Northern Michigan FruitNet 2013
Northwest Michigan Horticultural Research Center

Weekly Update

June 11, 2013

GROWING DEGREE DAY ACCUMULATIONS AS OF June 10th AT THE NWMHRC

Year	2013	2012	2011	2010	2009	2008	23yr. Avg.
GDD42	773	1166	762	1103	686	774	835.0
GDD50	441	661	408	609	310	405	447.7

Growth Stages at NWMHRC (June 10, 10:30 a.m.)
Apple: Red Delicious – 12 mm
Gala – 13 mm
Yellow Delicious – 11 mm
Pear: Bartlett: 13 mm
Sweet Cherry: Hedelfingen: 12 mm
Napoleon: 12 mm
Gold: 11 mm
Tart Cherry: 11 mm
Balaton: 11 mm
Apricot: 22 mm
Grapes: 10-16 " shoots

NORTHWEST MICHIGAN REGIONAL REPORT

N.L. Rothwell, NWMHRC
Cool weather is keeping all things pretty quiet out in the orchard.

Most fruit crops are moving along slowly, and fruit size has not increased much in the past week to 10 days except for MacIntosh apples that made a 8mm jump in size and winegrapes whose shoot length increased with the few warm days last week. Daytime temperatures were up in the 70s over the weekend, and most growers likely tried to thin with these conditions. Apples are at optimal thinning size here at the NWMHRC except for Macs which are close to out of the window now. Thinning has been a huge challenge with the temperature fluctuations this season. Growers are also trying to put on gibberellic acid applications in tart cherry, but again, most are waiting for a window of a few days of warm conditions. We have accumulated 773GDD base 42 and 441base 50. We have not had any substantial rainfall since last weekend, but it has been overcast for the past few days and humidity levels have been on the high side.

Apple. As mentioned above, thinning has been on the docket for most apple growers across the region. Most growers likely thinned late last week or early into the weekend as we had four days with daytime highs in the 70s. This week is predicted to be in the low 70s and partly sunny, so growers may have a last chance to thin if they did not achieve good results with previous thinning efforts. With all the potential **fireblight** infection conditions we had during bloom, very little fireblight is showing up in the region. We have had two **scab** infection periods this spring, we are starting to see some scab lesions in the orchard. With the little amount of precipitation we have received today, we may see another infection period. Growers should be sure to cover up for scab prior to these wetting events. According to the apple scab model (www.enviroweather.msu.ed), if temperatures do reach into the 70s today, we will be at 100% spore maturity and 89% spore discharge. We hope to call the end of primary scab with the next substantial rainfall event.

Insect activity has been off to a slow start with the variable weather conditions. We only caught one **codling moth** (CM) again this week, and with such low numbers, we still have yet to set a biofix for this insect. MSU E is recommending that growers trap for CM in their own orchards as population sizes vary across different blocks of apples. Many growers have set a biofix date two weeks ago while other growers just set one last week. We also have not caught any **obliquebanded leafroller** moths as of yet. Given the large size of the larvae last week, we predict to catch these moths in the coming week.

Cherry. Fruit size remains in the 11-12mm range for all varieties of tart and sweet cherries. We are at the right time for gibberellic acid (GA) applications as most tarts have 5-7 leaves or 3-5 fully expanded leaves. The warm conditions will help with this application as GA does not work well below 70 degrees F. We have had three infection periods for **cherry leaf spot** (CLS), and lesions are just beginning to show up in orchards. Lesions that are on the leaves now will pose a challenge in keeping these trees clean throughout the remainder of the season. Growers should be out scouting for lesions to know their level of control with their past applications. We have had some challenging weather that has been conducive for disease development. As mentioned last week, the new products like Luna Sensation and Merivon are good products for first cover control as they are excellent against CLS and powdery mildew.

We are still investigating the cause of declining spurs in tart cherries. In Balatons, we can confirm that most of these infections are caused by **European brown rot**. These symptoms are flagging leaves on a spur and eventually these leaves will turn brown and the whole spur will be killed. The symptoms look like fireblight but rather than kill a whole branch, European brown rot only takes out the spurs. However, if the infection is serious, a lot of fruiting surface can be lost to this disease in a bad year. We are also finding some European brown rot in Montmorency. The curious new twist in our investigation is that we have observed **American brown rot** in some Montmorency blocks, and we will put out a full report on this situation as soon as we have confirmed the species of the fungus and reviewed this spring's weather events. More information on this situation is forthcoming.
Insect activity in cherries is similar to apples, slow and spotty. We have seen **plum curculio** in cherry, and most growers have put on an insecticide spray in both sweets and tarts as soon as the fruit was out of the shuck. Plum curculio numbers seem to be a little higher this season. For those growers using the P.I.T.S model for plum curculio in tart cherry, we bloomed at the NWMHRC on May 17, and we have accumulated 272GDD since that date. Any eggs laid in the fruit prior to 375GDD post full bloom biofix, the larvae will have dropped out of the fruit and will not be present at harvest. This model is only good for tart cherries. We are still finding large **OBLR** larvae in cherry, and for most orchards, the timing for control of these insects is past. Growers should be trapping for adults to know if a pre-harvest control application is needed. We are catching both **American plum borer** (APB) and **lesser peachtree borer** (LPTB) in cherry at this time, and we caught an average of 10 APB and 14 LPTB in the traps this week.

Grapes
Duke Elsner, Grand Traverse County MSUE

Shoot growth has been kept at a slow to moderate pace due to cool weather conditions. All of the clusters are visible now, and the potential crop looks very good on all of the cultivars at the NWMHRC. I have received similar comments on crop potential from across the area.

No **powdery mildew** infections have been reported to this point. I have seen a nice sample of **phomopsis cane** and **leaf spot** from a home garden planting of table grapes. This disease rarely appears in our typical wine grape cultivars.
Some leaf injury symptoms typical of **potato leafhopper** have been reported, but I have not seen adult leafhoppers as of yet in any NW Michigan vineyard.

SPOTTED WING DROSOPHILA MONITORING SHOULD BE STARTED SOON – KNOW WHAT TO LOOK FOR

MSU statewide monitoring program is getting started this week, and urges growers to be able to tell the different between spotted wing Drosophila flies and other Drosophila flies.

Posted on **June 4, 2013, MSUE News,** by **Rufus Isaacs**, Michigan State University Extension, Department of Entomology, and Nikki Rothwell, Michigan State University Extension

Last year in the early 2012 season, the first captures of spotted wing Drosophila (SWD) were found in late May. With this more normal season, Michigan State University Extension has yet to trap SWD in any monitoring traps. Of the many traps already deployed in southwest and northwest Michigan, there have been no catches of SWD as of June 4, 2013. However, traps are catching other small Drosophila flies and it is important that those are not confused with SWD. The photo below is helpful to show the difference between spotted wing Drosophila on the left and another species that has no effect on fruit on the right. Notice that the spotted wing Drosophila on the left has a longer and darker ovipositor, with serrations, highlighted with a green oval.

Example photo of two female Drosophila flies that are (left) and are not (right) spotted wing Drosophila. The dotted green line indicates the well-developed and darker serrated ovipositor of the female spotted wing Drosophila.

Traps should be placed into fields of susceptible fruit crops before they start ripening so growers can be aware of whether the fruit will be at risk of infestation once they ripen. SWD cannot lay eggs into fruit until the fruit start to color, so if this fly has been detected and a susceptible crop is ripening, growers should be initiating their SWD control program.

More information on SWD identification and management is posted at the MSU IPM Spotted Wing Drosophila website. New management guides for blueberry and raspberry will be posted there next week.

Dr. Isaacs' work is funded in part by MSU's AgBioResearch.

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ENHANCE RETURN BLOOM ON APPLE VARIETIES BY USING SUMMER NAA

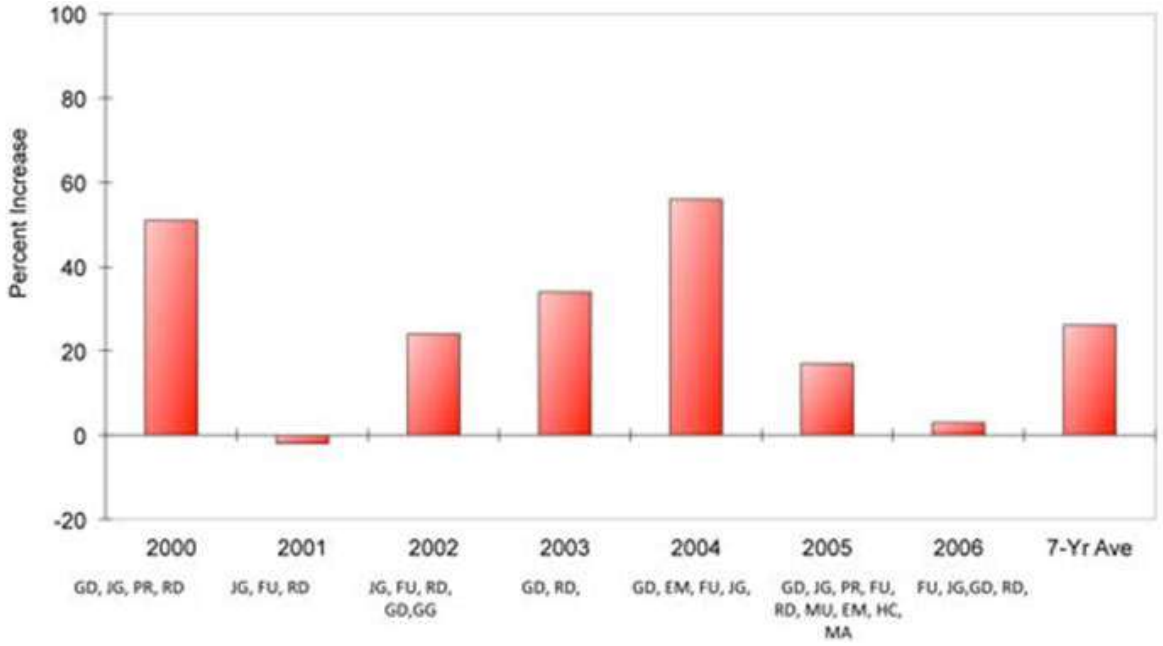
Guidelines for improving return bloom on apple varieties by using summer NAA applications.

Posted on **June 4, 2013, MSUE News,** by **Phil Schwallier**, and Amy Irish-Brown, Michigan State University Extension

Every year it can be desirable to enhance return bloom on apple varieties that tend to be biennial. This is especially important on trees that have a heavy crop load like we are predicting for this year (2013). Most years, treatments of summer NAA applied at five, seven and nine weeks after bloom will increase return bloom even on varieties that have heavy crop loads and tend to have poor return bloom. This timing is made after the thinning window and any potential thinning from NAA has past. Fruits are often 1 inch in diameter and won't respond to any NAA thinning action. Flower bud initiation has already begun, but according to Michigan State University Extension it can be enhanced by NAA treatments during the next 30 days after the thinning period ends.

Summer Ethrel can also enhance return bloom by treatments of 200 ppm made at the same timing of five, seven and nine weeks after bloom. However, summer Ethrel can thin 1-inch diameter fruit as well as advance maturity of early maturing varieties.
A study was initiated in 2000 on biennial varieties. These varieties (Goldens, Jonagold, Paulared, Red Delicious, Fuji Gingergold and Empire) were treated with three applications of NAA at 5 ppm (Fruitone N). Over seven years on average, return bloom was improved by 23 percent and some years as much as 55 percent. These trees were selected because they had heavy crop loads and were not thinned chemically (Figure 1).

Figure 1. NAA return bloom study 2000 to 2006 percent increase in return bloom/UTC Grand Rapids, Mich., area



Summer NAA

Apply 5 ppm (2 ounces per 100 of Fruitone N) of NAA starting five weeks after bloom and apply two additional spray treatments at seven and nine weeks after bloom. The rate of NAA applied per acre should be adjusted to tree row volume (TRV) levels. The applications can be concentrated, but treatments will benefit from increased water amounts. Try not to concentrate water amounts greater than four times. These sprays can be added right to the cover sprays during that time period. Some

years these treatments do not perform well, especially during droughty years.
Varieties that have a moderate to high biennial bearing tendency should be considered for bloom enhancement sprays (Table 1). Growers report that they have the best results by treating with summer NAA every year, regardless of crop load.

Table 1. Apple variety biennial tendency

Variety	Biennial bearing tendency
Cameo	Moderate
Cortland	Low
Empire	Moderate
Fuji	High
Gala	Low
Golden Delicious	High
Honeycrisp	High
Jonagold	High
Jonathan	Low
Macoun	Moderate
McIntosh	Low
Mutsu	High
Northern Spy	Moderate
Paulared	Moderate
Red Delicious	High
Rome	Low

Summer NAA treatments will not cause any adverse effects to the trees or crop. Treatments during extremely hot temperatures (maximum temperatures above 90 degrees Fahrenheit) should be avoided. If surfactant or oil is included with the application, consider reducing the NAA amount by one-third. Fruitone L has been reported to be slightly more effective than Fruitone N. Follow the guidelines listed below.

Summer NAA rate use guidelines

1. The target rate/acre is 8 oz Fruitone N (5 ppm) on full size trees (100% TRV).
   8 ounces per acre
2. Determine the target blocks TRV.
   Example: 75 percent TRV
3. Adjust the NAA rate per acre by the TRV.
   0.75 x 8 ounces = 6 ounces per acre
4. Apply at 4X water concentration or less.
5. If surfactants or oil is included reduce NAA by 1/3.
6. Avoid applications during extreme hot temperatures.

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TRAINING APPLES FOR HIGH DENSITY AND AVOIDING THE SPREAD OF FIRE BLIGHT

Avoid high density training on apple varieties susceptible to fire blight during infection periods, as this can encourage the spread of bacteria.

Posted on **June 7, 2013, MSUE News,** by **Ron Perry**, Michigan State University Extension, Department of Horticulture

In my previous Michigan State University Extension article "Training apples for high density systems," I gave some tips on training branches in high density apple plantings. I managed to forget to add a paragraph in that article regarding fire blight. If training susceptible and highly susceptible varieties to fire blight such as Honeycrisp, Gala, etc., be sure monitor fire blight activity in the young orchard. I have made the mistake years ago and trained trees during this period and managed to spread the disease right down the row!

The period for flower bud initiation for apples in the northern United States may coincide with fire blight activity. Be sure to avoid training on these susceptible varieties when there are high fire blight infection periods and warm, humid conditions which can encourage the spread the bacteria. On these varieties, try to train when you have dry conditions and low fire blight infection periods or no sign of the bacteria.

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USING GIBBERELLIC ACID

N.L. Rothwell, NWMHRC

Gibberellic acid (GA) is a plant hormone that promotes growth and elongation of cells. In tart and sweet cherries, GA has been used successfully to reduce flowering during the early years of an orchard's life. The reduced flowering and subsequent reduced fruiting helps young trees increase vegetative growth. In addition, minimizing flowering in early years slows the transmission of pollen-borne viruses in young trees. We have also shown that GA used in mature tart cherry orchards can increase fruiting capacity by stimulating the formation of lateral shoots and spurs.

When GA is applied to cherry trees in late spring, a percentage of the flower buds forming for the following season will be converted to vegetative buds. Therefore, GA application in 2013 influences flowering in 2014. The effectiveness of GA is dependent on rate, timing and temperature. Surfactants have also been shown to influence GA applications. As a rule of thumb, high GA rates are required to prevent young trees from fruiting, whereas much lower rates are used to keep bearing trees in a good balance between vegetative and fruit production. GA applications should be made when daily high temperatures are expected to be above 70° F for two to three days, if possible. We have observed poor results when applications are made when daily high temperatures are below 60° F as is the case with most growth regulators. Applying GA this year may pose a challenge as temperatures have been cool, and forecasts have been off. Temperatures today, Monday, June 10 were predicted to be in the low 70s, and the current temperature is now 60° F. Temperature is more important that timing, although we do recommend to time the application when 5-7 leaves are visible on the trees. Waiting until temperatures warm is recommended.

Non-bearing trees

GA is typically applied to non-bearing cherries with a hand gun, so rates are applied on a dilute basis. The best results are generally achieved with two applications of 50 ppm (20 fl. oz. of 4%

formulated product per 100 gallons of water). The first application should occur 3 to 3 ½ weeks after full bloom, followed by a second application 2 ½ to 3 weeks later. An alternative method, though slightly less effective, is to apply a single treatment of 100 ppm (40 fl. oz. per 100) at about 3 to 4 weeks after bloom. GA should not be applied to trees during the year of planting, due to possible phytotoxicity. Vigorously growing trees in their second leaf do not need GA, as these trees naturally produce little fruit the following year. GA application often starts in year three, but may be desirable in year two if trees start off poorly. These high rates should continue until the year prior to first harvest/year of production.

Early bearing trees

To bring young cherries into bearing following GA treatments with high rates, growers should phase down GA rates rather than discontinuing GA use all at once. A sudden drop of GA from high rates to nothing will result in oversetting of fruit and potential tree stunting. Trees that have been kept vegetative with GA use have a tremendous capacity to set (overset) fruit. The year prior to when growers first desire fruiting, they should apply GA at 30 to 40 ppm if spraying dilute (12-16 fl oz./100 gal.) or 20-24 fl. oz./acre if applied at a concentrated rate. This rate per acre for concentrate spraying already takes into account the average tree size of this age tree, therefore do not reduce the rate further based on tree row volume. The next year, decrease this rate to 15 to 20 ppm applied dilute (6-8 fl. oz./100 gal.) or 10-12 fl. oz./acre concentrate. The following year, 10 ppm is optional but often not required. In orchards where growth is weak, growers should continue annual GA applications at 10-15 ppm as described for bearing trees.

Bearing trees

Growers should apply GA 3 to 4 weeks after bloom or when trees have 5 to 7 leaves (3 to 5 fully expanded) on terminal growth. GA should be used at rates of 10 to 20 ppm or 4 to 8 oz/100 gallons of ProGibb 4% (or equivalent) when applied dilute. For concentrate application to full-sized tart cherries, use 6 oz/acre of product to achieve a 10 ppm response or 12 oz/a for a 20 ppm response. Lower rates are typically used on more vigorous orchards or those with previous successful use of GA. Adding surfactants has caused varied responses—everything from increased phytotoxicity to no GA-related effects. Therefore, adding a surfactant is not suggested unless a grower has enough experience with a product to have confidence in the response.

GA Use on Balaton

Balaton appears to have less need for GA during non-bearing years to maintain good tree growth, but as it matures, the variety produces a lot of blind wood. Therefore, using GA is strongly encouraged on bearing Balaton trees. Figure 1 shows the successful use of GA to increase lateral shoots and spurs in a Balaton orchard at the NWMHRS. However, we cannot conclude that GA applications improve Balaton yields based on 2008 data although GA does appear to help with yield (Figure 2).

Figure 1. Average number of shoots with terminal buds in a Balaton orchard (2008).

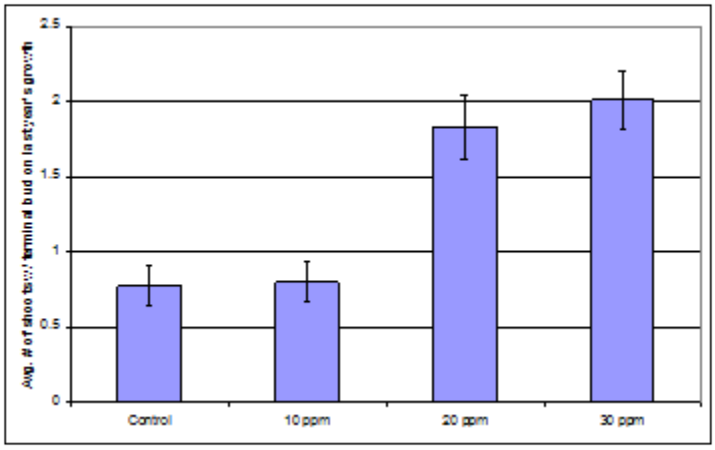
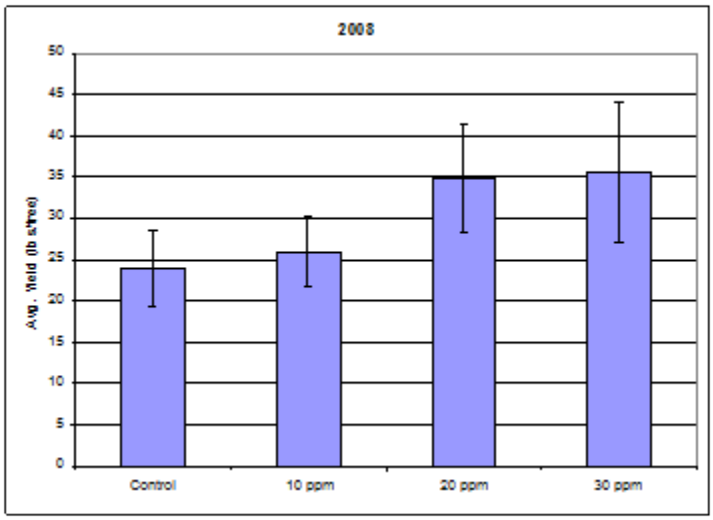


Figure 2. Average Balaton yield with different rates of GA (2008)



THINKING ABOUT CODLING MOTH, THE MODEL, AND THE HOT AND COLD TEMPERATURES

Nikki Rothwell, NWMHRC
Larry Gut, Dept. of Entomology, MSU

With fluctuating warm and cold temperatures, setting a biofix date for codling moth may be difficult With the current temperature fluctuations, we have seen inconsistent activity of pest insects in orchard systems. Since May 1, we have seen more than our fair share of two or three warm, 75 degree F days followed by days that topped out in the mid-50s; it has not been usual to see temperature swings of 25 degrees this season. Because all insect development is based on temperature, we have seen bursts of activity during these warm periods, and little to no activity during the cold snaps.

Codling moth (CM), like all insects, is dependent on temperature for development, but for this insect to fly, mate and lay eggs in fruit, a series of factors needs to align. We know from experience that CM adults emerge earlier and females lay more eggs during warm springs. Under these conditions we have a higher CM population, which in turn, is more likely to result in a higher proportion of larvae in the fruit at harvest unless a solid insecticide/mating disruption program is used. As with various insect species, a smaller population is easier to control than a large one. We have also seen a third or a partial third generation of CM in years with warm springs because of the accelerated development of the first and second generations.

In contrast, cool springs are not favorable for CM development and nature helps out when it comes to CM management. Cooler dusks mean less activity and mating flights and for each day with cold temperatures, female CM fecundity or egg-laying potential is reduced. Males do not fly and seek mates when dusk temperatures are below 60 degrees F. Furthermore, few eggs are laid at temperatures below 62 degree F, but as temperatures approach 70 degrees, egg-laying increases greatly. After four days of temperatures not conducive to mating and egg laying, a CM female's reproductive capacity is reduced by at least 75%. The bottom line is that cooler temperatures are a grower's ally when it comes to CM, helping growers naturally keep CM populations in check.

The current codling moth model is designed to help growers best time insecticides to prevent entry of larvae into fruit. The model is initiated on March 1st. Using 50 degree F as a base, degree-days (DD) for codling moth activity are as follows:

1st generation

- 0 DD--first adult emergence (biofix 1)
- 250 DD--first eggs hatch β treat*
- 350 DD--20% egg hatch
- 550 DD--peak egg laying

2nd generation

- 1,060 DD--first emergence of second generation adults (biofix 2)
- 1,250 DD--first egg hatch β treat*
- 1,600 DD--peak emergence of second-generation adults
- 1,700 DD--peak egg laying by second-generation adults

The challenge for a season like we are experiencing in 2013, one with high and low temperatures, is determining a 'biofix' date. For the past few years, we have been setting a biofix for each orchard based on monitoring with pheromone traps. We put pheromone traps into the orchard prior to bloom, and we begin accumulating degree days (base 50 F) on the day (biofix) at which the first moths (5+) are trapped after moths are captured on *two successive trapping dates*. For example, if we caught our first moths (5+) on Monday, June 3 and we catch moths again on Monday, June 10 (5+ moths), then the biofix date would be June 3, and we would start accumulating degree days from that date. The difficulty in setting a biofix arises when moths are caught, but then temperatures drop, resulting in little or no flight and no catch the following week.

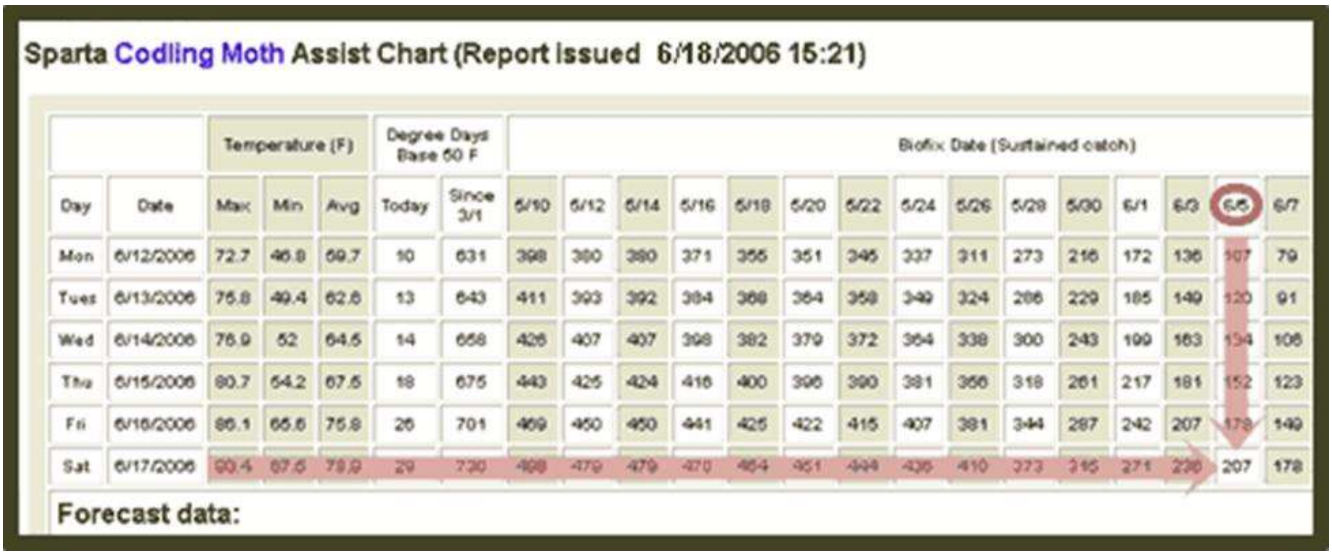
A possible solution to this quandary is to replace thinking of trap captures in terms of a single biofix but rather as a 'cohort' of the population. A cohort in this situation is a group of moths that are flying on a warm night(s) and are captured in the trap—this group of moths is capable of mating, laying eggs, and the hatching larvae pose a threat to the fruit. When this first cohort is caught in the traps, this is the date to begin accumulating degree-days to time insecticide sprays with respect to the portion of the population that has emerged and has the potential to infest fruit. So, in a warmer season, these cohorts fly on the first warm evenings, and we catch the moths in our pheromone traps; when we come back the following week, we see additional moths flying and set the date at the first trap catch—to begin degree-day accumulations (this is like the biofix). However, when we do not see a successive catch of moths two weeks in a row (i.e. growers catch moths the first week and not on the second week) should a grower set a date for determining spray timing on that first flight, even if he/she did not get moths in traps during that second week? The answer is only if enough moths were caught and temperatures were high enough to promote egg-laying. This situation of highly variable moth captures is typical in a year like this one where we have had a few warm evenings sprinkled in with cold temperatures—we caught moths last Friday and Saturday night (May 31 and June 1), but with cold temperatures for the remainder of this week, we will not likely have moths in the traps on this coming Friday and Saturday night—should we set the degree-day accumulation date for May 31?

With this new cohort thinking, it becomes a numbers' game. If a grower caught ~20 moths on May 31 and there were no moths in traps last Friday (June 7), we would consider that first cohort a threat to fruit with higher traps counts of 20 moths/trap and set the accumulation date on May 31. On the other hand, if we caught only 3 moths on May 31, and catch no moths on June 7, and with a trap catch so low on that first catch (3 moth/trap), we would not consider that first cohort a threat to fruit and would not set a degree-day accumulation date on May 31. The situation becomes more complicated if a grower catches 5-10 moths on May 31 and nothing on June 7—is that first cohort a threat? At this point, a grower will have to take into account other factors to decide if this first cohort of minimal catch poses a potential problem: early evening temperatures, past history of CM, spray program, mating disruption, etc.

In short, the biofix or cohort strategy is only a guiding principle, and in a year with temperature fluctuations, it is a challenge to decide when to set the biofix or start of degree-day accumulation for a cohort approach, and to use this date to best time insecticide applications for CM. In addition, population size influences trap catches: the higher the population, the higher the trap catches, the potentially more difficult to control the population. Therefore, growers should be trapping their own

blocks rather than relying on the NW Station, TNRC or a neighbor's trap counts. For instance, the CM populations are low here at the NW Station, and we have not yet set a biofix date, but growers that have higher populations set their biofix date two weeks ago. Despite this confusion with a biofix date, this date is important because all insecticide recommendation timings are based on this trap catch, so whether growers use a strict biofix or the cohort strategy, he or she will need to know this date to apply insecticide applications at the best timing.

Using the CM Model. Locate the Biofix Date (first date of sustained catch) on the top row. Follow that column down to determine the Base 50F Growing Degree Days (GDD) that have accumulated between the biofix date and the date listed at the left side of that row.



Compound trade name	**Chemical class**	**Life-stage activity**	**Optimal spray timing for codling moth**	**Mite flaring potential**
Guthion, Imidan	Organophosphates	Eggs, Larvae, Adults	Biofix + 250 DD	L - M
Asana, Warrior, Danitol, Decis, Baythroid XL	Pyrethroids	Eggs, Larvae, Adults	Biofix + 250 DD	H
Rimon	IGR (chitin inhibitor)	Eggs, Larvae	Biofix + 100 DD Residue under eggs	M*
Delegate	Spinosyn	Larvae	Biofix + 250 DD	
Altacor, Belt	Diamide	Eggs, Larvae	Biofix + 200-250 DD	
Assail, Calypso, Clutch/ Belay	Neonicotinoid	Larvae, Eggs & Adults (limited)	Biofix + 200-250 DD Residue over eggs	M*
Intrepid	IGR (MAC)	Eggs, Larvae, Adults(sublethal)	Biofix + 150-200 DD Residue over eggs	L
Avaunt	Oxidiazine	Larvae	Biofix + 250 DD	L
Esteem	IGR (juvenoid)	Eggs, Larvae	Biofix + 100 DD Residue under eggs	L
Proclaim	Avermectin	Larvae	Biofix + 200-250 DD	L
Granulovirus	Biopesticide	Eggs, Larvae	Biofix + 250 DD Residue over eggs	L

Voliam flexi	Diamide + Neonic.	Eggs, Larvae	Biofix + 200-250 DD Residue over eggs	
Tourismo	Diamide + IGR	Eggs, Larvae	Biofix + 200-250 DD	
Leverage	Pyrethroid + Neonic.	Eggs, Larvae, Adults	Biofix + 200-250 DD	H

*** May cause mite flaring in combination with carbaryl or pythrethroids that kill predacious mites.**

RAINFAST CHARACTERISTICS OF FRUIT CROP INSECTICIDES

Precipitation can impact insecticide performance, but some compounds resist wash-off.

Posted on **June 3, 2013, MSUE News,** by **John Wise**, Michigan State University, Department of Entomology

The rainfall events experienced in Michigan have prompted questions about the relative "rainfastness" of the insecticides used in fruit production. In 2006, AgBioResearch provided funds to purchase and install a state-of-the-art rainfall simulation chamber at the MSU Trevor Nichols Research Center (TNRC), after which Michigan State University Extension has conducted trials – with generous funding support from Michigan fruit commodity groups – on fruit crops for a range of insecticides.

There are several critical factors that influence impact of precipitation on a pesticide's performance. First is the plant penetrative characteristic of the various compounds. Some pesticide chemistries, like organophosphates, have limited penetrative potential in plant tissue, and thus are considered primarily as surface materials. Some compounds, such as carbamates, oxadiazines and pyrethroids, penetrate plant cuticles, providing some resistance to wash-off. Many newer compounds, such as spinosyns, diamides, avermectins, and Insect Growth Regulators (IGR) readily penetrate plant cuticles and have translaminar movement in leaf tissue. Others, like the neonicotinoid insecticides, are systemic and can have translaminar as well as acropetal movement in the plant's vascular system. Penetration of plant tissue is generally expected to enhance rainfastness of pesticides.

The second factor is the inherent toxicity of an insecticide to the target pest and the persistence of the compound in the environment. In some cases, a compound may be highly susceptible to wash-off, but its persistence and inherent toxicity to the target pest compensates for the loss of residue, thus delaying the need for immediate re-application.

The third factor is the amount of precipitation. In general, organophosphate insecticides have the highest susceptibility to wash-off from precipitation, but their high level of toxicity to most insect pests overcomes the necessity for an immediate re-application. Neonicotinoid insecticides are moderately susceptible to wash-off with residues that have moved systemically into plant tissue being highly rainfast, and surface residues less so. Carbamate, IGR and oxadiazine insecticides are moderately susceptible to wash-off, and vary in their toxicity to the range of relevant fruit pests. Diamide, spinosyn, avermectin and pyrethroid insecticides have proven to be moderate to highly rainfast on most fruit crops.
For most insecticides, a drying time of two to six hours is sufficient to "set" the compound in the plant. With neonicotinoids, for which plant penetration is important, drying time can significantly influence rainfastness. For neonicotinoids, up to 24 hours is needed for optimal plant penetration, thus the time proximity of precipitation after application should be considered carefully. Spray adjuvants, materials intended to aid the retention, penetration or spread on the plant, can also improve the performance of insecticides.

Based on the results from the current studies, the following charts have been developed to serve as a guide for general rainfastness characteristics and re-application recommendations for certain insect pests (also printed in the MSU Extension E-154 bulletin, "2013 Michigan Fruit Management Guide").

Note that these recommendations should not supersede insecticide label restrictions or farm-level knowledge based on site-specific pest scouting, but rather are meant to compliment a comprehensive pest management decision-making process.

Rainfastness rating chart: General characteristics for insecticide chemical classes.

Insecticide class	Rainfastness ≤ 0.5 inch		Rainfastness ≤ 1.0 inch		Rainfastness ≤ 2.0 inch	
	Fruit	Leaves	Fruit	Leaves	Fruit	Leaves
Organophosphates	L	M	L	M	L	L
Pyrethroids	M/H	M/H	M	M	L	L
Carbamates	M	M/H	M	M	L	L
IGRs	M	M/H	M	M		
Oxadiazines	M	M/H	M	M	L	L
Neonicotinoids	M,S	H,S	L,S	L,S	L,S	L,S
Spinosyns	H	H	H	M	M	L
Diamides	H	H	H	M	M	L
Avermectins	M,S	H,S	L,S	M,S	L	L

* H – highly rainfast (≤ 30 percent residue wash-off); M – moderately rainfast (≤ 50 percent residue wash-off); L – low rainfast (≤ 70 percent residue wash-off); S-systemic residues remain within plant tissue

Apple insecticide precipitation wash-off re-application decision chart: Expected codling moth control in apples, based on each compound's inherent toxicity to codling moth larvae, maximum residual and wash-off potential from rainfall.

Insecticides	Rainfall = 0.5 inches		Rainfall = 1 inch		Rainfall = 2 inches	
	*1 day	*7 days	*1 day	*7 days	*1 day	*7 days
Guthion				X	X	X
Imidan		X		X	X	X
Asana		X	X	X	X	X
Calypso			X	X	X	X
Assail			X	X	X	X
Proclaim		X		X	X	X
Rimon			X	X	X	X
Delegate					X	X
Altacor					X	X
Belt					X	X

* Number of days after insecticide application that the precipitation event occurred.
X – Insufficient insecticide residue remains to provide significant activity on the target pest, and thus re-application is recommended.
- An un-marked cell suggests that there is sufficient insecticide residue remaining to provide significant activity on the target pest, although residual activity may be reduced.

Grape insecticide precipitation wash-off re-application decision chart: Expected Japanese beetle control in juice grapes, based on each compound's inherent toxicity to Japanese beetle adults, maximum residual, and wash-off potential from rainfall.

Insecticides	Rainfall = 0.5 inches		Rainfall = 1 inch		Rainfall = 2 inches	
	*1 day	*7 days	*1 day	*7 days	*1 day	*7 days
Imidan		X	X	X	X	X
Sevin			X	X	X	X
Capture				X	X	X
Actara		X		X	X	X
Avaunt		X		X	X	X

* Number of days after insecticide application that the precipitation event occurred.
X – Insufficient insecticide residue remains to provide significant activity on the target pest, and thus re-application is recommended.
- An un-marked cell suggests that there is sufficient insecticide residue remaining to provide significant activity on the target pest, although residual activity may be reduced.

Blueberry insecticide precipitation wash-off re-application decision chart: **Expected cranberry fruitworm control in blueberries, based on each compound's inherent toxicity to cranberry fruitworm larvae, maximum residual, and wash-off potential from rainfall.**

Insecticides	Rainfall = 0.5 inches		Rainfall = 1 inch		Rainfall = 2 inches	
	*1 day	*7 days	*1 day	*7 days	*1 day	*7 days
Guthion		X	X	X	X	X
Asana		X	X	X	X	X
Intrepid		X	X	X	X	X
Assail		X		X	X	X
Delegate		X		X	X	X

* Number of days after insecticide application that the precipitation event occurred.
X – Insufficient insecticide residue remains to provide significant activity on the target pest, and thus re-application is recommended.
- An un-marked cell suggests that there is sufficient insecticide residue remaining to provide significant activity on the target pest, although residual activity may be reduced.

Blueberry insecticide precipitation wash-off re-application decision chart: Expected Japanese beetle control in blueberries, based on each compound's inherent toxicity to Japanese beetle adults, maximum residual, and wash-off potential from rainfall.

Insecticides	Rainfall = 0.5 inches		Rainfall = 1 inch		Rainfall = 2 inches	
	*1 day	*7 days	*1 day	*7 days	*1 day	*7 days
Imidan	X	X	X	X	X	X
Mustang Max		X		X	X	X
Sevin		X	X	X	X	X
Provado		X	X	X	X	X

* Number of days after insecticide application that the precipitation event occurred.
X – Insufficient insecticide residue remains to provide significant activity on the target pest, and thus

re-application is recommended.
- An un-marked cell suggests that there is sufficient insecticide residue remaining to provide significant activity on the target pest, although residual activity may be reduced.

Insecticide persistence, plant penetration and rainfastness rating

Compound class	Persistence (residual on plant)	Plant penetration characteristics	Rainfast rating
Organophosphates	Medium - Long	Surface	Low
Carbamates	Short	Cuticle Penetration	Moderate
Pyrethroids	Short	Cuticle Penetration	Moderate - High
Neonicotinoids	Medium	Translaminar & Acropetal	Moderate
Oxadiazines	Medium	Cuticle Penetration	Moderate
Avermectins	Medium	Translaminar	Moderate
IGRs	Medium - Long	Translaminar	Moderate
Spinosyns	Short - Medium	Translaminar	Moderate - High
Diamides	Medium - Long	Translaminar	Moderate - High

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TRAINING APPLE FOR HIGH DENSITY SYSTEMS

The window of opportunity to train apples growing in high density systems is approaching. This management tool influences flower bud initiation and can make a difference in developing a productive orchard.

Posted on **June 7, 2013, MSUE News,** by **Ron Perry**, Michigan State University Extension, Department of Horticulture

We are approaching a critical period for training apples growing in high density systems which influences flower bud initiation. This a management tool that is critical in the first four years of the life of a young orchard and can a make a difference in developing a productive orchard or one that challenges the boundaries of excessive vigor and low cropping.

What is flower bud initiation?
In apples, the period known as flower bud initiation begins about mid-June and continues through mid-July in the northern United States. Initiation is defined as the formation of flower parts within buds or the change from a vegetative to a reproductive bud. Frequently, the early portion of this stage is determined "induction" and the latter portion "development." This also means that flowers for next year's crop are being formed some seven to nine months in advance of bloom, or "anthesis." So, while growers are intent on managing the crop for the current year, they are also affecting the crop for next year. See the Michigan State University Extension article "Enhance return bloom on apple varieties by using summer NAA" for more information.

What affects is flower bud initiation?
In apples, the factors that are most critical during this period are light penetration into the canopy, current crop load, nutrition, water, temperature, rootstocks/vigor and branch angle, or "gravity." So if the tree or branches are stressed caused by excessive shade, drought stress, nutritional deficiencies or excessive crop load (on many varieties but not all, such as Gala) during this period, you can see a negative effect on flower bud initiation towards more vegetation and less reproduction; vigorous rootstocks can do this, as well. Knowing this, growers can influence flower bud initiation to their advantage by deploying practices that help encourage the potential for more flowers and fruit.

Branch angles
We have known for quite some time from various research studies that upright branches have a tendency to be more vigorous and less reproductive. Branches bent to horizontal or sub-horizontal angles will slow in growth rate that promotes flower bud initiation. This is commonly seen in branches with a large crop.

I can remember visiting Jeff DeCoster in the mid-1980s in Belgium who was promoting multi-row and Super Slender Spindle orchards by weighting down branches between June 22 (longest day of the year) and about mid-July using cement weighted hooks, weighted clothes pins, cotton string and rubber bands. I can even remember growers gluing nails formed in hook pattern to rocks for this practice. I began using the blue UVI-resistant rubber bands in those years with good success. The advantage of using bands is that over time, the bands disintegrate and avoid branch girdling. The practice is labor intensive and typically can't be done to all branches. However, being able to bend at least five to six branches that are exposed to light for each tree can induce more fruiting that, in turn, competes with vegetative growth and over all makes the tree more reproductive and less vigorous.

The practice of bending branches can and should begin immediately after planting (Photo 1). If "feathers," or 1- to 3-feet long branches formed in the nursery, come with trees, bend them down to horizontal for Vertical Axe or down to below horizontal for Tall Spindle. This practice is more critical at closer spacing such as 3 feet for Tall Spindle.

Photo 1. Bending branches in recently planted Tall Spindle apple trees. Rubber bands are used here (looped two together for added length).
For woody branches, I recommend the use of floral wire (18 inches) at 20 to 24 gauge (Photo 2). The floral wire can be moved at the beginning of the following season up into the canopy.

Photo 2. Using floral wire (20 gauge) to bend woody branches.
Rubber bands and floral wire are useful for new vegetative growth accomplished between mid-June and mid-July (Photo 3). Wait until growth is at least 10 to 12 inches long before bending to avoid breakage with pressure in bending. Be careful with young branches as the rubber band elasticity can change with temperature and amount of stress. I have gone back the next day and found many young branches broken overnight, so don't overdo it!

Photo 3. Using UV light-resistant rubber bands to bend young branches.

While this seems labor intensive, it will reduce pruning time and labor during winter, slow branch growth down, encourage more spurs and more flowering. In turn, the canopy is more compact and increased cropping slows down vegetative growth which is important in developing trees with good balance between fruit development and vegetative growth (Photo 4).

Photo 4. Impact of bending branches accomplished in previous years.

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OIL and GAS NEWSLETTER

Here is the link to the latest Oil and Gas Newsletter. Kendra Wills, one of our MSUE educators is the author of one of the articles.

Information in this Issue

1. Seeking input on lease negotiations
2. Some thoughts on the Order for Payment for an oil and gas lease
3. Encana Oil and Gas Outlines Utica-Collingwood play in Michigan
4. Dormant Minerals Act Question and Answer
5. Preserve Your Farm Through Purchase of Development Rights if you Have an Expired Oil and Gas Lease

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Farm management info on our new web site http://firm.msue.msu.edu/

WEBSITES OF INTEREST

Insect and disease predictive information is available at:
http://enviroweather.msu.edu/homeMap.php

60 Hour Forecast
http://www.agweather.geo.msu.edu/agwx/forecasts/fcst.asp?fileid=fous46ktvc

Information on cherries is available at the new cherry website:
http://www.cherries.msu.edu/

Fruit CAT Alert Reports have moved to MSU News
http://news.msue.msu.edu