato leafhopper right after the alfalfa is mowed. The adult potato leafhopper is iridescent green and wedge-shaped while the nymph is usually green and moves sideways in a unique crab-like manner when disturbed. Instead of feeding on cell contents of leaves like grape leafhoppers, potato leafhopper adults and nymphs use their sucking mouthparts to tap into the phloem vessels (the tubes used by plants to transport products of photosynthesis) of a number of different species of plants including grapes. In the process of feeding, they introduce saliva into the plant that causes, to varying degrees, distorted leaf and shoot development. Some cultivars of vinifera grapes seem particularly sensitive as does the French-American hybrid Cayuga White, but Labrusca cultivars also show symptoms. Feeding symptoms in grapes include leaves with yellow margins (more reddish for red Vinifera grapes) that cup downward. Often these symptoms are noticed before the leafhoppers themselves.

Potato leafhopper is a sporadic pest, although it can be serious in some places and some years. Long Island seems particularly hard hit. We currently do not have good estimates for an economic threshold. We do know that shoots will recover from feeding damage once the leafhoppers are removed. Several insecticides are registered for its control in grapes including Sevin, Danitol, Lannate, Assail and Provado. *Note that Provado is now a restricted use pesticide in NY (not PA).* Potato leafhopper is fairly mobile and it may require several treatments over the season as new infestations occur.

Grape Phylloxera. Grape phylloxera is an aphid-like insect with a complex life-cycle that causes feeding galls on either roots or leaves. Leaf galls are in the shape of pouches or invaginations and can contain several adults and hundreds of eggs or immature stages. Root galls are swellings on the root, sometimes showing a hook shape where the phylloxera feed at the elbow of the hook. At high densities, leaf galls can cause reduced photosynthesis. Root galls likely reduce root growth, the uptake of nutrients and water, and can create sites for invasion of pathogenic fungi. There is a wide range in susceptibility of grape varieties to both gall types. Labrusca-type grapes and vinifera grapes tend not to get leaf galls. Some hybrid grapes, such as Baco Noir, Seyval, and Aurora, can become heavily infested with leaf galls. Labrusca grapes will get root galls but these tend to be on smaller diameter, non-woody roots that may reduce vine vigor in some cases, but are not lethal. The roots of vinifera grapes are very susceptible to the root-form of phylloxera, including galls on larger, woody roots that can cause significant injury and even vine death. Indeed, most vinifera grapes grown in the eastern US are grown on phylloxera-resistant rootstock such as 3309 and this is the main method for managing the root-form of phylloxera. There are a couple of insecticides labeled for the control of leaf-form phylloxera, although we do not have a well-defined treatment threshold at this time. The organophosphate insecticide endosulfan [e.g. Thionex] is effective but causes phytotoxicity on some varieties such as Baco Noir and Chancellor. The neonicotinoid Assail (acetamiprid) and the pyrethroid Danitol (fenpropathrin) are also labeled for the leaf-form of grape phylloxera as is the systemic insecticide Movento (not available for NY). Leaf-galls first appear at low densities on the third or fourth leaf, probably originating from overwintered eggs on canes. The crawlers from these first generation galls disperse out to shoot tips and initiate more galls around the end of June or beginning of July. These second generation galls tend to be more noticeable to growers. Imidacloprid applied through the soil (e.g. Admire) is labeled for the root-form of phylloxera and can provide some control, especially when applied through a drip system.

Spider Mites. There are two species of spider mites that attack grapes in the Eastern US, two-spotted spider mite (TSSM) and European red mite (ERM), but ERM typically is the more common. Indeed, until the 2007 season I rarely observed TSSM on grapes in our area. For reasons I don't fully understand, I observed TSSM about as frequently as ERM in 2007 and to some extent, also 2008. This trend may be anomalous, however, in case this situation continues, it is important to know the difference between the two species.

An important difference between the two is that ERM overwinters as eggs in bark crevices of older wood while TSSM overwinters as adult females, probably in ground cover. As the name indicates, ERM is reddish in color and lays red eggs. Adult female TSSM tend to have large black spots on the top of the abdomen but this is a pretty variable. TSSM eggs are clear to opaque. TSSM tends to stay on the bottom side of leaves and produces obvious webbing while ERM can be found on either side of the leaf and does not produce much webbing. Both species have the capacity to go through a number of generations during the season. However, we typically do not see significant populations and damage until mid to late summer. This is especially true of TSSM since they do not start off on the vine.

Because of their small size, it is often difficult to know if you have mites. Foliar symptoms (bronzing of leaves) are one clue, although if you have wide spread, obvious symptoms then economic damage may already be occurring. The working threshold for spider mites (TSSM and ERM combined) in our area is 7 to 10 mites per leaf, although this will vary depending on health of the vineyard, crop load, value of the grape, etc. In summer, I suggest sampling at least 50 mid-shoot leaves from both the edge and the interior (25 leaves each) of a vineyard block, examining both sides of the leaf. A hand lens will be necessary to see the mites for most people. Even with a hand lens, it is challenging to count the mites. Thus, we recommend estimating the proportion of leaves infested with mites and use something like 50% infested as a treatment threshold. A leaf is considered infested if it has one or more spider mites. Remember to keep rough track of which species is most common.

We have several chemical options available for mite control in New York and Pennsylvania: Kelthane [dicofol], Vendex [fenbutatin-oxide], Agri-Mek [abamectin], Nexter [pyridaben] (not on Long Island), Acramite [bifenazate], JMS Stylet Oil [aliphatic petroleum distillate], Zeal Miticide¹ [etoxazole], Onager [hexythiazox], Danitol [fenpropathrin] and Capture [bifenthrin]. Kelthane and Vendex are the old standards that have been relied upon for a number of years. Kelthane is fairly hard on predatory mites while Vendex is not. Kelthane 50W is no longer being manufactured but material in stock can be used. Read the label carefully since JMS Stylet Oil is not compatible with a number of other products including Captan, Vendex, and sulfur. Also, although Stylet Oil can help with mite problems, it is not likely to provide complete control in problem vineyards. Nexter has been registered for use on grapes in New York (but not on Long Island) for a couple of years. It is very effective against ERM but higher rates should be used for TSSM. Nexter is pretty soft on predatory mites except at high rates. It also provides some partial control of leafhoppers. Agri-Mek currently has TSSM on the label but not ERM, although in apples both species are on the label. Acramite includes both TSSM and ERM, although it calls for higher rates for ERM. Acramite and Agri-Mek are relatively soft on beneficial arthropods. Zeal miticide 1 has recently been labeled for grapes in NY against TSSM. You need the 2(ee) recommendation, which is readily available, for use against ERM. Since Zeal miticide 1 affects eggs and immatures, it is advised to apply before populations reach damaging levels to give the material time to work. Zeal Miticide¹ is also relatively soft on beneficial mites. As noted above, Onager has recently been labeled for grapes, including in NY. It is similar to Zeal miticide 1 in that it affects eggs and immatures but not adults. Danitol and Capture are broad-spectrum insecticides that also have good miticidal activity.

Spider mites are often thought of as a secondary pest. In other words, something must happen in the vineyard that disrupts their natural control by predators, particularly predatory mites, before their populations can increase to damaging levels. Several insecticides used in grapes, including Lannate, Danitol, Capture and possibly Sevin can also suppress predatory mites. Since Danitol and Capture have miticidal activity they would not be expected to flare spider mites. However, in the past, spider mites have been

quick to develop resistance to frequent use of pyrethroids like Danitol and Capture. This may or may not happen but it is worth keeping in mind. One of the first things to watch out for is initial good suppression of mites followed by a resurgence indicating the spider mites recovered more quickly than the predatory mites. Overall, paying attention to conserving predatory mites can pay economic dividends since miticides are quite expensive.

Japanese Beetle. Japanese beetles were abundant in 2008 although perhaps not quite as abundant and long-lasting as in 2007. Although the adults (1/2 inch body, metallic green in color) seem to have a fondness for grape foliage, they also feed on a number of other plant species. Japanese beetles were introduced into the eastern USA a number of years ago and have been spreading throughout the Northeast and Great Lakes regions. Although the adults have broad diets, the larvae feed principally on the roots of grasses. Hence, we often find the most significant problems with adult Japanese beetles in areas surrounded by an abundance of turf. The adults emerge from the soil in mid-summer and begin feeding and then mating and egg-laying.

The feeding damage caused by adults can be quite extensive, perhaps exceeding 10 or 20% of the foliage. Fortunately, grapes seem fairly tolerant of this type of feeding at this time of the season. Research in Kentucky and also in Michigan examining the impact of foliar damage by Japanese beetle on grape productivity, fruit quality and yield indicate that both natives and vinifera grapes can tolerate some leaf damage. The exact amount is hard to nail down but it seems up to 15 or 20% leaf damage has little impact. Note, though, that the actual impact of leaf feeding will depend on a number of factors including health and size of the vine and the cultivar. Moreover, if it is a high value cultivar then the economic injury level will be lower compared to a lower value cultivar. Young vines in growth tubes may be particularly vulnerable in that they have fewer reserves to draw upon to recover from damage and the beetles are protected in the tubes from insecticide sprays. You should make a special effort to regularly monitor vines inside growth tubes for Japanese beetles and apply insecticides directly into the tubes if treatment is warranted. Grape cultivars do seem to vary in resistance to Japanese beetle. Thick leaved native cultivars are the most resistant followed by hybrids and then *V. vinifera*.

There are several insecticides labeled for use against Japanese beetles on grapevines (Table 1). These all are roughly similar in efficacy but they do vary in impact of beneficial arthropods like predatory mites. I mention this because multiple applications of something like Sevin could depress predatory mite populations and promote spider mite outbreaks. Also keep in mind that the adults are very mobile and can re-colonize a vineyard block after being treated with an insecticide. Regular monitoring of the situation is recommended.

Table 1. Summary of the main insecticides labeled for use against Japanese beetle on grapes in New York and PA.

Material	Efficacy JB	REI	DTH	Pred. Mites	Spider Mites
carbaryl [Sevin]	+++	12 hr	7 d	+?	0
phosmet [Imidan]	+++	14 d	7 d	0?	0
fenpropathrin [Danitol]	+++	24 hr	21 d	+++	++
bifenthrin [Capture]	+++	12 hr	30 d	+++	++
cyfluthrin [Baythroid]	+++	12 hr	3 d	+++	?
acetamiprid [Assail]	++?	12 hr	7 d	0?	0
indoxacarb [Avaunt]	++?	12 hr	7 d	0?	0
azadirachtin [Aza-Direct]	+	4 hr	0?	0?	0
pyrethrin [Evergreen]	+	12 hr	0	+	0

Multicolored Asian Lady Beetle (MALB). MALB was introduced into the US from Asia to help control aphid pests. It has spread to many areas in the southern and eastern US and into Ontario Canada and has generally been an effective biological control agent. However, it has the habit of moving into vineyards in the fall near harvest time. When disturbed, the adult MALB releases a defensive chemical out of its joints that helps it ward off enemies. Unfortunately, the defensive chemical has a nasty taste and bad odor that gets carried into the juice and wine. Relatively low densities of MALB (10 per grape lug) can cause off-flavors in juice and wine. MALB is sporadic both in where it shows up during a given year and from year to year. Vineyards in the Niagara Peninsula in Canada appear particularly vulnerable. Also, vineyards adjacent to soybeans in a year when soybean aphid is abundant may be more vulnerable. I recommend that you scout your vineyards before harvest to see if MALB is present. There could be several different species of ladybugs in your vineyard but probably only MALB would be at high densities on the clusters. You can recognize MALB by the black markings directly behind the head that look like an M or W depending on which direction you look from. The color or number of spots is variable. I would also pay attention to the crop updates to see if and when MALB is turning up in vineyards. As indicated above, the abundance of MALB appears to be closely tied to the abundance of soybean aphid, which tends to alternate between high and low years. Thus, researchers predicted a high soybean aphid population in 2007 and that actually did not occur. Their abundance in 2008 was also on the low side. There are a few chemical approaches to managing MALB: Danitol [fenpropathrin], Aza-Direct and Evergreen [natural pyrethrins]. To use Danitol in New York for this purpose, you need to have the 2(ee) label. Danitol is toxic to MALB based on field and laboratory trials conducted by Roger Williams at Ohio State University. Aza-Direct, which is based on the active ingredient azadirachtin from the neem tree, appears to have a repellent effect on MALB, again based on trials by Roger. Based on a trial a few years ago by Tim Weigle, Evergreen appears to have both toxic and repellent effects on MALB. Note that Danitol has a 21 days to harvest restriction, and Aza-Direct and Evergreen have no days to harvest restrictions. For Aza-Direct, pH in spray water should be 7 or less (optimum is 5.5 to 6.5).

Bottom line comments

The bottom line message for insect and mite pests is to regularly monitor your grapes. There is no guarantee that a particular pest will show up in a particular year or at a particular site. Moreover, you typically have time to react using an eradicator if a pest does reach sufficient densities to cause economic damage. Knowledge of what is present will lead to better management decisions. But out of the many potential pests, here let me focus in on the ones that are most likely to show up and/or can really do a lot of mischief if unattended.

During the period from budbreak to bloom **plant bugs (banded grape bug and *Lygocoris inconspicuus*)** represent the greatest insect risk for yield loss.

Monitor for the nymphs at about 10-inch stage, keying in on the flower buds. Here is a picture of banded grape bug. If you find more than one nymph per 10 clusters, consider an insecticide treatment such as Sevin or Danitol or Imidan. Other than these plant bugs, there are few insect pests during the budbreak to bloom period that can cause significant harm. A caveat to this is for



some sites, especially sites with sandy soils, that are prone to **rose chafer**. The adults of the chafer feed on flowers and young clusters and can reduce yields.

Mid-summer is the time where insects and mites often create the most concern. On the top of the list is **grape berry moth**. Traditionally for high-risk sites we have recommended an insecticide during the postbloom period to kill first generation larvae. But except for super high-risk sites or high value varieties, our research indicates this postbloom spray is not useful. Focus should be on the second-generation larvae in mid-summer and late summer damage from a combination of second and third generation larvae. Timing of insecticides is important for many of our new insecticides since they need to be ingested as the young larva penetrates the berry. For the last several years the second generation has begun in early to mid-July rather than late July or early August as has been the traditional timing. Follow email pest updates and also monitor for new stings, probably starting in early July. Use a long residual material (Intrepid is a good option for PA) if available since we have observed large overlap between the second and third generation later in the summer. Also good coverage of the fruiting zone is important. Continue to monitor damage and be particularly vigilant in years with above average temperatures during the first half of the season. Above average temperatures in the first half of the season increases the chances of a third or even partial fourth generation of moths. You may need to add an additional insecticide in late summer. Insecticides with shorter days to harvest restrictions may need to be used at this time.

Two additional comments on grape berry moth. First, damage from berry moth is often

concentrated on the edge of the vineyard. When rows run parallel to the wood edge, insecticides can easily be applied to only the first six rows thereby saving time and money. Second, for wine grapes, feeding by berry moth can exacerbate problems with bunch rots. Hence, the tolerance (threshold) for grape berry moth damage for varieties prone to rots should be lower than varieties less prone to rots.

Two other pests are worth mentioning for the mid-summer period. One is conspicuous and you probably will be tempted to spray for it even if it does not make economic sense to do so because the damage looks bad. I am speaking of **Japanese beetle**. Granted, there have been a lot of these beetles around these past few years. But remember that for a healthy vineyard, especially a vigorous one, the vines can probably handle conservatively 15% foliar damage. If you do need to treat, be aware of the potential for some insecticides to flare spider mites. **Spider mite** is the second pest I wanted to mention. They are actually not very conspicuous and as a consequence growers may miss them. Be on the look out for yellowing or bronzing leaves and generally low thrift during the hot days of late July and August. Use a hand lens and scan both sides of mid-shoot leaves for European red mite or possibly two-spotted spider mites. If you are uncertain what to look for bring suspicious leaves into the nearest extension office for a second opinion. You can also contact me at my office (315-787-2345) in Geneva. Threshold for mites will depend on health of the vines as well as value but a useful guide is 50% of leaves infested with at least one mite. A sample of 60 leaves per block is recommended.

In summary, there is a seasonality to pests and checking the electronic updates from your regional grape extension programs is an excellent way to stay on top of what you should be on the look out for during the season. Generally speaking we have good chemical control options available for most arthropod pests. But be smart about using them. Pay attention to label restrictions and review recommendations in the pest management guidelines. Rotate among materials with different modes of action to reduce development of resistance. Be aware of consequences of your choice of pesticides on natural enemies. The cheapest material to apply on a per acre basis may not always result in the lowest cost because of unintended consequences. Most important, only use pesticides or other control options when it makes economic sense to do so (monitor and apply economic thresholds where available). If you have questions or concerns please let me know.