Crop Advisory Team
Alert
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Fruit Crop Advisory Team Alert

In this issue

Next issue: April 14

Starting up the season

Welcome back, *Fruit CAT Alert* readers. Spring is right around the corner, so it's time to start planning for the upcoming season. Our first issue offers research on strobulurin resistance, American brown rot, and pheromone-based approaches for managing tree fruit pests, upcoming meeting for blueberries and wine grapes, fruit insecticide registration updates and regional reports.

We appreciate suggestions from you, our readers. Please feel free to contact Andrea Buchholz at (517) 353-4703 or email catalert@msu.edu. Internet readers can also sign up to receive a brief email when we post new issues on the Internet or use our new RSS feed. Details are at: http://ipm.msu.edu/email-fruit.htm

We look forward to joining with MSU's faculty and educators to provide you with up-to-date information for this season. – *Joy Landis, editor, and Andrea Buchholz, assistant editor.*

Strobilurin resistance in the apple scab fungus in Michigan

George Sundin, Kim Lesniak, Tyre Proffer, Plant Pathology
Amy Irish-Brown, MSU Extension Educator

Apple scab, caused by the fungus *Venturia inaequalis*, is an important constraint on apple production in Michigan. The primary inoculum for apple scab develops in the spring in infected leaves on the orchard floor from the previous season. If primary scab infection is not controlled, significant levels of leaf and fruit infection can be expected. Infection periods for apple scab occur every year in Michigan orchards. Although apple varieties with resistance to scab do exist, these varieties are not widely planted; thus, scab must be actively controlled each year through intensive usage of fungicides. This intensive fungicide usage has led to the development of resistance in *V. inaequalis* to some classes of fungicides such as dodine and the benzimidazoles in Michigan.

The strobilurin class of fungicides was first used in Michigan in 1999 when Sovran was registered. A second strobilurin fungicide, Flint, was registered soon after that. Both of these fungicides provided excellent control of apple scab. However, since these fungicides have a single site mode of action, there was always a risk for the development of resistance in the pathogen population. We now have confirmation that this has occurred in two growing regions of Michigan.

We use two tests to identify strobilurin resistance. The first is a genetic test for the

Table 1. Strobilurin resistance results in analyses of apple scab fungal isolates from Michigan orchards.

	G143A		G143A
Fruit Ridge	**# res isol. / total isol.**	**Eastern Michigan**	**# res isol. / total isol.**
Orchard 1	20 / 25	Orchard 1	5 / 11
Orchard 2	25 / 25	Orchard 2	3 / 10
Orchard 3	16 / 21	Orchard 3	9 / 10
Orchard 4	25 / 25	Orchard 4	6 / 10
Orchard 5	24 / 24	Orchard 5	0 / 10
Orchard 6	22 / 22	Orchard 6	0 / 13
Orchard 7	15 / 22	Orchard 7	0 / 11
Orchard 8	20 / 20	Orchard 8	0 / 7

G143A mutation, which is known to confer resistance to strobilurins in many different fungal pathogens. The second is a spore germination test that compares germination of fungal isolates on a growth medium amended with a high rate of strobilurin with one that does not contain any fungicide. If the spores can germinate on both media, that fungal isolate is resistant. We found that the results of the spore germination test correlated with the G143A genetic test in our studies.

In 2008, we sampled eight orchards in the Fruit Ridge area and eight other orchards in eastern Michigan. Our results indicated a widespread strobilurin resistance problem (Table 1).

Isolates that carry the G143A mutation are immune to the stobilurins and cross resistance is observed between Sovran and Flint. Thus, these fungicides are no longer effective for scab control. Note: we do not have information on the status of susceptibility of other fungal pathogens in which strobilurins are effective for control (e.g. powdery mildew, black rot, summer diseases).

The results in Table 1 tell us several things and let us speculate about the current status of orchards in other locations in Michigan. First, the occurrence of resistance at such high levels on the Ridge suggests that these resistant strains have been developing over the last few years. 2008 was not an especially bad scab year, in fact, conditions were dry on the Ridge throughout much of the primary scab season. We only observed scab problems on the most susceptible variety, McIntosh, and believe that we were fortunate that scab infection pressure was not as high in the year where we discovered problems due to a fungicide control failure. The lower level of resistance observed in the eastern Michigan orchards suggest that these orchard populations are likely a year or two behind those found on the Ridge. However, one strobilurin application in an orchard that currently harbors 50 percent resistant isolates is enough to change the orchard population to 100 percent resistant by killing off the sensitive isolates. This is why it is important to not utilize strobilurins in orchards where resistance is known.

The geographic distribution of orchards with strobilurin resistant apple scab isolates suggests that we may have a wider problem in Michigan. Thus, orchards in Southwest, West Central, and Northwest Michigan may have some population of strobilurin-resistant apple scab fungus. We will be sampling orchards in these locations in 2009 to get a definitive picture of the problem in these other locations.

What are the alternatives to strobilurins for apple scab control? We address these options in the accompanying article. Any use of strobilurins in Michigan apple orchards in 2009 should be at full rates in a tank mix with a broad spectrum protectant. The next fungicide application should follow on a shorter interval (7 day maximum) and include a broad spectrum protectant.

We are facing the loss of the strobilurin fungicide mode of action in Michigan which will put a serious constraint on apple scab disease control. As we lose fungicide modes of action, other methods of control, including reduction of overwintering inoculum, will become more and more important. **IPM**

Apple scab control without strobilurin fungicides

George Sundin, Plant Pathology and Amy Irish-Brown, MSU Extension Educator

The preceding article describes our discovery of resistance to strobilurin fungicides in the apple scab fungus *Venturia inaequalis* in Michigan orchards. Eight of eight orchards sampled in the Fruit Ridge area harbored strobilurin-resistant isolates at close to 100 percent frequency. In eastern Michigan, four of eight orchards harbored resistant isolates at mostly lower levels. It is important to remember that resistance to strobilurins conferred by the G143A mutation is complete, meaning that these fungi will not be affected at all by this class of fungicides. Thus, even in orchards currently harboring a lower level of resistant isolates, use of a strobilurin (Flint or Sovran) would be predicted to result in the rapid increase in resistance frequency. Furthermore, increasing the rate of a strobilurin will not increase effectiveness – this is an all or nothing type of resistance.

What classes of fungicides are left for scab control in affected orchards? The number of different fungicide modes of action is dwindling as we lose compound classes to resistance (Table 1).

Here are a few notes on the various fungicide classes available for scab control in 2009:

1. **Copper**. A good scab protectant fungicide; however, use of copper is discouraged after about one-half of an inch green tip because of russeting problems on fruit. May have a place as the first scab fungicide application of the season and also provide fire blight control of inoculum emerging from cankers if fire blight was active in the orchard in the previous two seasons.
2. **Anilinopyrimidines**. Effective scab materials, but at risk for resistance development. At a minimum, should be tank-mixed with a three lbs/acre rate of EBDC for resistance management. This class of fungicide is more effective in colder weather. Highly systemic material that doesn't redistribute well and is not as effective in controlling scab on fruit. Good choice for early-season scab control.
3. **EBDCs, Captan**. Both excellent scab protectants, five to six days of protectant activity when used at full rates. Excellent choice for scab control; remember that intervals will be tighter when relying on these materials.
4. **Sterol inhibitors**. Resistance to sterol inhibitors in the scab fungus is fairly well distributed in Michigan orchards. However, this resistance is quantitative which means each orchard contains fungal isolates with a range of sensitivities. Thus, some control will be observed when using these fungicides. Two sterol inhibitors, Indar and Inspire Super (which contains an sterol inhibitor plus Vangard), are reported to control sterol inhibitor-resistant strains and they do to some degree. However, continued use of these fungicides is predicted to increase the overall level of sterol

Table 1. Fungicide modes of action registered for apple scab control in Michigan.

Fungicide	Mode of action	Risk of resistance development
Anilinopyrimidines Scala, Vangard	Single site	High
Captan	Multi-site	Low
Copper	Multi-site	Low
EBDCs Dithane, Manzate Polyram, Penncozeb	Multi-site	Low
Sterol Inhibitors Procure, Rally	Single site	High
Sterol Inhibitors* Indar, Inspire Super**	Single site	High
Sulfur	Multi-site	Low
Ziram	Multi-site	Low

* Indar and the sterol inhibitor fungicide component of Inspire Super are reported to control sterol inhibitor-resistant isolates of the apple scab fungus better than traditional sterol inhibitors.
** Inspire Super is used as a tank mix of a sterol inhibitor fungicide as well as Vangard (anilinopyrimidine), thus mixing two modes of action.

inhibitor resistance in orchards.

5. Sulfur and Ziram. Both are weaker protectants with a shorter duration of protectant activity meaning more applications required.

There are several keys for successful apple scab control in 2009 in orchards impacted by strobilurin resistance:

Start control early. The first fungicide **must** be applied before the first scab infection after budbreak. Once scab becomes established in orchards, it is difficult to rein in, and we are lacking another tool for management.

Fungicides must be used in a protectant strategy, i.e. applied prior to rains and scab infection periods. The protectant strategy ensures a fungicide barrier is present protecting susceptible tissue from apple scab spores. This strategy also accomplishes a secondary goal for resistance management in which we want to kill the scab fungus and not allow any growth – because any growth increases the chances that the scab fungus can mutate to fungicide resistance.

Keep spray intervals tighter (seven days or less) to maximize control.

Spray all middles. Full coverage is necessary to ensure the presence of the chemical barrier.

If we experience extended periods of wet weather during primary scab season, several fungicides can be sprayed under light rain conditions including mancozeb (Dithane), Captan, Polyram, and Sulfur. This practice again will maintain a protective barrier.

Increasing problems with fungicide resistance in Michigan will require more grower action to achieve the same levels of apple scab control we were accustomed to. Stay ahead of the game in 2009. **IPM**

Sensitivity of American brown rot to sterol inhibitor fungicides in 2008

Erin Lizotte, IFP/IPM District Educator, NWMHRS and George Sundin, Plant Pathology

American brown rot (AMERICAN BROWN ROT) is caused by the ascomycete fungus *Monilinia fructicola,* and is an important pathogen on cherry (particularly sweet cherry varieties), peach, apricot, nectarine, and plum. The fungus attacks fruit, blossoms, spurs and shoots with ideal infection conditions initiating epidemic inoculum levels in as little as 24 hours. Brown rot causes fruit rot before and after harvest, greatly reducing the quality and quantity of the yield, particularly in heavily bunching sweet cherry varieties.

During the 2008 growing season many factors contributed to the high level of brown rot observed in sweet cherry orchards around the state. Pollination problems, unusually long retention of unfertilized cherries, and wind and hail damage combined with ideal conditions for disease development leading up to harvest creating epidemic levels of brown rot infection in many sweet cherry blocks around the state. Due to the high levels of brown rot, the efficacy of sterol inhibitor fungicides, such as Indar, Orbit and Elite, was called into question. Field trials testing Elite and Indar were conducted at the Northwest Michigan Horticultural Research Station in Traverse City, Michigan during 2008. Disease pressure was extraordinarily high because we inoculated trees with the brown rot pathogen. Despite this high pressure, Indar adequately suppressed brown rot (Table 1). Elite was not as effective as in previous trials and will be tested again in 2009 to confirm these observations.

In addition to field efficacy trials, *in vitro* sensitivity of *M. fructicola* to Indar and Orbit was assessed in 2008. Twenty-one sweet and nine tart cherry orchards were screened, from northern Leelanau County south to Benton Harbor. Thirty *M. fructicola* samples were collected at each orchard and were then single-spore isolated in the lab. Fungicide resistance studies use reduced mycelial growth to measure sensitivity. In this case, we examined growth of the fungi on agar amended with sterol inhibitors, relative to normal growth of the fungi in the absence of the inhibitor. Propiconazole concentrations used in our tests were based on a discriminatory dose (0.3µg/ml a.i. propiconazole) established in peaches (Schnabel, et al. 2004), a stone fruit generally less susceptible to brown rot. This discriminatory dose defines sensitive *M. fructicola* isolates as those that do not grow on agar amended

with 0.3µg/ml a.i. propiconazole (the discriminatory dose). Resistant *M. fructicola* isolates are defined as those which have a relative growth of greater than or equal to 50 percent on agar amended with the discriminatory dose of 0.3µg/ml a.i. propiconazole, compared to a control. In the case of Indar, the discriminatory dose of 0.1µg/ml a.i. of fenbuconazole was based on a discriminatory dose that we established in 2007 by sampling an abandoned Michigan orchard, representing a fungal population with minimal exposure to sterol inhibitor fungicides.

None of the orchards screened confirm resistance to propiconazole (Orbit) but many orchards, particularly sweet cherry orchards are approaching 50 percent relative growth, characteristic of resistant *M. fructicola* isolates in peaches (Figure A). Currently, this screening process cannot confirm or reject the presence of fenbuconazole (Indar) resistance as practical field resistance has not been conclusively proven (Figure B). Indar sensitivity levels can be used to gauge changes in sensitivity over time and to compare the average sensitivity of orchards based on the history of sterol inhibitor use.

Table 1. 2008 *M.fruticola* fungicide efficacy data

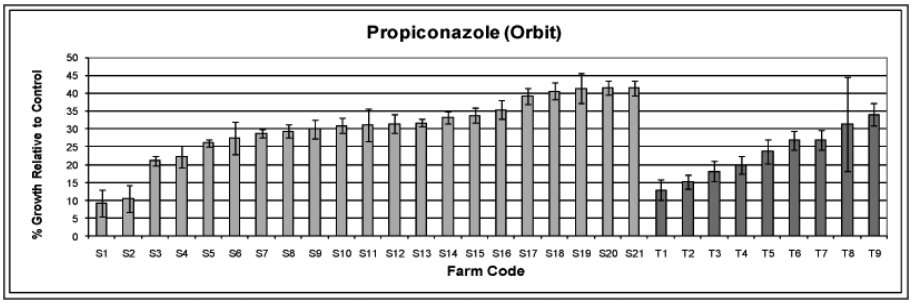
Treatment and Product/acre	Percent Infection*, 25 Jul
Bravo Ultrex 82.5% WDG 3 lb Elite 45WP 6 oz	25.1b
Bravo Ultrex 82.5% WDG 3 lb Indar 2F 6 fl oz	5.8c
Untreated control	70.5a

* Means within a column followed by the same letter are not significantly different according to Fisher's Protected LSD (P<0.05).

Treatment dates: May 15 (petal fall -Bravo); May 20 (shuck split-Bravo); May 29 (first cover SI); June 9 (second cover - SI); June 19 (third cover-SI) and June 30 (fourth cover-SI).

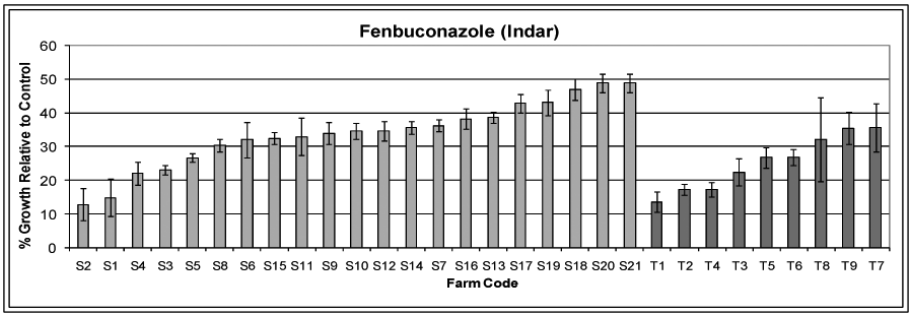
Projected harvest date was July 18.

Figure A.



Average relative growth of Monilinia fructicola isolates in the presence of propiconazole (Orbit) based on orchard site. Pink bars indicate samples collected from sweet cherry orchards, red bars indicate samples collected from tart cherry orchards. Greater than or equal to 50 percent relative growth would be indicative of propiconazole resistance.

Figure B.



Average relative growth of Monilinia fructicola isolates in the presence of fenbuconazole (Indar) based on orchard site. Pink bars indicate samples collected from sweet cherry orchards, red bars indicate samples collected from tart cherry orchards.

Interesting patterns emerge from the data when orchards are sorted based on past sterol inhibitor use. There are few sites available with limited or no history of sterol inhibitor use, so sampling is limited to organic/organic-transitional sites, and abandoned blocks. Despite the small sample size, significant differences in *M. fructicola* sensitivity exist based on sterol inhibitor history (Figure C). These data point to sterol inhibitor fungicides having a definite effect on *M. fructicola* population sensitivity, the same pattern which was confirmed in a 2007 survey of brown rot.

The results of the *in vitro, M. fructicola* inhibitor sensitivity trial produced two indicators that sterol inhibitors are influencing shifts in the fungal populations. First, there is an overall variability in *M. fructicola* sensitivity, an indicator that the population is being affected by the fungicide (Figures A and B). Second, there is a significant difference in the population's sensitivity based on the past exposure of the fungi to the fungicide (Figure C available online at www.ipm.msu.edu/fruit-cat.htm).

What methods can be used to limit further shifting in the brown rot populations that will lead to resistance to sterol inhibitors? Tank mixing and fungicide rotation are a **must** to preserve SI efficacy for as long as possible. Full rates and good coverage are also very important. Iprodione (Rovral® 50WP) may be applied for the spring, blossom-blight application to help limit the number of sterol inhibitor sprays used in a season. Iprodione is a protectant fungicide that affects the fungus differently than sterol inhibitors and may help reduce the speed at which sterol inhibitor resistance is developing. Pyraclostrobin and boscalid mixtures (Pristine®) and trifloxistrobin (Gem)

are also rated as providing good control of American brown rot under lower disease pressure and can be utilized as a rotational partner during some seasons. We are also awaiting word on a special Section 24(c) label for Indar which will increase the allowable rate used in orchards from 6 fl oz per acre to 6-12 fl oz per acre. Since differences in sterol inhibitor sensitivities are quantitative in the brown rot population, increasing the rate of Indar should be effective in controlling strains with shifted phenotypes.

The most important factor in limiting further shifting in brown rot populations is to effectively kill the fungus in orchards and limit exposure to sterol inhibitors. This can be best accomplished as stated above by rotating modes of action (especially to Iprodione during bloom). In addition, increasing the rate of Indar initially to at least 8 fl oz per acre would increase the effectiveness of the best tool for killing American brown rot fungi. We will pass word along of the Section 24(c) label when it becomes available. **IPM**

Pheromone-based approaches to managing tree fruit pests in Michigan

Larry Gut, James Miller, Peter McGhee, David Epstein, Entomology, Michigan State University; and Lukasz Stelinski, University of Florida

Many fruit growers are making pheromone-based mating disruption the foundation of their pest management programs. An estimated 500,000 acres worldwide, including nearly 175,000 acres in North America, are treated with pheromone to control codling moth.

There are some features unique to mating disruption that continues to make adoption of this technology challenging for growers. Unlike most pest controls, the targeted pest is not killed. Rather, the approach entails dispensing pheromone (synthetic sex attractant) into a crop so as to interfere with mate finding. Control is thereby achieved by curtailing the reproductive phase of the pest's life cycle.

To achieve control, the grower typically must apply the pheromone treatment before the adult stage of the insect shows up, prior to knowing whether the pest is present in numbers sufficient to warrant treatment. The decision to spend up-front is made more difficult by the high cost of mating disruption products.

While insecticides can control very heavy infestations, mating disruption works best when pest densities are low, and its effectiveness declines as pest pressure increases. Under even moderate pest densities, achieving control usually requires that a grower apply supplemental insecticides to provide acceptable levels of crop protection. The need to supplement mating disruption with insecticides makes it difficult to determine how much of the success in preventing fruit injury is attributable to the pheromone treatment. The effectiveness of mating disruption is measured by the extent that moths are prevented from finding pheromone traps. Although this method better reflects the level of control provided by the pheromone treatment, using pheromone traps to measure the effectiveness of mating disruption has its own set of challenges.

Three general types of mating disruption technologies comprise the majority of commercially available products. At present, mating disruption of orchard pests is largely achieved through the manual application of reservoir-type release devices, commonly refereed to as hand-applied dispensers. Pheromone is enclosed in plastic or dispersed in synthetic polymers and slowly diffuses from these reservoirs over a period of three to six months.

Substantial efforts have been invested in other formulations to make the technology easier to use and perhaps more efficacious. Two kinds of formulations have been developed that allow the pheromone to be sprayed on the crop either by ground or air. Pheromone has been dispersed into microcapsules or beads small enough to be applied through conventional spray equipment. Pheromone also has been formulated into plastic flakes or chopped fibers that are delivered using custom-designed equipment, often with a sticker added so that the flakes or fibers will adhere to foliage. These machine-applied formulations are designed to distribute pheromone into the orchard via thousands or hundreds of thousands of small pheromone release units.

A very different approach to reducing application costs entails the formulation and release of pheromone via aerosol-emitting devices. These devices are deployed at extremely low densities of only one or two per acre. Aerosol emitters control the release of pheromone mechanically to provide a regular, predetermined emission of a large amount of pheromone.

It would be great if each of these approaches to mating disruption were equally effective and growers simply needed to choose the one that is most economical or easiest to use. However, our experience with the various mating disruption formulations suggests that this is not the case. Rather, they have different strengths and weaknesses and vary in their ability to interfere with moth mating. Thus, growers must be informed and thoughtful in choosing which of these very different approaches to use. We believe that understanding how mating disruption might actually be achieved is an important first step guiding adoption of this novel technology. With a solid understanding, growers should be in a better position to both compare technologies and use them most effectively for their particular needs.

In practice, the success of mating disruption depends on the cost-effective delivery of an appropriate blend, amount, and spatial distribution of pheromone for an extended period. Once the pheromone is delivered though, how is the behavior of males impacted to achieve mating disruption?

As illustrated in Figure 1, there are two general ways this might be achieved: 1) by competitive attraction where males are diverted from orienting to females because of competing attraction of nearby false trails emanating from pheromone dispensers, or 2) by a non-competitive means where exposure to synthetic pheromone subsequently reduces or blocks the male's ability to sense pheromone normally, and this happens without attraction. The latter could be achieved by negating the male's ability to respond

to pheromone or by camouflaging the location of a pheromone-emitting female.

Our findings over the past several years indicate that both mechanisms are operating, but that in by far the most cases competitive attraction is the key initial step. Three principal lines of evidence support the primary importance of competitive attraction. Extensive observations of male response to reservoir dispensers in the field reveal that male moths readily approach the dispensers, even in a fully pheromone-treated orchard. Additionally, mating disruption appears to be highly dependent on moth density. This is consistent with a scenario in which the capability of false pheromone sources in competing with females for searching males is easier if there are fewer individuals in the competition. If, on the other hand, the presence of pheromone in the orchard atmosphere impacted a male's ability to respond to pheromone, all males present in the pheromone-laden area should be affected regardless of how many are present. In other words, non-competitive mating disruption would not depend on the pest's density.

Finally, the effect of increasing numbers of point sources on mating disruption is predictable and the outcome should look something like Figure 2 if competitive attraction is operating. The first few dispensers have the greatest impact, but as more and more dispensers are added the effect of each diminishes. In other words, achieving 60 percent disruption takes only a few dispensers; bringing this up to 80 percent disruption requires a substantial number of additional dispensers; and levels of disruption above 90 percent require a huge bump in the number of point sources.

The remainder of this article focuses on the primary options growers have at their disposal for controlling pests by mating disruption. The discussions are largely based on our experience in Michigan and are guided by the above understanding of how mating disruption is achieved in the field and its resulting implications. The key practical implications if competitive attraction is a crucial step toward achieving mating disruption are:

- Dispenser density should be high
- Distribution should be uniform, rather than clumped
- Lots of attractive point sources should provide the best disruption

Hand-applied reservoir dispensers

The tree fruit industry is probably most familiar with reservoir-type dispensers, such as plastic tubes, membranes, puzzle-pieces or spirals. Pheromone is dispensed from these devices at rates that are thousands of times greater than the release rate of pheromone from a female moth. Reservoir dispensers are hand-applied at a rate of 100-400 sources per acre, depending on the targeted species and other factors including pest density and the product's label.

Oriental fruit moth is easier to disrupt than codling moth, thus application rates of 100-150 dispensers per acre generally provide 97 percent to near complete inhibition of Oriental fruit moth mating. Our experience is that higher numbers of dispensers are needed to disrupt codling moth in apple, unless pest densities are very low. Also, codling moth disruption is not as robust. Inhibition of moth captures is often near or above 90 percent, but occasionally below 70 percent due to factors such as high pest density (Figure 3A). The more point sources the greater the impact on orientation, as documented in Figure 2. We have found that reservoir formulations having as much as a fourfold difference in release rates still provide very similar patterns of improved performance with increasing dispenser density.

The potential benefit of applying a high number of dispensers for codling moth disruption is illustrated in Figure 4. These results, from a study conducted by Jay Brunner, Washington State University, and colleagues show a general pattern of higher point source densities providing greater inhibition of moth catch and protection from fruit injury than lower densities. The orchard perimeter is especially vulnerable to increasing incidence of fruit damage when too few dispensers are applied. Thus, it is not surprising that growers benefit the most if disruption is applied on a whole-farm basis.

Microencapsulated sprayable pheromone

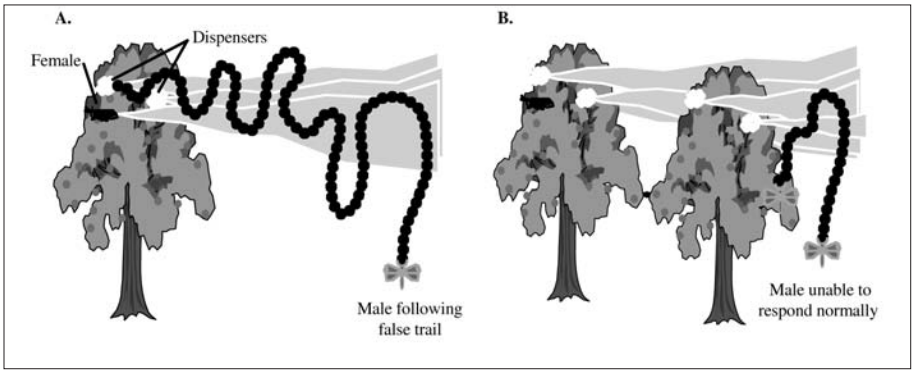
The application of a sprayable disruption formulation results in the dispersion of up to a half million pheromone-containing microcapsules per acre. If each were capable of diverting the attention of males, this approach should be tremendously effective. However, each capsule releases pheromone at a very low rate, well below that of a female moth. The broadcast application of microencapsulated pheromone using an airblast sprayer appears to achieve mating disruption by camouflaging the female's signal.

For some pests, like Oriental fruit moth, the approach can yield a high level of disruption. Oriental fruit moth females release low amounts of pheromone, thus a camouflaging level of pheromone might be easier to attain. Indeed, spraying pheromone microcapsules is quite effective for Oriental fruit moth. In opting for this approach, however, the user must take into account that microcapsules release sufficient quantities to disrupt for about two to three weeks or less if hard rains dislodge the capsules from the foliage. The best approach for disrupting Oriental fruit moth with sprayable pheromone is to apply low rates at frequent intervals.

Control of codling moth using sprayable pheromone has proved more difficult. Female codling moth release pheromone at a higher rate than Oriental fruit moth females, and this likely makes it harder to disguise their plume. In trials with microencapsulated pheromone formulations, we have achieved only low to moderate levels of disruption, typically around 70 percent inhibition of moth captures in traps (Figure 3B).

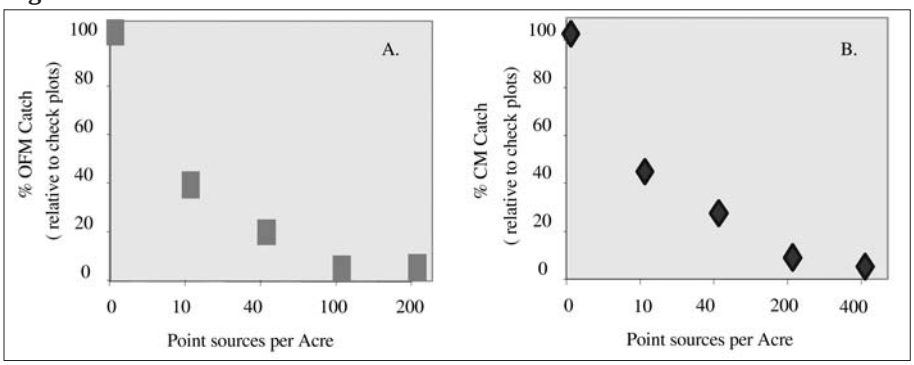
The highest level of disruption is achieved when the sprayable product is applied using the "ultra low volume" approach pioneered by Tom Larson and Alan Knight in Washington State University. The improved efficacy when the treatment is made using only 1.5 gallons of water appears to result from the clustering of microcapsules that might lead to competitive attraction between clumps of capsules and females. Although the low volume approach improves the performance of sprayable pheromone, it still requires multiple applications to inhibit mate location through the season, including reapplication after a rain event, and the best disruption is achieved when

Figure 1.



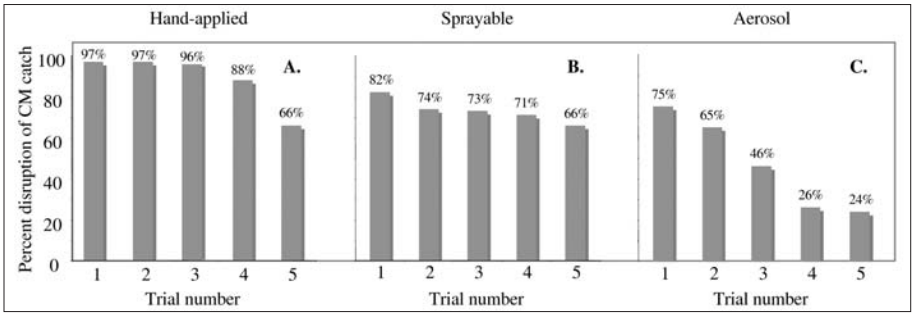
The two principal means by which mating disruption is achieved: A) by competitive attraction where males are diverted from orienting to females due to competing attraction of nearby false trails emanating from pheromone dispensers, or B) by a non-competitive means where exposure to synthetic pheromone subsequently negates the male's ability to sense pheromone normally.

Figure 2.



Percent disruption of (A) Oriental fruit moth and (B) codling moth male orientation to pheromone-baited traps in disrupted compared with non-disrupted control plots at varying point source densities. All Oriental fruit moth plots were treated with 200 Isomate® M Rosso dispensers, but dispensers were distributed in bundles of 20, five or two dispensers to achieve the lower point source densities. All codling moth plots were treated with 400 Isomate® C Plus dispensers, but they were distributed in bundles of 40, 10 or two dispensers to achieve the lower point source densities.

Figure 3.



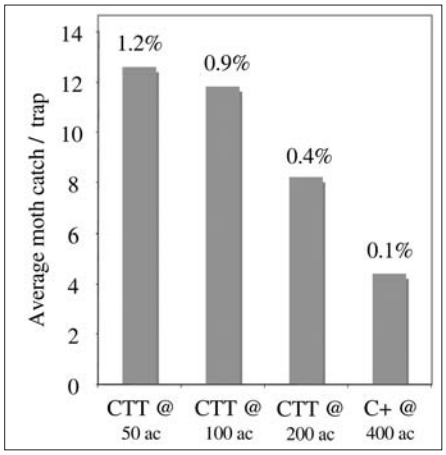
Percent disruption of codling moth male orientation to pheromone-baited traps in disrupted plots compared with non-disrupted control plots in trials conducted over the past several years using: A) a hand-applied reservoir type dispenser applied once per season, B) microencapsulated pheromone applied at 10-14 day intervals throughout the pest's flight, and C) a single application of an aerosol emitter. The five trials for a particular type of dispensing system were conducted independently of trials for the other types.

pest densities are low. Thus, use of the microencapsulated formulation is a good option if you are dealing with low codling moth pressure and wish to enhance the effectiveness of an insecticide-based management program.

Aerosol emitters

Aerosol emitters are deployed at densities of one-half to two per acre,

Figure 4.



Average moth captures in plots treated with Isomate® twin-tube (CTT) or C Plus (C+) dispensers at 50-400 dispensers per acre. Percentages above the bars are the average fruit injury recorded for each treatment. (Data provided by J. Brunner, Washington State University).

but each unit releases pheromone every 15-30 minutes at a rate equivalent to that of 50-100 hand-applied reservoir type dispensers. These devices provide a stable environment for the large volume of pheromone prior to its release and control the emission of pheromone mechanically to give a constant predetermined release rate. Researchers and practitioners in the western United States have reported high levels of orientational disruption using this high release, low point source pheromone-dispensing strategy. In field trials in Michigan, aerosol emitters have provided up to 97 percent disruption of male Oriental fruit moth orientation to pheromone-baited traps in treated plots compared with untreated controls.

The outcome in codling moth trials has not been nearly as robust, however, with only 24–75 percent disruption of male codling moth (Figure 3C). Our experience has been that disruption attained with such a low emitter density approach is insufficient to control codling moth unless pest density is very low or supplemental insecticides are applied.

Achieving complete coverage of the orchard with pheromone appears to be especially problematic with such a wide spacing of aerosol emitter type dispensers. We most often catch moths upwind of the aerosol emitters or on orchard borders. Similar to our findings with hand-applied dispensers, increasing the number of units per area appears to

fill some of the holes and increase the level of disruption.

In review, there are a couple of themes from the above discussion we wish to emphasize. Oriental fruit moth is much easier to disrupt than codling moth using any of the available technologies. The grower has several good options for economical and effective management of this pest with pheromones including hand-applied, sprayable and aerosol emitter products. The best results for codling moth are generally achieved when dispensers are distributed uniformly and at a high point source density.

Regardless of the technology deployed, the outcome is always affected by pest density. Currently, the most robust approach to disrupting codling moth is to deploy a very high number of hand-applied dispensers. This strategy is especially warranted at moderate to high pest densities. In addition, combining a high point-source approach with supplemental insecticides is the best means of reducing pest densities to very low levels and can result in the ability to sustain these very low pest levels over the long term with minimal intervention with insecticides.

To reduce material and labor costs, growers are interested in reducing dispenser density. This can be done. However, using a low number of dispensers will be most effective when pest densities are also low. Growers can explore this strategy to manage codling moth, but should be mindful that more supplemental insecticides will likely be needed than would be the case if a high number of point sources were deployed. **IPM**

2009 Fruit insecticide registration update

John Wise, Rufus Isaacs and Larry Gut, Entomology

This is a summary of insecticide/miticide label new additions and corrections to the 2009 MSU Fruit Management Guide (E-154). Agri-chemical labels and regulations can change quickly so use this information within the context of each compound's actual label.

New labeled insecticide descriptions (not included in MSU Fruit Management Guide)

Assail (60) (acetamiprid) belongs to a new class of insecticides called neonicotinoids (chloronicotinyl subclass). Assail is registered for use in pome and stone fruits, targeting aphids, leafhoppers, leafminers, psylla, plum curculio, apple maggot, oriental fruit moth, and codling moth. Assail is labeled on grapes for control of leafhoppers and aphids, rose chafer, phylloxera, and Japanese beetle. Assail is labeled for use on strawberry, blueberry and caneberry for leafhoppers, aphids, sap beetle, blueberry maggot, fruitworms, and Japanese beetle. This translaminar (locally systemic) material has long residual inside the plant. Because most of Assail's surface residue is quickly absorbed into the plant, negative impact on natural enemies is minimized.

Clutch (71) (clothianodin) belongs to a new class of insecticides called neonicotinoids. Clutch is registered for use in apples, pears and grapes, targeting aphids, leafhoppers, leafminers, psylla, plum curculio, apple maggot, oriental fruit moth, grape berry moth and codling moth. In grapes, the multi-colored Asian lady beetle has been added to the label with a zero-day phi. This translaminar (locally systemic) material has long residual inside the plant. Clutch has a broad spectrum of pest activity, being effective on piercing/sucking insect pests, as well as controlling several internal feeding insects of fruit. Clutch 50 WDG is restricted to a total of 6.4 oz per acre per season in pome fruits, and 6 oz in grapes.

Insecticide 2009 additions, label changes, restrictions

Compound	Label Changes/ Restrictions	Crop	Target pests
Assail 30SG	New use	stone fruits	see article
Clutch 50WDG	New use	grapes	multi-colored Asian lady beetle
Tourismo	New label	pome fruits	see article
	New label	stone fruits	see article
	New label	grapes	see artcile
Zeal 72WDG	New use	cherry	spider mites, European red mites

Tourismo (flubendiamide/buprofezin) is a new insecticide that combines two active ingredients as a pre-mix formulated compound. Tourismo is registered for use in pome fruits, stone fruits and grapes targeting codling moth, oriental fruit moth, leafrollers, grape berry moth, fruitworms, mealybug, cutworms and scale insects. Tourismo holds the combined performance attributes of the flubendiamide and buprofezin chemistries. For the purposes of resistance management, after using Toruismo in a given pest generation, products containing either one of flubendiamide and buprofezin shouldn't be used in the subsequent generation.

Zeal (63) (etoxazole) is a growth regulator miticide labeled for use in apples, cherries and strawberries for the control of mites. Zeal is primarily active against major tetranychidae mites (spider mites and red mites) in the egg and larval stages of growth, providing control ranging from eight weeks to full season depending on mite pressure, the extent of tree vegetative growth, and predator mite populations. Zeal controls susceptible mites by inhibiting the molting process through disruption of the cell membrane. Since Zeal's activity depends upon mite development, control may not be observable for several days. Etoxazole exhibits pronounced translaminar movement in plant leaves, enhancing activity when the pest is located on the undersides of leaves. Zeal is not known to have risk of cross-resistance with other currently registered

miticides. Zeal is restricted to one application per acre per season

New insecticide label descriptions for compounds included in MSU Fruit Management Guide

Beleaf (87) (flonicamid) belongs to a new class of insecticides registered for pome fruits and stone fruits. This compound's anti-feedant activity provides control of aphids and suppression of tarnished plant bug. The maximum yearly amount of Beleaf 50SG that can be applied is 4.8 oz per season.

Altacor (88) (rynaxypyr; chlorantraniliprole) belongs to a new class of insecticides called the anthranilic diamides, which work on the insect by activating ryanodine receptors, thus depleting internal calcium and preventing muscle contraction. Altacor is registered in pome fruits, stone fruits and grapes for control of a range of pests including leafrollers, codling moth, oriental fruit moth, grape berry moth, and is also active on the apple maggot and cherry fruit fly via ingestion. Altacor has shown to be relatively safe on many beneficials. The maximum yearly amount of Altacor 35 WG that can be applied is 9 oz per season.

Belt (89) (flubendiamide) belongs to a new class of insecticides called the anthranilic diamides, which work on the insect by activating ryanodine receptors, thus depleting internal calcium and preventing muscle contraction. Belt is registered in pome fruits, stone fruits and grapes for control of a range of pests including leafrollers, codling moth, oriental fruit moth, and grape berry moth. Belt has shown to be relatively safe on many beneficials. The maximum yearly amount of Belt 4 SC that can be applied is 15 fl oz in pome fruits and 12 fl oz in stone fruits and grapes per season.

Movento (91) (spirotetramat) belongs to a new class of insecticides called the tetramic acid derivatives, which work on the insect by inhibiting lipid biosynthesis. Movento is registered in pome fruits, stone fruits and grapes for control of aphids (including wooly apple aphid), scale insects, mealy bugs, phylloxera and pear psylla. Movento has a unique two-way systemic movement in the plant (phloem and xylem), such that with foliar applications it is transported to young leaf tissue, but also down to the root tips. It has shown to be relatively safe on many beneficials. The maximum yearly amount of Movento 2F that can be applied is 25 oz in pome fruits and 15.3 oz in stone fruits, and 12.5 oz in grapes per season.

Mustang Max (86) (zeta-cypermethrin) is a pyrethroid insecticide registered for use on grapes, blueberries, caneberries, pome and stone fruits for the control of many insect pests, including cutworms, plant bugs, leafhoppers, leafrollers, fruitworms, beetles, and fruit flies. This material is highly toxic to bees and is disruptive to natural enemies. Do not apply more than 24 fl oz of Mustang Max 0.8EC per acre pre season.

Voliam flexi (90) (thiamethoxam + chlorantraniliprole) is a new insecticide that combines two active ingredients as a pre-mix formulated compound. Voliam flexi is registered for use in pome fruits, stone fruits and grapes targeting codling moth, oriental fruit moth, leafrollers, grape berry moth, aphids, leafhoppers, leafminers, psylla, cherry fruit fly and plum curculio. Voliam flexi holds the combined performance attributes of the thiamethoxam and chlorantraniliprole chemistries. For the purposes of resistance management, after using Voliam flexi in a given pest generation, products containing either one of thiamethoxam and chlorantraniliprole shouldn't be used in the subsequent generation. The maximum yearly amount of Voliam flexi 40 WDG to be applied is 16 oz on pome fruits, 14 oz on stone fruits, and 9 oz on grapes per season.

Leverage (93) (imidacloprid + cyfluthrin) is a new insecticide that combines two active ingredients as a pre-mix formulated compound. Leverage is registered for use in pome fruits, stone fruits and grapes targeting codling moth, oriental fruit moth, leafrollers, aphids, leafhoppers, leafminers, psylla, fruit flies and plum curculio. Voliam flexi holds the combined performance attributes of the thiamethoxam and chlorantraniliprole chemistries. For the purposes of resistance management, after using Voliam flexi in a given pest generation, products containing either one of thiamethoxam and chlorantraniliprole shouldn't be used in the subsequent generation. The maximum yearly amount of Leverage 2.7 SE (suspension emulsion) to be applied is 5.1 oz on pome fruits, 10.2 oz on stone fruits, and 8 oz on grapes per season. **IPM**

Small fruit news

Virus survey planned in Michigan blueberry fields in 2009

Annemiek Schilder, Plant Pathology

Virus diseases of plants are systemic, and once plants are infected, they cannot be cured. Virus symptoms include plant stunting, leaf and flower malformation, reduced yield, progressive decline and even plant death. Viruses spread via a range of mechanisms, including insect and nematode vectors, cuttings, etc. The main control method is prevention, especially via the use of clean planting material. Virus-free certification programs are credited with lowering the incidence of virus diseases in blueberry fields nationwide. It is especially important that we keep new viruses like blueberry scorch virus out of our production region.

However, symptoms of virus diseases are not uncommon in Michigan blueberry fields. Mostly, these are of known viruses such as blueberry shoestring virus and tomato ringspot virus, but sometimes other symptoms appear that don't seem to fit specific descriptions. Last year, plants with purple blossom symptoms and plant decline were noticed in some blueberry fields in Southwest Michigan. In summer, leaf scorching, defoliation, and plant decline were seen in other locations. No viruses other than the ubiquitous blueberry shoestring virus were detected in these samples, which suggest that more sleuthing is necessary. It is also possible that some of these symptoms are due to new viruses or that they are due to herbicide injury. Some of the newer herbicides have growth regulator properties and all

the manifestations of injury caused by these herbicides may not yet be known. However, a spotty distribution and a progressive decline of affected plants may be indicative of a virus disease.

To improve our diagnosis of virus and virus-like diseases and assess disease occurrence in Michigan blueberry fields, a field survey will be conducted in 2009. We also plan to evaluate a new DNA detection method for blueberry stunt phytoplasma, which would allow us to have a fast and sensitive method at hand for confirmation of blueberry stunt disease. We will invite blueberry growers to send leaf samples of blueberry bushes with suspicious virus-like symptoms. Testing will be free. There will be several dates during the growing season when we will conduct large-scale serological testing of blueberry leaf samples. Advance notice of these dates will be given through the *Fruit CAT Alert*, Blueberry IPM Update and at grower meetings so that samples can be submitted on or before those dates. We will also arrange field visits to take plant samples. To sign up or for more information, contact Jerri Gillett at gillett@msu.edu or Annemiek Schilder at schilder@msu.edu. You can also reach us by phone at 517-355-7539 or contact your local extension educator. **IPM**

Other news

Enviro-weather: New look, new tools

Beth Bishop, Enviro-weather Coordinator

Spring has finally arrived. Despite recent snow, signs of the upcoming growing season are all around. Enviro-weather has been updated for 2009 with a new look and some new tools.

New look

The commodity and station pages have been reorganized and reformatted making them easier to understand and to navigate. The same links, weather summaries, and pest and production tools are there; they've just been rearranged and spiffed up a bit.

New tools

We've added some new tools to the fruit pages. An **apple maturity model** was added late in 2008 (predicts maturity date for three apple varieties based on bloom date). Two **new weather summaries**, a "regional" degree-day summary and a "historical" degree-day summary, are now available. Another weather summary, **soil conditions**, allows users to view soil temperature and soil moisture at two and four inches.

Coming soon – small fruit insect models

Enviro-weather will soon debute some small fruit insect pest models. Models that will help growers manage **grape berry moth**, **cranberry fruitworm** and **tussock moth** will be on-line very soon. These models are the result of a cooperative project funded by Project GREEEN and headed by Dr. Rufus Issacs. We also plan to debut a fire blight model that will allow users to change specific weather data to reflect their local conditions.

As always, I look forward to hearing your questions, concerns or new ideas about Enviro-weather. I can be contacted at (517) 432-6520 or bishopb@msu.edu. **IPM**

1 – Southwest

Mark Longstroth and Bill Shane

Weather

Spring has begun in Southwest Michigan. Weather in the middle of March was warm with highs near 70 and lows in the 50s. The last two weeks were relatively warm, with highs in the 50s and lows above freezing. Buds are beginning to swell. At this time, we would need temperatures below 20°F to cause significant freeze injury. When buds become noticeably swollen temperatures in the low 20s will cause damage.

Tree fruit

Fruit tree buds are beginning to swell. Growers are beginning to assess and report winter damage in stone fruit and small fruit such as strawberries and blueberries. While some damage has been reported many growers are surprised at how many viable buds there are. Growers still have the opportunity to apply dormant sprays to reduce overwintering disease inoculum.

Apricot buds are at calyx red.

Peaches buds are swelling. No green tissue is exposed. It is probably too late to apply peach leaf curl sprays in the more advanced areas, but were buds have not started to swell peach leaf curl sprays should be applied.

Both **sweet cherries** and **tart cherries** are at swollen bud. Copper can still be applied to sweet cherries as a dormant spray to reduce bacterial canker.

In **plums,** Oriental plum buds are at white side. European plums buds have just begun to swell.

Apples are at silver tip. Growers need be ready for apple scab. Because of mild conditions in March, we expect scab spores from the leaf litter will be ready as soon as green tissue is available for infection. Growers should be ready to apply scab sprays as green tissue appears.

Pears buds are beginning to swell. Pear psylla adults should emerge soon when warm weather returns.

Southwest Michigan growing degree day totals March 1 through March 29				Grapes, from April 1
Location	**GDD 42**	**GDD 45**	**GDD 50**	**GDD 50**
SWMREC:	106	76	40	
Lawton	103	75	40	
Fennville:	77	53	26	

Small fruit

The window for lime sulfur applications is now in blueberries, grapes and brambles to suppress diseases that overwinter on the plant.

Blueberry fruit buds are beginning to swell, but leaf buds have not moved. It is too early to look for mummyberry mushrooms; the soils are too cool.

Grape buds are tight and dormant. Growers are tying canes.

In **strawberries,** growth is just beginning, there are few new leaves emerged. Growers are applying herbicides and putting down straw mulch.

Raspberries are dormant. Now is the window for lime sulfur applications to suppress anthracnose.

Cranberries are dormant.

Miscellaneous

Growers are pruning and clearing brush.

The Fruit Code-A-Phones in Van Buren (269) 657-8217 and Berrien (269) 944-4126 ext 1, will be working and updated by April 1. The first Monday Fruit IPM Update meeting will be, Monday, April 13 at the Fruit Acres Farm in Berrien County. **IPM**

2 – Southeast

Bob Tritten

Weather

The winter of 2008-2009 has generally been cold with a fair amount of moisture, mostly in the form of snowfall. Our trees went into dormancy very well last November and December. We had good bud set on most varieties last fall.

Most areas of southeast Michigan had two to three cold snaps with a wide range of minimum temperatures. For example, Romeo and Commerce had cold on the January 16 and 20 and again on February 5. Their low temperatures recorded were generally close to minus 11 degrees. Lapeer had some of the same earlier cold, but on February 5 had a minimum temperature of minus 22 degrees. Lastly, Petersburg had three very cold mornings, January 15 and 17 saw temperatures with a maximum of minus 25 degrees, and again on the February 5 with minus 21 degrees. How are these low temperatures going to impact the fruit crops? I think that Romeo and Commerce Township areas will be fine, however, stone fruit, particularly peaches, around Lapeer and Petersburg will most likely not have much of a crop. I have done some flower bud forcing of peaches from the Romeo area, and it appears they have a nice crop of flower buds coming along.

We have good amounts of soil moisture, and the soil profile has more than adequate moisture supplies.

We have had generally below normal degree day accumulations for March. All of the buds of our fruit crops are pretty tight at this time.

Southeast Michigan growing degree day totals for March 1 to March 31

Location	GDD42	GDD45	GDD50
Commerce (Oakland)	75	51	25
Emmett (St Clair)	58	38	17
Flint (Genesee)	74	51	26
Lapeer (Lapeer)	72	50	25
Petersburg (Monroe)	89	59	26
Romeo (Macomb)	67	45	22

Tree fruits

Apple buds are still very tight with little silver tip showing.

Pear buds show little to no movement.

Peach buds have swollen a bit on a few warmer days. Now is an excellent time to apply peach leaf curl sprays if applications were not applied last fall. Pruning has not begun yet on peaches.

Cherry buds are dormant to slightly swollen.

Small fruits

Strawberry growth has just begun to start, with very few leaves emerging from the crown.

Raspberries show no movement. There was a fair amount of winter kill to the to the tips of canes of summer red raspberries.

Blueberry buds appear to be dormant.

Grapes are dormant. **IPM**

3 – Grand Rapids Area

Amy Irish Brown and Phil Schwallier

Tree fruit

There's not much happening on the crop development front. Even peach and cherry buds are pretty tight yet. In 2007, we had the first signs of green tissue showing about this same time. In 2008, the story was nearly the same as I'm writing today. Normal first green for apples in the Grand Rapids area is around April 10 to 15 and if the weather continues as it is, it looks like we will reach April 15 or even later before we see any apple growth starting. The grass is starting to look a little greener, but not much. The forecasted temperatures for the next two weeks don't show much change either – highs in the 40's or low 50's and low's every night right around freezing.

Growers are wrapping up winter pruning of apples and removing brush from blocks. Ground applied fertilizer applications could be started soon, but with the price of fertilizers, growers should carefully time applications so that they are not wasted by being put on too early. Tree planting could start in another couple of weeks if the soil warms up. It's been unusually dry, so working ground this early is not out of the question.

Copper applications to **sweet cherries** should be started at the first signs of green tissue showing to help with bacterial canker.

Copper use in **apples** for the earliest apple scab spray is highly recommended this season. Copper is an excellent scab material. It is thought that apple scab spores mature early with heavy snow cover, so we should be ready for any early scab infections and be ready to cover for them. Preventative scab sprays will be crucial this year mostly because we only have control materials that work best ahead of an infection rather than in catch up mode. I am not recommending the use of strobilurins for apple scab control for the greater Grand Rapids area any longer. The resistance we

found in eight sites in 2008 was fairly widespread across the entire area, so it is most likely a factor in all apples in this area. If you want to use strobilurins for powdery mildew, be sure you are adding something else in for scab.

Also, copper or lime sulfur sprays for **peaches** should go on right away if you haven't done so already. Peach leaf curl is a sporadic disease that we only really see much of every six or eight years of so. Peach leaf curl is favored by cool and wet temperatures early at bud break, but management sprays need to go on well before then.

Announcements

The Ridge area Code-A-Phone is operational. The number is (616) 451-8065.

The Spring Spray meeting will be Thursday, April 16 at Bill and Patrick Goodfellow's farm on 12 Mile, just west of M-37 near Sparta. The meeting run from 6:00 PM to 8:00 PM. **IPM**

Weather news

Jeff Andresen, Geography

If the past winter seemed unusually long and cold, your weather senses are right on the money. A high amplitude jet stream pattern characterized by large troughs across western and central North America set up just before Thanksgiving last fall and persisted into early March. This pattern, typical of La Niña events in the equatorial Pacific (La Niña conditions have been in place since last fall), led to a very active storm track through the Ohio Valley region and to the passage of a number of cold, arctic-origin air masses through the Great Lakes region. Mean temperatures for December through February generally ranged from two to five degrees Fahrenheit below normal across the state, and would have been even colder if not for milder than normal temperatures during February. A time series graphic of mean winter temperatures for Michigan is given in Figure 1a (courtesy of NOAA). It is interesting to note that the relatively cold weather of this past winter and that of last years' winter has at least temporarily ended a trend towards milder winter temperatures, with mean values this year the coldest since the winter of 1993/1994.

In terms of precipitation, winter totals generally ranged from near to slightly below normal levels across western sections of Upper Michigan to much above normal over large sections of the Lower Peninsula, where some areas received more than 200 percent of normal values. A time series plot of statewide winter precipitation (Figure 1b also courtesy of NOAA) suggests that this past winter was among the wettest 10 percent of winters since 1895, and that winter precipitation has generally trended upwards since the 1980's. Not surprisingly with colder and wetter than normal weather during much of the winter, seasonal snowfall totals were heavier than normal across almost all areas of the state. Soil moisture levels currently range from much above normal levels across southern and central sections of the state to drier than normal across some northern sections (especially subsoils across western Upper Michigan where dryness has been a lingering problem for the past couple of years).

In the forecast, an active weather pattern is expected through early next week with a series of low pressure systems moving from the western United States into the Upper Midwest. The first of these systems will bring a good chance for rain (and some snow in western sections of Upper Michigan) to the state overnight Tuesday, March 31 in to early Wednesday. Most areas should see a quarter to half an inch of precipitation with widespread areal coverage. Cool, windy, and drier conditions are expected Wednesday through early Thursday. An area of low pressure is forecast to move through the Ohio Valley Thursday and Friday, bringing the next chance for rainfall mainly to southern sections of the state by Thursday afternoon continuing into Friday morning. Rainfall totals with this system are expected to be heaviest in southeastern sections of the state (where a quarter to half an inch is possible), decreasing to trace amounts across northern sections of the state. Temperatures will moderate with highs ranging from the upper 30's north to the low 40's south through Friday and lows from the 20's north to 30's south. Mostly dry and milder conditions are expected Saturday into early Sunday, but yet another low pressure system will bring the threat of more precipitation statewide by late Sunday continuing into Monday.

Current medium-range forecast guidance suggests a split-flow jet stream pattern across North America with Michigan and the Great Lakes region under troughing in the northern branch. The official NOAA **6-10 day** and **8-14 day outlooks**, covering April 5-9 and 7-13, call for mean temperatures to range from near normal levels across southern sections of the state to above normal levels in the north. Near normal precipitation totals are forecast statewide during the 6-10 period with below normal totals expected statewide in the 8-14 day time frame.

Long lead outlooks

There is not much new to report in the equatorial Pacific region, with a general continuation of La Niña conditions. The official Climate Prediction Center long lead outlooks assume La Niña will continue through the spring months before dissipating into neutral conditions this summer. The new CPC outlooks put Michigan in the equal odds or climatology scenario for both mean temperatures and precipitation totals for April and for the April through June period. It is interesting to note that spring conditions during La Niña events in Michigan are typically wetter and cooler than normal, so in my mind this remains a possibility as well. **IPM**

Upcoming meetings:

Sustainable viticulture meeting April 9 from noon until 5:00 PM at the Southwest Michigan Research & Extension Center. For more information, contact: (269) 944-1477

Southwest Michigan 2009 Fruit IPM meetings will begin April 13 and run until June 29. Meetings will take place from 5:00-6:30PM at Annette and Randy Bjorge's Fruit Acres in Berrien County. For more information, contact: Mark Longstroth at (269) 657-8213

ACTUAL AND PREDICTED DEGREE-DAY
ACCUMULATIONS SINCE MARCH 1 2009 (*)

STATION OR DISTRICT	BASE 42 BE DEGREE-DAYS AS OF 03/30 2008	2009	BY 04/04	BY 04/09	BASE 50 BE DEGREE-DAYS AS OF 03/30 2008	2009	BY 04/04	BY 04/09
WEST UP NORMS**		12	18	26		0	1	4
MARQUETTE	0	13	13	14	0	2	2	2
EAST UP NORMS		1	5	10		0	0	0
CORNELL	0	20	20	20	0	3	3	3
SSMARIE	0	4	4	4	0	0	0	0
N.W. LP NORMS		22	31	43		3	6	9
BEULAH	0	42	43	50	0	10	10	10
BINGHAM	0	39	40	46	0	11	11	11
NORTHPORT	0	24	25	28	0	8	8	8
OLDMISSION	0	35	36	41	0	10	10	10
N.E. LP NORMS		18	24	33		3	4	5
ALPENA	0	22	22	26	0	5	5	5
ROGERCITY	0	24	24	29	0	6	6	6
W. CENT. LP NORMS		34	49	64		9	15	20
FREMONT	0	64	70	81	0	15	15	15
HART	0	54	59	68	0	12	12	12
LUDINGTON	0	50	55	63	0	12	12	12
CENT. LP NORMS		37	52	70		8	15	20
ENTRICAN	0	63	70	83	0	18	18	18
E. CENT. LP NORMS		39	55	74		9	15	21
BADAXE	0	47	53	64	0	15	15	15
SAGINAW	0	75	84	101	0	19	19	19
S.W. LP NORMS		62	85	110		23	32	41
BHARBOR	0	113	123	144	0	43	43	45
FENNVILLE	0	89	96	113	0	31	31	33
GLENDORA	0	109	118	139	0	39	39	41
GRANDJUNC	0	118	128	150	0	46	46	48
HOLLAND	0	107	116	136	0	41	41	43
KENTCITY	0	109	118	139	0	39	39	41
SPARTA	0	77	83	98	0	21	21	22
WATERVLIET	0	109	118	139	0	39	39	41
S. CENT. LP NORMS		58	79	102		22	30	39
BELDING	0	82	89	104	0	26	26	27
COLDWATER	0	121	131	153	0	45	45	46
ELANSING	0	99	107	125	0	35	35	36
S.E. LP NORMS		53	72	94		18	26	35
DETROIT	0	112	122	144	0	36	36	36
FLINT	0	87	95	112	0	29	29	29
MILFORD	0	81	88	104	0	26	26	26
ROMEO	0	64	70	82	0	19	19	19
SALINE	0	83	90	107	0	27	27	27
TOLEDO	0	125	136	161	0	41	41	41

* Since weather data for some agricultural stations are not available prior to April 1st, GDD values for those stations during February and March are estimated with closest available station data.
** District normals were calculated as the mean of daily GDD totals at several stations within each district for the period 1951-1980.

Michigan State University Cooperative Agricultural Weather Service
Cumulative Precipitation Summary For 03/30/2009

PRECIPITATION TOTALS SINCE

STATION	DIST	03/24/2009 (last week) Actual	03/17/2009 (last 2 weeks) Actual	Dev. Norm.	03/03/2009 (last 4 weeks) Actual	Dev. Norm.	04/01/09 (since Apr.1) Actual	Dev. Norm.
MARQUETTE	WU	0.32	0.54	-0.34	0.83	-0.95	0.00	0.00
CORNELL	EU	0.55	0.93	0.01	1.28	-0.53	0.00	0.00
SSMARIE	EU	0.35	0.44	-0.48	0.71	-1.10	0.00	0.00
BENZONIA	NWL	0.21	0.22	-0.59	1.20	-0.48	0.00	0.00
BEULAH	NWL	1.14	1.24	0.43	2.53	0.85	0.00	0.00
BINGHAM	NWL	0.19	0.24	-0.57	1.22	-0.46	0.00	0.00
NORTHPORT	NWL	0.15	0.16	-0.65	0.87	-0.81	0.00	0.00
OLDMISSION	NWL	0.10	0.11	-0.70	0.78	-0.90	0.00	0.00
ALPENA	NEL	0.87	1.06	0.24	1.56	-0.15	0.00	0.00
ROGERCITY	NEL	0.61	0.72	-0.10	1.36	-0.35	0.00	0.00
FREMONT	WCL	1.03	1.03	0.02	3.46	1.40	0.00	0.00
HART	WCL	0.71	0.71	-0.30	2.72	0.66	0.00	0.00
LUDINGTON	WCL	0.48	0.48	-0.53	2.15	0.09	0.00	0.00
LUDINGTON	WCL	0.48	0.48	-0.53	2.15	0.09	0.00	0.00
ENTRICAN	CL	0.41	0.43	-0.49	1.44	-0.54	0.00	0.00
BADAXE	ECL	0.72	0.72	-0.19	2.64	0.76	0.00	0.00
SAGINAW	ECL	0.62	0.62	-0.29	2.23	0.35	0.00	0.00
BHARBOR	SWL	0.61	0.61	-0.56	3.92	1.60	0.00	0.00
FENNVILLE	SWL	0.80	0.80	-0.37	2.93	0.61	0.00	0.00
GLENDORA	SWL	0.72	0.72	-0.45	3.24	0.92	0.00	0.00
GRANDJUNC	SWL	0.75	0.75	-0.42	3.03	0.71	0.00	0.00
HOLLAND	SWL	0.94	0.94	-0.23	3.79	1.47	0.00	0.00
KENTCITY	SWL	0.72	0.72	-0.45	3.24	0.92	0.00	0.00
SPARTA	SWL	1.33	1.33	0.16	3.12	0.80	0.00	0.00
WATERVLIET	SWL	0.72	0.72	-0.45	3.24	0.92	0.00	0.00
BELDING	SCL	0.74	0.74	-0.34	2.41	0.26	0.00	0.00
COLDWATER	SCL	0.01	0.01	-1.07	0.25	-1.90	0.00	0.00
ELANSING	SCL	1.05	1.05	-0.03	3.00	0.85	0.00	0.00
DETROIT	SEL	0.96	0.96	-0.14	3.80	1.62	0.00	0.00
FLINT	SEL	0.84	0.84	-0.26	2.91	0.73	0.00	0.00
MILFORD	SEL	0.36	0.36	-0.74	3.01	0.83	0.00	0.00
ROMEO	SEL	0.03	0.03	-1.07	0.03	-2.15	0.00	0.00
SALINE	SEL	0.61	0.62	-0.48	3.92	1.74	0.00	0.00
TOLEDO	SEL	0.50	0.63	-0.47	4.79	2.61	0.00	0.00

Crop Advisory Team Alerts
Integrated Pest Management Program
Michigan State University
B 18 Food Safety & Toxicology Building
East Lansing, Michigan 48824 -1302

The *Fruit Crop Advisory Team (CAT) Alert* is brought to you by:

MSU Extension and Agricultural Experiment Station Field Staff

Robert Tritten, District Educator - SE Michigan
Mark Longstroth, District Educator - SW Michigan
Dr. Bill Shane, District Educator - SW Michigan and Horticulture Specialist
Dr. John Wise, Research/Extension Coordinator -Trevor Nichols Research Complex
Dr. Carlos Garcia-Salazar, Small Fruit Educator - Central Region
Amy Irish-Brown, ICM Fruit Educator -West Central Michigan
Phillip Schwallier, District Educator - Clarksville Horticulture Experiment Station
Dr. Mira Danilovich, District Educator - West Central Michigan
Dr. Duke Elsner, ANR Educator - Grand Traverse & Kalkaska Counties
Dr. Nikki Rothwell, Station Coordinator - NW Michigan Horticultural Research Station
Erin Lizzotte, District Educator - NW Michigan Horticultural Research Station
Dr. Rob Sirrine, Extension Director, Leelanau County

MSU Extension Campus Specialists

Dr. Annemiek Schilder, Plant Pathology (small fruit)
Dr. George Sundin, Plant Pathology (tree fruit)
Dr. Larry Gut, Entomology (tree fruit)
Dr. Rufus Isaacs, Entomology (small fruit)
Dr. Jeff Andresen, Geography/Agric. Meteorology
Dr. Ron Perry, Horticulture
Dr. Eric Hanson, Horticulture
David Epstein, Integrated Pest Management Program
Paul Jenkins, Small Fruit Education Coordinator

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Joy Neumann Landis, editor
Andrea Buchholz, assistant editor

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To subscribe or for information:
Crop Advisory Team Alerts
243 Natural Science Bldg.
Michigan State University
East Lansing, MI 48824
(517) 353-4703
E-mail: catalert@msu.edu

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