



Grape Insect and mite pests-2011 field season

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In considering the weather and prospects for the upcoming field season, I am reminded of a quip attributed to the late Dr. Bob Pool, long-time viticulturalist at Geneva, of having never seen an “average” year in his 30 plus year career (growers know this better than anyone). This time last year we were looking at one of the warmest springs in recent memory and this year it has been fairly cool and VERY wet. That early spring last year did continue, leading to well above average temperatures for the season, which translated into a pretty “good” year for insect and mite pests. If the trends this spring continue through the 2011 season, you may not need to worry much about insect pests (they generally do not like cool, wet weather), which is good since you will likely have your hands full dealing with grape diseases. Time will tell. But to be on the safe side, here is my annual spring review of insect and mite pests. I will start off reviewing recent changes in pesticide news and then go on to focus on some of the important grape insect and mite pests. I will summarize their biology and the damage they cause, including any new information that is available, and then go on to discuss management options. This information is similar to past spring updates with some modifications due to changes in pesticide availability or new research (e.g. section on mealybugs, grape phylloxera and grape berry moth). I also briefly describe two new invasive species of insects that have or about to have arrived in New York and that may have implications for grape growers.

The material I present here is based on the work of many people at Cornell and elsewhere. I want to thank Ted Taft Jr., Terry Bates, Kelly Link, Mike Vercant and the rest of the crew at Cornell Lake Erie Research and Extension Laboratory (CLEREL), Tim Weigle and Juliet Carroll of the NY IPM Program, Hans Walter-Peterson, Alice Wise, Jodi 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). Steve, in particular, deserves thanks for his efforts in running the day to day operations of a busy lab and field research program. We have been working closely with Marc Fuchs and Pat Marsella-Herrick of the Department of Plant Pathology at Cornell on our mealybug/leafroll disease research, Terry Bates, Peter Cousins (USDA ARS in Geneva) and Rick Dunst (formerly at CLEREL) on root phylloxera research and entomologists Mike Saunders, Jodi Timer (Penn State University) and Rufus Isaacs (Michigan State University) on our grape berry moth phenology research. We are very appreciative of the growers and other industry representatives for their many contributions ranging from letting us work on their farms to sharing their observations and opinions to support of grant proposals.

Update from NY and Pennsylvania Grape Guidelines. Several anthranilic diamide insecticides have been labeled for use on grapes in the last few years (Belt SC [flubendiamide], Altacor WG [chlorantraniliprole] , Voliam Flexi WG [imidacloprid + chlorantraniliprole], Turismo SC [flubendiamide + buprofezin], including New York (Altacor and most recently Belt). This is a new class of insecticide affecting a part of the insect nervous system involving calcium channels leading to muscular paralysis. They act fairly specific on Lepidoptera like grape berry moth and climbing cutworm, but have activity on some other groups, including Japanese beetle. **Please note that Altacor and Belt have some additional restrictions for NY included on a supplemental label (e.g. not allowed on Long Island, they are considered restricted use in NY, no aerial application, can't be applied within 100 ft of body of water).** Voliam Flexi blends two insecticides with different modes of action: the anthranilic diamide chlorantraniliprole (same active ingredient as in Altacor) and thiamethoxam, a neonicotinoid that has good activity on sucking insects and some beetles. Turismo combines the anthranilic diamide flubendiamide (same active ingredient as Belt) with buprofezin, an insect growth regulator that has good activity against some sucking insects like mealybugs (not currently on the label). Generally speaking, these new products are fairly soft on beneficial arthropods.

The insecticide Movento [spirotetramat, EPA # 264-1050, Signal Word = Caution, Re entry interval (REI) = 24 hours, Days To Harvest (DTH) = 7] was labeled for use on grapes in New York (and elsewhere) two+ years ago. A year ago it temporarily lost its registration due to a legal challenge, although that challenge has now been addressed. 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 (root and leaf forms). Movento must be applied with an adjuvant 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 could lead to phytotoxicity. In our trials we have been using LI 700 (0.25% V:V) with success.

New formulations of several insecticides have come on the market, replacing or supplementing older formulations. Leverage 360 (combines neonicotinoid imidacloprid and the pyrethroid B-cyfluthrin, EPA # 264-1104, Signal Word = Caution, REI = 12 hrs, DTH = 3 days) evolved from Leverage 2.7. This involved using the most active form of cyfluthrin (B-cyfluthrin) rather than a mixture of isomers. Similarly, the pyrethroid Baythroid XL (B-cyfluthrin, EPA # 264-840, Signal Word = Warning, REI = 12 hrs, DTH = 3) evolved from Baythroid 2. Lorsban (chlorpyrifos, 4-E and WG formulations) has a limited label for grapes for the control of grape root borer through a ground application targeting the hatching larvae. (Note the grape root borer has not been found in NY but is present in some eastern PA vineyards and vineyards in the mid –Atlantic and southern states). Recently, an emulsion formulation of this active ingredient (Lorsban Advanced, EPA # 62719-591, Signal Word = Warning, REI = 24 hrs, DTH = 35 days) has been labeled for grapes (including NY). In addition to ground application for control of grape root borer, Lorsban Advanced is labeled for climbing cutworm and grape mealybug (pre-bloom period only).

One other insecticide related news item. Recently the neonicotinoid insecticide Provado 1.6 [imidacloprid] was granted a 2(ee) recommendation to allow use against the multicolored asian lady beetle (MALB). This is a nice addition for two reasons. First, MALB is really only a potential problem at harvest (see additional information on MALB later in the article) and Provado 1.6 has a pre-harvest interval of zero days. Second, research by Roger Williams at Ohio State University indicates that Provado has both toxic and repellent effects on MALB. Since even dead MALB can taint juice, it is desirable to encourage MALB to leave the cluster.

Review of key arthropod pests

There are over 30 insect and mite pests that attack grapes in New York and surrounding states, 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 as we progress through the field season. 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: 2011 now on line [<http://ipmguidelines.org/grapes>]. For greater focus on organic options, refer to the new online organic grape guide [http://www.nysipm.cornell.edu/organic_guide/default.asp]. 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. Arthropods are generally detectable in the field before they cause economic injury. Moreover, most insecticides and miticides work as eradicates as opposed to preventative agents. They can be quite expensive and some are harsh on beneficial insects and mites. Because of all these factors, 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 517-353-674. There are also a number of fact sheets on grape insect pests available through NYS IPM at <http://nysipm.cornell.edu/factsheets/grapes/default.asp>.

Before reviewing the better known insect and mite pests of grapes, let me start by introducing two new invasive species of insects that may become pests of grapes: the brown marmorated stink bug and the spotted wing drosophila.

Brown Marmorated Stink Bug. The brown marmorated stink bug (BMSB) originates from Asia. It was accidentally introduced into Pennsylvania about 15 years ago and has been spreading through the

USA ever since, reaching NY a few years ago. This insect is a plant feeder, using its soda straw like mouthparts to suck out plant juices. Adult BMSB are good-sized insects, about ½ inch in length. It is known to feed on a wide range of plant species, including a number of fruit, vegetable, and field crops where it can cause serious damage. Pome fruit seem to be particularly vulnerable but they do feed on grapes. When it feeds on developing fruit, you may only observe small blemishes or slight to moderate deformations on the surface, but underneath you will find corky, necrotic tissue. In addition to its feeding habits, BMSB is also a nuisance pest. It overwinters as an adult, often in homes, barns and parked vehicles like RVs, etc. They can be very numerous and although they do not bite, they can release an unpleasant odor (hence the name stink bug). This stink bug odor has caused some problems for the grape industry in mid-Atlantic states where populations can be very high. Adults congregate in vineyards in the fall and can get accidentally harvested with grapes. In the process they release their alarm odors, which can result in unpleasant aromas in wine. Initial observations by Dr. Gavin Sacks (Cornell University, Dept. of Food Science, Geneva) indicate that the stink bug odor is particularly offensive in the juice, but diminishes after fermentation. However, more research is needed. A good fact sheet on BMSB, with photographs of adults, eggs and immatures and damage, has been produced by Penn State University [<http://ento.psu.edu/extension/factsheets/brown-marmorated-stink-bug>].

BMSB has caused serious economic damage to fruit, vegetable, and field crops in the Mid-Atlantic States. Time will tell to what extent BMSB will be a problem for NY and to what extent pest management practices will need to change to accommodate them. I recommend learning how to recognize BMSB and monitor for its presence in your fields. University and USDA scientists are working hard to learn more about the biology of BMSB and effective ways to control it. Right now NY has one insecticide labeled for use against BMSB (Danitol [fenprothrin] has a 2ee exemption for use on grapes and some other fruit crops). However, over time additional insecticides will be added and hopefully some innovative alternatives will also be developed.

Spotted Wing Drosophila. Spotted Wing Drosophila (SWD) (also known as *Drosophila zuzukii*) looks superficially like your every day Vinegar Fly *Drosophila melanogaster* of genetics fame (and my kitchen in the summer), but Vinegar Flies generally are not a serious economic threat to fruit growers. Female Vinegar Flies typically lay eggs in damaged and/or overripe fruit and hence, are mostly just a nuisance. On the other hand, female SWD have very robust ovipositors (the rear end portion of the fly used for egg laying) and will lay their eggs in ripe, marketable fruit leading to damage and contamination with maggots (generally not desirable unless you are looking for extra protein in your diet).

As of the 2010 field season there has been no verified reports of SWD in New York, but it seems to be getting closer. SWD first showed up in California in about 2005 and has spread north into Oregon, Washington, and western Canada, south into Florida and recently has been reported at significant numbers in North Carolina and Michigan. Research in the western US indicates that SWD

is able to lay eggs in grapes and successfully develop. There is also a report out of Washington State of significant Concord acreage with unacceptable levels of insect contamination from SWD. However, to what extent it will become a problem for grape growers in NY and PA is not clear yet. Rufus Isaacs, Fruit Entomologist in Michigan, has a nice fact sheet for SWD that includes excellent photos and also a description of the trap [<http://www.ipm.msu.edu/SWD.htm>]. One interesting observation from the work being done in Michigan is that the abundance of SWD in traps dramatically increased late in the season, well past harvest. We began monitoring for SWD in a few vineyards in the Finger Lakes in 2010 without any confirmed discoveries and hope to expand monitoring to more sites for 2011 depending on the availability of funding. Delegate insecticide [spinetoram] has a 2ee exemption for use on grapes in NY for controlling SWD and I anticipate other materials being labeled as the pest becomes established in NY.

Budswell to Bloom

Steely Beetle (grape flea beetle) and Climbing Cutworm. The steely beetle (shiny black or dark blue in color) overwinter as adults and become active as temperatures increase in the spring. A fact sheet on steely beetle can be found at <http://nysipm.cornell.edu/factsheets/grapes/pests/gfb/gfb.asp>. 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. This has been the situation this spring. Look for damage from steely beetle along the edges of the vineyard. The wet conditions have added to the problem since even if you do find significant damage, it has not been possible to get a sprayer into the vineyard. Hopefully the past few dry days have helped the situation out in most locations. Climbing cutworm (fact sheet at <http://nysipm.cornell.edu/factsheets/grapes/pests/cc/cc.asp>) 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 significant 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, Baythroid, Leverage and Danitol. Sevin, Danitol, Baythroid, Brigade, Leverage, and Brigadier are labeled for use against cutworms along with several more selective materials such as Altacor, Belt, and Delegate.

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 viruses, 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 (Fig. 1). They have limited ability to move at this stage. As the spring progresses they complete development and begin laying eggs (mid-May to early-June or 260 to 360 GDD from January 1 in °F, based on our observations from 2009), 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.

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, see Fig 2). 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. In 2009 this occurred on 11 June, at about 480 GDD, and the first instar crawlers (summer generation) were first observed on about 1 July or 800 GDD. These crawlers go on to mature, being found on various tissue including clusters. As they become adults they migrate back to the trunk regions to lay eggs, which mostly hatch and then spend the winter as first instar crawlers. Grape mealybug is 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.



Fig. 1, photo S. Hesler



Fig. 2, photo S. Hesler

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 another matter. Dr. Marc Fuchs, virologist at NYSAES, has quantified some cases where virus has increased within a vineyard and vectors are likely responsible. Can the spread of leafroll disease be slowed or prevented by controlling the vector? We completed an experiment last year trying to test this out and basically found that moderately effective insecticides targeting the crawler stages (50% population reduction) did not reduce virus spread in a chardonnay vineyard block. It's possible a more effective insecticide would have produced better results, something we will investigate in the next year or two. In particular, in a small plot efficacy trial last year we found that the systemic insecticide Movento provided 95% control of grape mealybugs compared to unsprayed vines (Fig. 3).

There are several insecticide control options for soft scale and mealybugs and the choice will depend on the target species and your goals. As noted above, its not clear if controlling the vector with insecticide will be sufficient to manage virus spread. Certainly, the control will need to be very good, hence, our interest in Movento for mealybugs. Stay tuned.

There are two windows of vulnerability for controlling soft scale and mealybugs with insecticides. The first window is during the spring before budbreak where the target is the overwintering stage.

Dormant oil is recommended at this time.

The idea is the oil will smother the scale or mealybug. We have not tested oil

against soft scale, although I suspect it would be effective since the soft scale overwinter out on the canes where they are more exposed. We obtained some data on efficacy of dormant oil just prior to budbreak for mealybug crawlers, however. Overall it was not very effective, I believe because the overwintered crawlers are often well protected under bark on the trunk and canes. The second window is the crawler stage of the first generation. This occurs in mid or late June for soft scale and late June to early July for mealybugs. The crawler stage is the most mobile stage and hence, you have the best chance of exposing them to insecticides. To make certain of timing, you can check underneath soft scales on canes in June or examine mealybug egg masses under loose bark on the trunk in later June with a hand lens and look for crawlers.

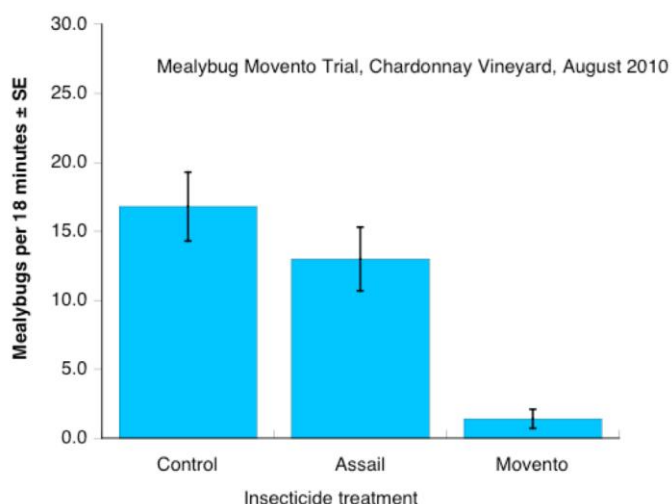


Figure 3. Mean total mealybugs counted on vines over 18 minute observation period ± SE for chardonnay vineyard plots treated with two different insecticides.

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 Movento, Provado [imidacloprid], Assail [acetamiprid], Brigadier, Leverage, Portal, Baythroid and Imidan [phosmet]. Since Movento is systemic, it does not need to directly contact the mealybugs.

Banded Grape Bug and Lygocoris Bug.

Both species overwinter as eggs, presumable 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 (see Fig. 4). Nymphs of Lygocoris are pale green with thin antennae and about half the size of BGB. Nymphs of both species can cause serious economic damage by feeding on young clusters (buds, pedicel and rachis) prior to flowering. Adults, which appear close to bloom,



Fig. 4, photo J. Ogradnick

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. However, in 2010 I did observe damaging populations in several Finger Lakes vineyards at the end of May and early June. 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 (Fig. 5). Sometimes the flower buds get caught up in the webbing and get fed on and this is where the potential for damage

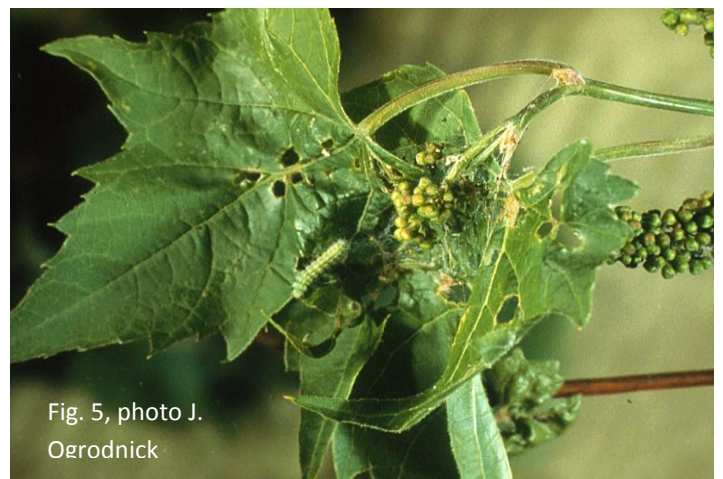


Fig. 5, photo J. Ogradnick

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. Dipel can be used in PA.

Bloom to Mid-season

Grape Berry Moth. Grape berry moth is familiar to most grape growers in the eastern US. See our fact sheet on grape berry moth at <http://nysipm.cornell.edu/factsheets/grapes/pests/gbm/gbm.asp>. 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 it 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 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. Also, high value grapes are considered high risk. In the past we have recommended treating these high

risk sites shortly after bloom (first generation larvae) and in late July/early August (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, may 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, using estimates of degree day requirements, recommended a treatment in early to mid-July. A similar discrepancy occurred in 2009. The difference was even larger in 2010 where temperatures and heat accumulations were well ahead of average (see Fig 6). In our trials damage at the end of the season has been lower or the same in vines treated according to the model compared to the standard timing even though vines were only treated twice compared to three times for timings based on risk assessment protocols.

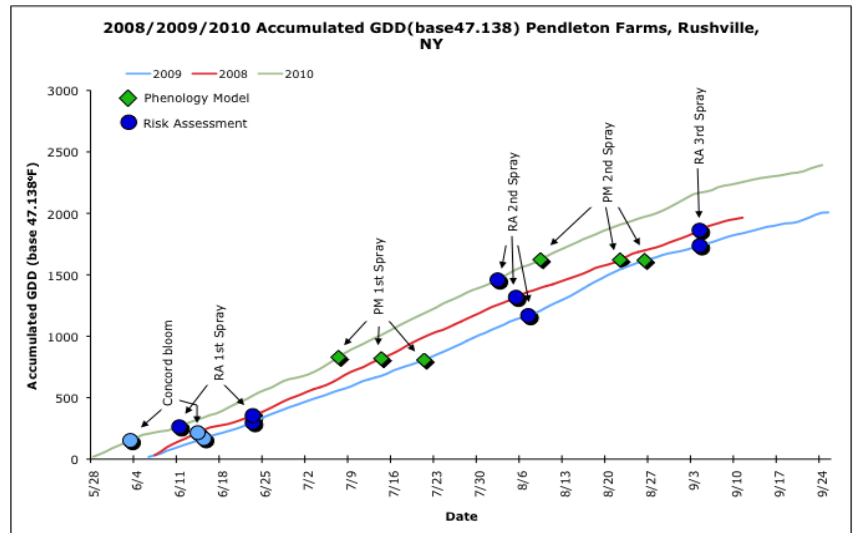


Fig. 6. Relationship between degree day accumulation for grape berry moth development and date for three years from one site in the Finger Lakes, NY. Green diamond provides timings for insecticide treatments based on the phenology model, dark blue circles gives timings based on risk assessment protocols. Light blue is concord bloom.

We now have sufficient confidence in the phenology model to make it available to growers via a web-based system managed by the NYS IPM NEWA (Network for Environment and Weather Applications) system (thanks to Julie Carroll and Tim Weigle for pulling this together). Although we are still making improvements, the forecast model is now available online (see <http://newa.cornell.edu/> and look under pest forecasts). This is how it will work. To use the model, you need to provide a starting point to begin accumulating degree days. We have found bloom date of the wild grape *V. riparia* is a pretty good indicator or biofix. The program asks that you provide a date for 50% bloom time of *V. riparia*. If this is hard to come by, the program will estimate it based on historical records. Using this date, the model accumulates degree days using the nearest NEWA weather station (you choose the weather station on the web site; four new weather stations in the Lake Erie region will be added to the system in 2011). At any given date, the model will provide the degree day accumulations from the biofix, a forecast of accumulation over the next several days, and pest management advice based on current

accumulations. For example, as accumulation gets close to 810 degree days (July 22 in our test plots for 2009 and July 6 in 2010), the program notes that this is approaching the peak of the second GBM generation eggs and you are advised to apply an insecticide at near 810 for a high risk site and to scout for damage for low or intermediate risk sites. Note that this model is still being worked on and should be used as a guide for making pest management decisions. I believe it's an improvement over the current calendar-based practice. If you try using it this season, please forward feedback (good and bad) to me (gme1@cornell.edu), Juliet Carroll (jec3@cornell.edu), or Tim Weigle (thw4@cornell.edu) to help us improve future versions.

There are several options available for chemical control of GBM. See the guidelines for a full listing. The most commonly used products are the pyrethroid Danitol and the carbamate Sevin. Other broad-spectrum pyrethroids (e.g. Brigade and Baythroid) are also effective. Leverage and Brigadier include 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. We have found that 2 applications of Dipel per GBM generation, 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. Another selective material from Dow AgroSciences, Delegate [spinetoram], has been effective in our test trials. The insect growth regulator Intrepid, also from Dow, 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. 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, several new anthranilic diamide insecticides have been labeled for use on grapes in the last several years (Belt SC, Altacor WG, Voliam Flexi WG, Turismo SC) with Altacor and Belt now labeled for New York. These materials are pretty selective for Lepidoptera such as grape berry moth and are reported to have pretty good residual activity. Similar to Intrepid, Delegate, and Bt, they work best when ingested by the first instar (recently hatched) larvae as they try to move into the fruit.

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 real 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 (Isomate GBM Plus) is now the main method for releasing pheromone. Dr. Rufus Isaacs at Michigan State University has been working with a new method of application of a sex pheromone called SPAT GBM™. Basically the pheromone is mixed into a wax material that is sprayed on the foliage as small droplets. Each droplet acts like a small twist tie, releasing sex pheromone over an extended time period. Dr. Isaacs has had some success with this technique and there is a product labeled by EPA. It is not yet labeled in New York.

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 (see fact sheet at <http://nysipm.cornell.edu/factsheets/grapes/pests/qlh/qlh.asp>) while several additional species feed on *V. vinifera* and hybrids including *E. bistrata/vitifex*, *E. vitis*, *E. vulnerata*, and *E. tricincta*. 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 causing white stippling (Fig. 7). 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, although I am not certain why.

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



Fig. 7, photo J. Ogrodnick

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, Brigade, 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 year round residents 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



Fig. 8, photo D. Gadoury

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 (Fig. 8). 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. Vineyards next to alfalfa also may be particularly vulnerable after the alfalfa is cut. 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, Leverage, 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 (Fig. 9). 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



Fig 9. A single grape phylloxera leaf gall, with the side of the gall opened to show adult female and many yellowish eggs. Photo by J. Ogradnick.

vine death. Indeed, most vinifera grapes grown in the eastern US are grown on phylloxera-resistant rootstock and this is the primary method for managing the root-form of phylloxera.

Motivated by the difficulties associated with needing to hill up around grafted vines each winter to protect some buds of the scion in the case of a severe winter, there has been some recent interest in growing vinifera vines on their own roots. Root-form phylloxera throws a potential monkey wrench to this strategy. We have been asking the question, therefore, whether we can manage root-form phylloxera well enough with insecticides to allow the use of own rooted vinifera vines in some circumstances. We have been looking at this issue in two ways. One is conducting insecticide efficacy trials. To date we have found that both Movento applied to foliage and the insecticide Admire Pro [imidacloprid] applied through a drip system or as a drench have been fairly effective in reducing galling on the roots of *V. vinifera* vines. Our second approach has been to establish a new planting of Riesling vines at CLEREL that have either been grafted (Riparia Gloire) or on their own roots and are either treated with an insecticide to manage root phylloxera or left untreated. In 2011 (fourth year of the planting) we will be collecting data on phylloxera galls on roots, vine growth (periderm counts, pruning weight), yield (first harvest) and some fruit quality traits. Our hope is that over a five or six year time frame we will be able to estimate some of the costs and benefits of growing *V. vinifera* on their own roots and whether insecticide can be used to keep root-phylloxera in check.

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. 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 shoots 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.

As noted above, imidacloprid applied through the soil (e.g. Admire Pro) is labeled for the root-form of grape phylloxera and can provide some control, especially when applied through a drip system. Movento, applied as a foliar spray, has also shown some reasonably good efficacy on root-form phylloxera in our trials both with *V. vinifera* vines, but also with Concord. It's worth mentioning the Concord trial a bit more here. This experiment was

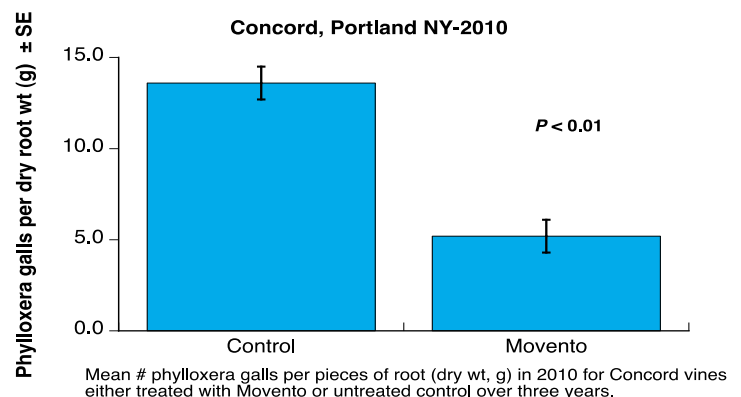


Fig. 10. Concord Movento trial, third year of treatments.

originally initiated by former Cornell undergraduate student Misha Kwerswicwski (Shaulis scholar) in 2008. Misha is currently a graduate student with Gavin Sacks and Wayne Wilcox. For each of the past three seasons mature Concord vines at CLEREL were either treated twice with Movento (plus the adjuvant LI 700) or only with LI 700. In each of the years we found significantly more phylloxera galls on control vines than vines treated with Movento (2010 results shown in Fig. 10). We also found a significant 18% increase in yield in the third year for vines treated with Movento. We assume that the increase is due to the reduced number of phylloxera galls on roots, but other factors could be involved. For example, Movento is also known to negatively affect nematodes. But the results are interesting enough that we plan to repeat the treatments for a fourth year.

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 in 2008. It is important to know the difference between the two species. Problems with spider mites tend to be more serious in hot and dry years.

An important difference between the two spider mite species 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 (Fig. 11). 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.



Fig. 11. Highly magnified. Photo by J. Ogrodnick.

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: 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 Brigade [bifenthrin]. A new miticide, Portal, has also recently been labeled for spider mites on grapes. Read labels carefully. 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 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 is 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. Similar advice can be applied to Onager and Portal. Zeal miticide 1, Onager, and Portal are relatively safe for beneficial arthropods. Danitol and Brigade (two-spotted only) are broad-spectrum insecticides that also have fairly 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 broad-spectrum insecticides used in grapes, including Lannate, Danitol, Brigade, Brigadier, Leverage, Baythroid and possibly Sevin can also suppress predatory mites. Since Danitol and Brigade 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. 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. Given the hot growing season I expected Japanese beetles to be abundant in 2010. However, with some exceptions, they were not as bad as they were a few years ago. I don't really have an explanation. The adults (1/2 inch body, metallic green in color) seem to have a fondness for grape foliage, but also feed on a number of other plant species. 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 fact that most vineyards have sod row middles probably exacerbates problems with adults. 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 may be particularly vulnerable in that they have fewer reserves to draw upon to recover from damage. 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 (see 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 [Brigade]	+++	12 hr	30 d	+++	++
bifenthrin+imidacloprid [Brigadier]	+++	12 hr	30 d	+++	++
cyfluthrin [Baythroid]	+++	12 hr	3 d	+++	?
cyfluthrin+imidacloprid [Leverage]	+++	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. By the way, reports are that soybean aphid will be abundant this year. I recommend that you scout your vineyards before harvest to see if MALB is present.



Figure 12. Photo by Scott Bauer, USDA

The economic injury level for Concord grapes has been established at about 6 beetles per 10 pounds of fruit by National Grape Cooperative. For wine grapes, something in the range of 5 beetles per 25 clusters could result in off-flavors. 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 (Fig. 12). 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.

There are a few chemical approaches to managing MALB in New York: Danitol [fenrothrin], 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. However, a 21 days to harvest restriction limits its usefulness. 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. 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). The neonicotinoid insecticide Venom [dinotefuran] has shown good efficacy against MALB (both toxic and repellent) in trials conducted by Rufus Isaacs at Michigan State University. It only has a 1 day to harvest restriction. Venom is labeled for use in PA but not NY. Just

this year, however, as noted under chemical news, Provado 1.6F received a 2(ee) label expansion for MALB. Provado 1.6F has a zero day to harvest interval. It has both toxic and repellent effects on MALB similar to Venom.

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 eradicant if a pest does reach sufficient densities to cause economic damage. Knowledge of what is present will lead to better management decisions.

During the period after 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. Although sporadic, I did find several vineyard blocks in the Finger Lakes with damaging populations in 2010. If you find more than one nymph per 10 clusters, consider an insecticide treatment such as Sevin or Danitol or Assail. Other than these plant bugs, there are few insect pests between budbreak to bloom period that can cause significant harm. A caveat to this is for sites, often with sandy soils, that are prone to **rose chafer**. The light-brown adult beetles 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. The current practice is to use calendar date to determine timing of scouting and insecticide control for second and third generations.

However, we know that temperature is the primary determinant of insect and vine phenology. Check out the temperature-based phenology forecast model available online at <http://newa.cornell.edu/> (look under pest forecast models for grape berry moth). This model can help you better time the occurrence of grape berry moth flight activity. It also provides useful pest management sign posts and guidelines. The model uses bloom date of wild riverbank grape *V. riparia* as a biofix (starting point for accumulating degree days to be used to predict timing). This generally occurs about a week before Concord bloom. If you don't know the bloom date of wild grape, the model will estimate it based on historical data. Also remember to follow email pest updates. Use a long residual material (Intrepid is a good option for PA) for the second generation 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 essential. 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 (this is what occurred in 2010). 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, these guys can do a lot of feeding during July. 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 or my email at gme1@cornell.edu. 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.

Toward harvest keep an eye out for **multicolored asian lady beetle (MALB)**. This normally beneficial insect can become a pest at this time of year by congregating in the clusters at harvest. The beetles release a noxious chemical when disturbed (such as by harvesting the fruit) and this can taint wine and juice. Their populations have been fairly low in recent years although we are overdue for a big year. In the past, Lake Erie vineyards and the Niagara Peninsula have been particularly vulnerable. Also vineyards near soybeans. There are some people suggesting that soybean aphid will be very abundant this year, which could lead to high MALB populations. Keep an eye out for email alerts.

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.