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Management of Grape Insect and mite pests-2008

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I think there is a general consensus that the 2007 field season was the year of the Japanese beetle. They showed up at the beginning of July and seemed to stay around well into late summer. In a dry and warm year such as 07 we would also typically expect widespread grape berry moth damage but beyond the traditional high risk sites, the Lake Erie and Finger Lakes regions did not really experience major problems. In a bit of a switch, however, Long Island did see higher than normal pressure. There were sites where mites were a problem, but we observed many instances where two-spotted spider mite was the dominant species rather than European red mite, the species we normally see in grapes. Overall, with the exception of the beetles, 2007 was not a bad insect year. It is hard to predict what kind of insect year we will have in 08.

In preparation for the 2008 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. 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 and the rest of the crew at the Vineyard Lab, Tim Weigle of the NY IPM Program, Tim Martinson, 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).

Insecticide and miticide news

Avaunt, a DuPont product [indoxacarb, EPA # 352-597, Caution signal word] was labeled last year for grapes by the EPA and has also now received a label to be used in New York. This insecticide is labeled for grape berry moth (we give it two pluses in our guidelines), Japanese beetle, and a few other insect pests of grapes. The label recommends the higher rate for moderate to heavy insect pressure. There is a limit of 2 applications per year, with minimum of 21 days between sprays, and no more than 12 oz per acre per season. An adjuvant is recommended to help increase coverage. It has a novel mode of action and should not be cross resistant with other insecticides. Avaunt will also provide suppression of leafhoppers, although it is not recommended as a superior leafhopper material.

In other insecticide news, the patents have ended for several grape insecticides leading to the marketing of generic materials, often at lower costs. With a few exceptions, we have not compared the efficacy of these generic insecticides with the main brands in head to head comparisons. The active ingredients are the same but they can differ in inert materials and formulations. I am aware of two generic materials for the pyrethroid insecticide Capture (bifentrhin): Bifenture EC (EPA # 70506-57) and Fanfare 2EC (EPA # 66222-99). The pyrethroid insecticides have broad-spectrum activity against moths, beetles, leafhoppers, and even some activity against mites. They are also quite hard on beneficial arthropods. The neonicotinoid insecticide imidacloprid has also come off of patent protection. Alias 2F (EPA # 264-758-66222) is a generic to the soil applied systemic insecticide Admire 2F and the Pasada 75 WSB (EPA # 264-761-66222) is a generic version to the foliar applied Provado Solupak 75 WSP. The neonicotinoids are particularly good against sucking insects such as leafhoppers but also have activity against some beetle species and even moths depending on the product (see the labels).

There is one other new insecticide that EPA recently granted a label for use on grapes, although it is not yet labeled in NY. This is Delegate WG [spinetoram], a next generation material related to Spintor [spinosad]. Delegate WG [EPA # 62719-541, Caution signal word, REI = 4 hours, DTH = 7 d] is a selective insecticide with activity against Lepidoptera such as grape berry moth and also against thrips. It is easy on beneficial arthropods. I have not tested its efficacy against grape berry moth. It is reported, though, to have longer residual activity than Spintor, which would be a nice improvement.

Over the past several years we have been testing the efficacy of a new insecticide in the anthranilic diamide class called rynaxypyr. Rynaxypry is active against Lepidopteran pests like grape berry moth as well as some other insect pests. With the correct timing and rate, it has been quite effective against berry moth as well as shown activity against Japanese beetle in our trails. The Dupont product called Altacore apparently is close to receiving an EPA label for use on grapes. I am not sure when this will get labeled for grapes in NY, but it will at least be a year away. Syngenta will also be selling materials containing rynaxypyr in combination with other Syngenta insecticides, although I am not certain when they anticipate EPA approval.

In miticide news, Onager [hexytiazox, EPA # 10163-277, Caution signal word, REI = 12 hrs, DTH = 28 d] has been labeled for use on grapes, including in New York. This miticide principally is active against eggs and immature stages and therefore, you may not see as rapid a knock down of populations as some other miticides that are active against adults and immature states. It is limited to 1 application per season. As noted last year, Envidor [spirodiclofen, EPA # 264-831, Caution signal word, REI = 12 hrs, DTH = 14], a miticide with a novel mode of action has received a federal label for use against spider mites, including European red mite, on grapes. Envidor is not yet labeled for use in NY.

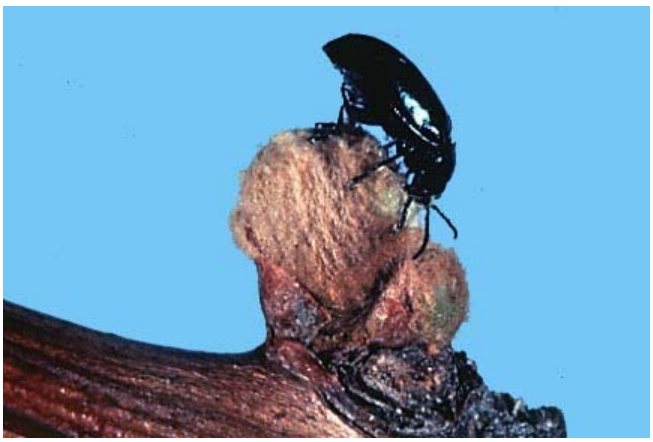
Review of key arthropod pests

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. Each year I seem to add another species to the list and this year its soft scales and mealybugs. 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: 2008 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, 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. You can 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 Eire 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, moving out to foliage or clusters as the spring progresses. 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. We also believe the numbers are too low to be effective vectors of leafroll virus, although we continue to research this question. 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 Imadan [phosmet]. Timing these foliar applications is difficult. For the scale insects, crawlers are active after bloom (around July 4th in 2006). For mealybugs,

Banded Grape Bug Adult on Flower Cluster

first generation eggs hatch in the middle or later part of July. Egg hatch for the second generation is in late summer.

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, its 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 as noted above, it was in 2007. 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 (vineyards with at least one side bordered by woods, prone to heavy snow accumulation, history of GBM problems) should be treated with insecticides shortly after bloom (first generation larvae) and in July (second generation). They should be scouted for GBM damage in mid to late August to see if a third insecticide application is required. Determining the exact timing of these later insecticide applications has proven tricky. We are currently testing a temperature-based phenology model, using bloom time as the starting point, that we hope will help growers time treatment for second and third generation larvae. 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 late 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 an insecticide treatment for first generation (immediate post bloom)

and scout for GBM in July and August. The current thresholds are 6% cluster damage for late-July and 15% at the end of August. These thresholds have been developed for native grapes bound to processing plants. 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. 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 is usually a good idea. The pyrethoids 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 Bacillis 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 (bloom instead of immediate post bloom, for example). Intrepid has fairly long residual activity. Finally, as noted above, Avaunt has recently been labeled for use on grapes, including use in NY. Avaunt has good activity for GBM and some other pests, but is considered fairly safe for beneficial insects.

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 or intermediate risk of GBM damage, you would probably 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 to late 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 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) 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 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. 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. 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. 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, but may have something to do with the dry conditions in 2007, I observed TSSM about as frequently as ERM. I suspect 2007 was an anomaly. However, in case this situation occurs again, 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: Kelthane [dicofol], Vendex [fenbutatin-oxide], Agri-Mek [abamectin], Nexter [pyridaben] (not on Long Island), Acramite [bifenazate], JMS Stylet Oil [aliphatic petroleum distillate], Zeal Miticide[1] [etoxazole], Onager [hexythiazox], Danitol [fenpropathrin], 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 Miticide[1] 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 in that it affects eggs and immatures but not adults. Danitol and Capture are broad-spectrum instecticides 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 pyrethoids 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 and widespread last year. Indeed, I met a number of growers who treated for Japanese beetle two or three times. 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. Dr. Rufus Isaacs of Michigan Sate has been examining the economic impact of Japanese beetle for the last couple of years. Removal of up to 30% of leaf area on young Niagara vines at veraison did not cause significant decreases in growth or yield the next

season. 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. Just something to be aware of in case 2008 is similar to 2007. 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.

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 in 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

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

Material	EfficacyJB	REI	DTH	Pred.Mites	SpiderMites
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

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 hence, also a high MALB population. This fortunately did not occur and it is unclear what to expect for 2008. If you do end up with a problem, there are a few chemical approaches you can try. Note that we have yet developed a good estimate of the economic threshold for MALB. There are several pesticides now labeled for MALB: Sevin [carbarly], Danitol [fenropathrin], Aza-Direct and Evergreen [natural pyrethrins]. To use Sevin and Danitol in New York for this purpose, you need to have the 2(ee) label. Sevin and Danitol are 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 21days to harvest restriction, Sevin has a 7 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).

Some final comments

There are a large number of potential arthropod pests of grapes and it is possible to get overwhelmed with information on biology, symptoms, control options, etc. Here are a few points to keep in mind to help simply things.

Although there are a large number of potential pests, there are relatively few that consistently represent a major threat (grape berry moth, leafhoppers, mites, and a few others). And of those that can cause significant injury, they may not become a pest at a particular site or a particular year. Generally speaking, with arthropod pests you have time to make management decisions based on what is present in the vineyard rather than before it develops. There is a distinct time of the season when particular pests may turn up in your vineyard. In other words, you can focus your scouting on a limited number of pests at a given vine phenology. Look for steely beetles, climbing cutworm, grape cane borer at budswell; plant bugs and plume moths when shoots are between 3 and 10 inches; grape rootworm, rose chaffer around bloom; grape berry moth, leafhoppers, leaf phylloxera, Japanese beetle, and spider mites after bloom to late August. Don't put your sprayer away too early in the season. Watch out for late-season damage from grape berry moth. Read extension pest alerts available through the grape extension programs. If you don't have access to email, see if you can get someone who does to makes copies for you. To sign up for electronic updates, please contact the Finger Lakes or Lake Erie extension programs directly. 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. Be aware of the potential for grape berry moth and grape leafhopper resistance to Sevin. Rotate among materials to reduce development of resistance. Be aware of consequences for 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.