M I C H I G A N

Blueberry Newsletter

A newsletter from Michigan State University for the Michigan blueberry industry

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MICHIGAN STATE UNIVERSITY | Extension

Michigan Blueberry Advisory Committee
MBBAC.ORG

News you can use

Crop development. In Van Buren County, Jersey in covert is beginning to show color, and Bluecrop and Blueray in Grand Junction is 7-10 days from first harvest. In Ottawa County, Bluecrop in West Olive is at early fruit coloring.

Insect management. Cranberry fruitworm flight is essentially over. As of July 5, no spotted wing Drosophila flies have been trapped. Japanese beetles are emerging.

Disease management. Continue monitoring plantings for disease symptoms. Mummy berry fruit infection will become visible as berries ripen. Apply preventative fungicide sprays for anthracnose and Alternaria fruit rots.

Thank you. The seasonal grower meetings for 2011 have finished. Thank you to all of the growers who hosted a meeting this year: True Blue Farms, A & L Farms, New Day Farms

Bluecrop in West Olive

Bluecrop in Grand Junction

GROWING DEGREE DAYS

From March 1

	2011		Last Year	
	Base 42	Base 50	Base 42	Base 50
Grand Junction, MI				
6/28	1626	1026	1954	1254
7/5	1837	1181	2145	1390
Projected for 7/12	2042	1330	2389	1578
West Olive, MI				
6/28	1405	860	1758	1084
7/5	1604	1003	1936	1208
Projected for 7/12	1821	1163	2177	1393

See http://enviroweather.msu.edu for more information.

Blueberries harvesting in SW Michigan

Mark Longstroth
Michigan State University Extension
Van Buren County

The beginning of July was warm with highs generally in the 80s. Strong storms moved down the Lake Michigan shore on Thursday and Friday, but these storms only affected the coastal counties. Highs were near 90 on Monday. Rainfall for the week was almost an inch close to Lake Michigan. Rainfall away from the lake was less than half an inch. Soils are drying out due to the lack of rain and corn is rolling up in sandy soils. Soil temperatures are in the mid-60s. Check your own weather by following the closest weather station at: enviroweather.msu.edu.

Blueberry harvest is well underway. Duke and other early varieties are being harvested. Fruit in later varieties such as Bluecrop and Jersey are coloring. Shoot growth is slowing in many fields as the soil dries. Cane collapse from phomopsis cane blight has begun. Trap catches of fruitworm adults has fallen off significantly. Only a few cranberry fruit worm have been trapped recently. Insects of concern include blueberry maggot and Japanese beetle. See the article on "Monitoring and management strategies for blueberry maggot". Glyphosate herbicide injury symptoms are very common in blueberries this year.

Fig. 1. Tufts of tiny leaves are a symptom of a large dose of glyphosate last fall. Note the healthy plants in the next row. This young plant will probably not survive since the whole plant is affected. ***Photo: M. Longstroth.***

Be careful using Round up and other glyphosate herbicides

Mark Longstroth
Michigan State University Extension
Van Buren County

Many fruit growers, especially small growers use Roundup (glyphosate) herbicide, and its generic cousins for weed control. This spring I am seeing lots of symptoms of glyphosate injury. This is probably due to glyphosate use last fall. Glyphosate materials interfere with amino acid synthesis and disrupt protein synthesis. They are nonselective postemergent materials that work well against both annuals and perennials. Glyphosate is absorbed by the leaves other tissues. It poisons the biochemical machinery in the plant. It is translocated with the sugars from photosynthesis to actively growing tissues where it poisons them. Glyphosate materials cause little damage if they not do drift on to green tissues such as green leaves and young stems. If it is applied in the fall when there is little growth you probably will not see any symptoms from small amounts of drift. You may not even remember that you used an herbicide in the fall when you wonder what is causing the stunted growth in your plants in the spring. Growers forget that this powerful herbicide can kill most plants at low doses and begin to think that it is safe to use around blueberries.

Glyphosate is easy to apply with a hand sprayer and can be used to spot treat problem weeds. Some farmers and homeowners are using glyphosate as a total weed control program with several

Fig. 2. This low branch received some drift from a glyphosate application last fall. Note the thin strap-like leaves and short shoots in comparison to the healthy leaves in the upper left. There is no reason to save this shoot on a mature bush. ***Photo: M. Longstroth.***

applications per year to kill weeds. This eliminates the use of soil active materials that require accurate sprayer calibration to avoid damaging the blueberry plant. I often recommend Roundup or other materials in the fall to kill invasive perennials in blueberry plantings. This is because the fall is the best time to kill perennial weeds with glyphosate materials. I usually caution that extreme care be used, because this is an excellent time to kill any plant with this broad-spectrum plant killer. The herbicide is taken up by the plant and stored in the bark and wood of the stems as well as the root system. When the plant begins growth in the spring the herbicide stunts new growth and if the dose was high enough it will kill the plant.

The symptoms I am seeing vary depending on the dose of drift that the plant received last fall. The worst case is extreme stunting of the growing points where there are only small tufts of tiny leaves instead of new shoots. Less extreme, are the short shoots of small thin leaves. I see a wide range in the short shoots crowded with narrow leaves symptom that I think is dose related. I am also seeing thin willow like leaves on normal looking shoots that I assume are from a very low dose of the herbicide.

What to do depends on the extent of the injury. I often see only a few canes affected in the bush. These canes were the ones that received drift last year and the herbicide was stored in the cane and perhaps in the portion of the root system that feeds that shoot. If the symptoms are severe I do not believe that that shoot will ever become a normal shoot and should be removed. Where the symptoms are less severe I think the grower can wait and see if the shoot grows out of the symptoms. If the symptoms persist, cut out the shoot and grow a new one. In cases where most of a small plant are affected you would be best severed to cut out most of the severely affected shoots and hope the bush recovers. If not, replace it.

Fig. 3. This shoot shows the full range of glyphosate herbicide injury symptoms; small tufts of leaves, short shoots with strap-like leaves, excessive branching, and normal shoots with narrow willow-like leaves. Note the healthy leaves and shoots on the bush behind it. This was the only affected branch on this bush so the affected shoot should be removed. ***Photo: M. L.***

Fig. 4. This shoot in the center of the photo with narrow leaves crowded on the growth probably received a small dose of glyphosate to the green bark at the base of the shoot last fall. This shoot may recover. ***Photo: M. Longstroth.***

Fig. 5. Most growers might wonder what caused the narrow willow like leaves on this bush. Excessive branching is another symptom of glyphosate injury. The newest leaves at the tips of the shoots show less damage than the first shoots out at the base of the shoots. This shoot is recovering from a small dose of glyphosate last fall. ***Photo: M. Longstroth.***

Insect update

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Cherry fruitworm (CFW) moth flight has ended and cherry fruitworm eggs have not been seen for over two weeks at the farms we scout. Some feeding on single berries by cherry fruitworm larvae can be seen near wooded borders in some fields, but very little single berry damage (much less than 1% of berries with damage) was observed this week at all the farms we scouted (Fig. 6). This damage is indicative of cherry fruitworm feeding or the early stages of cranberry fruitworm feeding.

Cranberry fruitworm (CBFW) flight has diminished greatly at all the sites we visit. We are at the tail end of flight for this pest in Van Buren and Ottawa Counties. Cranberry fruitworm eggs were not observed during scouting, and no cluster damage (the result of continued feeding by cranberry fruitworm) has been seen at these sites this season (Fig. 7). The cranberry fruitworm model on enviroweather predicts egglaying for this pest is over for most areas in southwest Michigan.

The number of blueberry aphids at the farms we scout has generally decreased over the past two weeks and this is likely the result of insecticide treatments. We are also seeing an increase in parasitized aphids and predators that eat aphids in the fields we scout. Growers and scouts should continue checking fields for aphids, and with the high levels of rain this spring there will be many vigorous young shoots for supporting aphid colonies.

Table 3. Insect scouting results.

Farm	Date	CFW moths per trap	CBFW moths per trap	BBA infested shoots (%)	SWD adults per trap	BBM adults per trap	JB per 20 bushes
			VAN BUREN COUNTY				
Covert	6/27	0	24	10%	0	0	0
	7/5	0	2	0%	0	0	0
Grand Junction	6/27	0	4	20%	0	0	0
	7/5	0	2	15%	0	0	2
			OTTAWA COUNTY				
West Olive	6/27	1	3	10%	0	0	0
	7/5	0	2	5%	0	0	1

CFW=cherry fruitworm; CBFW=cranberry fruitworm; BBA=blueberry aphid; SWD=spotted wing drosophila; BBM=blueberry maggot; JB=Japanese beetle

Blueberry maggot traps should already be hung and these traps should be monitored until harvest. See the article in the June 28, 2011 edition of The Michigan Blueberry IPM Newsletter for additional information on monitoring and control of blueberry maggot.

Japanese beetles are emerging (Fig. 8). Beetles were seen at the Grand Junction and West Olive farms, but no Japanese beetle feeding damage was observed on leaves or fruit at the sites we monitored. To monitor for Japanese beetle, examine 10 bushes on the field border and 10 bushes in the field interior and record the number of beetles on each bush. Keep in mind Japanese beetles are normally more common adjacent to grassy areas on sandy soils, and they prefer to be in sunny areas. Regular monitoring will aid growers and scouts in timing control measures to keep fields clean of Japanese beetles before harvest, and reduce the possibility of contamination during picking. Read more about Japanese beetle at the blueberries.msu.edu website.

As of July 5th, no spotted wing drosophila (SWD) flies have been trapped. See article comparing methods to detect SWD larvae in fruit in this edition of The Michigan Blueberry IPM Newsletter. For more information about this new invasive pest, please check out the MSU spotted wing Drosophila page at www.ipm.msu.edu/SWD.htm.

Fig 6. Early signs of feeding by fruitworms. Note the hole in the berry and premature coloring; *Photo: K. Mason.*

Fig 7. Cluster damage by Cranberry Fruitworm, indicative of ongoing fruitworm feeding; *Photo: K. Mason.*

Fig 8. Scout for Japanese beetle adults on the top of the canopy and on fruit clusters; *Photo: K. Mason.*

Comparison of fruit sampling methods for detecting SWD in fruit

RAPID RESEARCH REPORT

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At the time of this article, there have been no detections of SWD in monitoring traps in Michigan in 2011. Fields are being monitored carefully, and the fruit industries are preparing multiple approaches to ensure that there is no economic impact of this insect. One important component of an SWD Management Plan is the ability to detect larvae and pupae in fruit samples so that infested fruit is not marketed. With blueberries starting to ripen in Michigan fields, it is essential that growers and processors are prepared in case there are detections of this pest in traps, so that they can then sample their fruit for potential larval infestation. We have recently compared the effectiveness of four sampling methods for detecting SWD larvae and pupae in fruit, including a boil method that is widely used to detect blueberry maggot in fruit. This results from this study are reported below.

Methods: Organic, store-bought blueberry fruit were exposed to SWD adult flies for 12 days, using insects from a colony maintained at Michigan State University. Adult flies were then anaesthetized with CO_2 and removed from the containers, and then the berries were mixed and sorted into 100 berry samples. Sixteen replicates were set up, for four per treatment with fruit sampled using one of the following methods:

1. **Manual sort:** manual sampled through each berry carefully under a microscope to detect all larvae and pupae of SWD.

2. Sugar: mashed fruit manually in a Ziploc bag followed by suspension in 1.5 cups of sugar water (quarter of a cup of sugar in a quart of water) and searched for SWD in the liquid.

3. Salt: covered berries with 100 ml of a salt solution (quarter of a cup of salt in a quart of water) and examined after 20 minutes for larvae and pupae on the berry surfaces and in the liquid.

4. Boil: boiled the berries in 150 ml of water for 3 mins 20 seconds (=1 minute boiling) in a microwave and then crushed berries over a 4 mesh/inch screen with the back of a spoon and rinsed the fruit with cold water over a dark colored tray to collect the juice and larvae.

Results: Figure 9. The boil method was the most effective for detecting larvae in berries, providing significantly greater ability to detect small larvae, and being 2-3 times more effective than the sugar or salt methods for detecting large SWD larvae. Even though the manual sorting was done using a microscope and careful examination of the berries, it failed to detect small larvae and the fruit pulp hampered detection of the large larvae and pupae. The sugar method was effective for detecting pupae because they all floated on the liquid surface, but the cloudy liquid obscured some of the larvae, and smaller larvae were not detected. The salt method was the least effective, detecting the lowest number of each stage of SWD.

Summary: From the results of this study, the boil method is recommended for use by Michigan producers and processors that are sampling fruit to detect contamination by this insect. This method provided high sensitivity to large and small larvae, gave rapid results and could be implemented at a receiving station to determine the infestation status of berries. Further research is needed to determine the sensitivity of this method for low infestation situations, and to optimize the sampling to ensure the highest possibility of detecting berries infested with SWD.

Thanks to Katie O'Donnell and Noel Hahn for technical assistance. Funding for this research was provided by Project GREEEN.

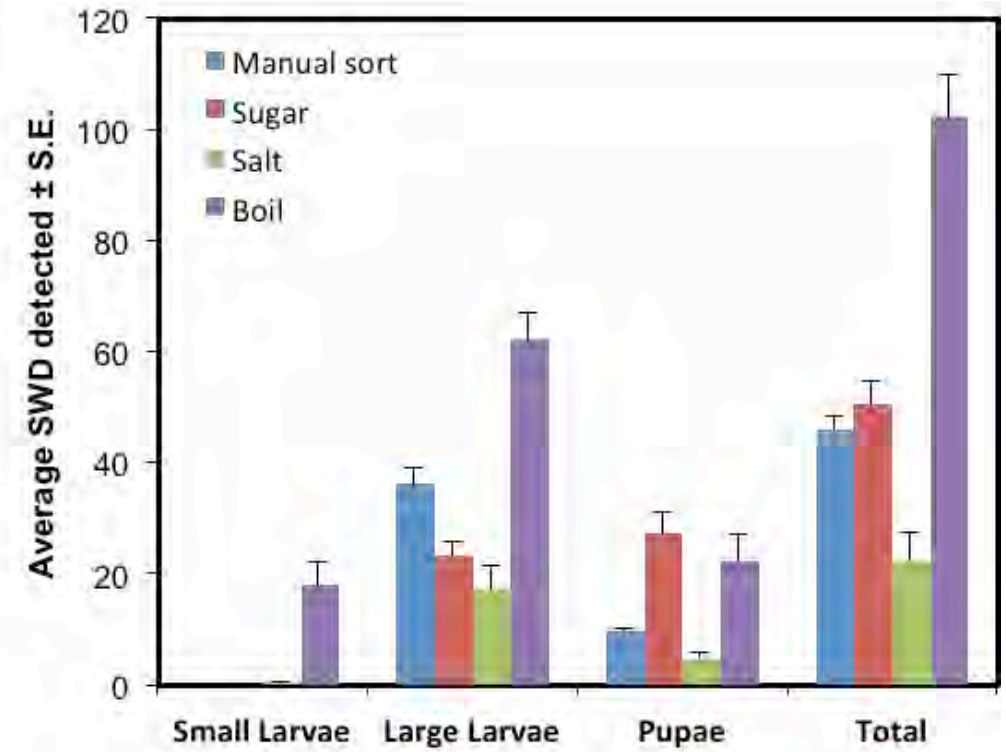

Fig 9. Comparison of the number of small SWD larvae, large SWD larvae, SWD pupae, and total SWD detected from 100 berry samples of blueberry artificially infested with spotted wing Drosophila, when sampled using four different sampling methods.

Rainfast characteristics of insecticides

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The numerous rainfall events experienced in Michigan over the last several weeks has prompted many 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 we have begun conducting trials (with generous funding support from MI fruit commodity groups) on fruit crops for a range of insecticides.

There are several critical factors that influence impact if 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 as primarily surface materials. Many compounds, such as spinosyns, diamides, carbamates, avermectin, pyrethroids and some Insect Growth Regulators readily penetrate plant cuticles and have limited 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. Second is the inherent toxicity of an insecticide on the target pest. A given compound may be highly susceptible to wash-off, but if the target pest is very sensitive to the compound there may be sufficient residue remaining to protect the crop. Related to this is the importance of understanding pest biology and behavior, and the resulting threat to the crop. For an indirect pest that feeds primarily on leaves, the rainfastness of a compound on foliage is the most relevant, and generally tolerance of leaf feeding injury is high compared to that of fruit. For direct pests that threaten a crop, the rainfastness of residues on fruit and leaves are both relevant. We have learned that wash-off potential for a given compound may be different on fruit than on leaves. The fourth factor is the amount of rain received from a precipitation event. Our research suggests that the duration of a precipitation event is relatively unimportant, but the amount of rainfall will significantly impact the insecticide residues remaining on the fruit and leaves of the plant. Thus the decision making process, whether to re-apply or not, must include knowledge of the pest, the precipitation event as well as the compound's rainfastness characteristics and relative toxicity to the target pest.

In general organophosphate insecticides have the highest susceptibility to wash-off from precipitation, although their toxicity level to most insect pests can often overcome the necessity for an immediate re-application. Neonicotinoid insecticides are moderately susceptible to wash-off, although residues that have moved systemically into plant tissue are highly rainfast, and surface residues less so. Pyrethroid, carbamate and IGR insecticides are moderately susceptible to wash-off, and vary in their toxicity to the range of relevant fruit pests. Diamide and spinosyn insecticides have proven to be highly rainfast. There is much more work to be done in this area of research, so we expect to update our findings to you as they develop over the coming years.

Based on the results from the current studies the following chart was developed to serve as a guide for general rainfastness characteristics and re-application recommendations for certain insect pests (also printed in the 2011 Michigan Fruit Management Guide E-154). 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.

Table 2. Blueberry Insecticide Precipitation Wash-off Re-application Decision Chart: Expected cranberry fruitworm control in blueberries, based on each compound's inherent toxicity to CBFW larvae, maximum residual, and wash-off potential from rainfall.

Insecticides	Rainfall = 0.5 inch		Rainfall = 1.0 inch		Rainfall = 2.0 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.

Bronze leaf curl - a mystery disease

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An unknown disorder of blueberry bushes has become more common over the last several years, although the problem has been noticed as far back as 2004 and probably earlier. We have named it "bronze leaf curl", after the symptoms which include browning or bronzing of the interveinal areas of leaves as well as cupping of the leaves (Figure 1). These symptoms become visible as leaves unfold in late spring and may persist until fall. In addition, the bushes are stunted with fewer, weaker canes and may eventually die (Figure 2). However, the roots and shoots look relatively normal (green) when cut open, which seems to rule out fungal wood decay. The problem occurs primarily in older fields and can affect multiple varieties, including Jersey, Bluecrop, Elliott, and Pemberton. Initially, new herbicides were suspected to be associated with the disorder, but this is unlikely to be the case because there are usually a few affected bushes scattered throughout the field, suggesting a biological origin. In addition, symptoms were seen before newer herbicides were available. However, a complicating factor is that bushes may not show foliar symptoms every year and healthy current-season growth may obscure diseased shoots to some extent.

In the disease diagnostic survey in 2010, many fields with blueberry bushes showing decline but testing negative for all viruses actually showed bronze leaf curl symptoms. In 2009 and 2010, we tested affected bushes for all known blueberry viruses and only found blueberry shoestring virus in some plants, which could not explain the symptoms. Samples also tested negative for *Xylella fastidiosa*, a bacterial pathogen causing Pierce's disease of grapevine and bacterial leaf scorch of blueberry in the southeastern United States. We are currently working with Dr. Robert Martin at the USDA-ARS in Corvallis, Oregon, to try and identify the causal agent. He has detected a type of closterovirus in leaf tissue of affected bushes. However, this does not prove that this virus is to blame for the symptoms, since some viruses can infect bushes without causing symptoms (latent infection). The case would be strengthened if the virus were only associated with diseased bushes and not with apparently healthy bushes. Once the disease has been fully diagnosed and the causal agent genetically characterized, we will be able to identify possible means of spread and devise control strategies. For this, we will need more samples. Please contact us if you have seen bronze leaf curl-like symptoms on your farm and would like to provide some samples for further research (contact Jerri Gillett at 517-355-7539 or at gillett@msu.edu).

Fig 10. Bronzing and curling of blueberry leaves. ***Photo: M. Longstroth.***

Fig 11. Declining bush with bronze leaf curl symptoms. ***Photo: M. Longstroth.***

Control of fruit rots in blueberries before harvest

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As blueberries are now in various stages of ripening, the main diseases of concern are fruit rots, such as anthracnose (orange spore masses) and Alternaria fruit rot (green velvety mold). Botrytis fruit rot (gray mold) is not as common in Michigan and tends to show up more as a postharvest rot in some years. Anthracnose tends to be a problem in cultivars such as Bluecrop, Jersey, Blueray, and Rubel, while Alternaria fruit rot may be visible before harvest in Bluecrop. Cultivars Duke and Elliott are resistant to anthracnose. Fruit rots are generally separated into two types: field rot and post-harvest rot. The former can be seen on berries in the field before harvest, and is especially common when berries are left on the bushes too long. So timely harvesting is an important control measure. Post-harvest rot can develop on sound-looking berries, as spores from infected berries can infect them before or during harvest or during processing. Often, these berries look healthy at harvest, but start to rot soon after in the lugs while awaiting processing. Rot may be slowed down by refrigerated storage, but will resume on the supermarket shelves, lowering fruit quality. These infections can also contribute to high microbial counts in frozen berries, leading to rejection of fruit lots by some buyers. Rapid cooling of harvested fruit is important in reducing post-harvest fruit rot incidence, particularly at the later harvests when disease pressure is generally high.

Fruit rot is often not visible until the berries ripen or even after harvest. Fortunately, the weather has been warm and on the dry side in much of Michigan over the past month, with occasional precipitation which has led to possible infection periods. A fungicide application is recommended as the berries are first starting to turn blue. If the first ripe berries are starting to show rot, fungicide sprays can still limit new infections of neighboring healthy berries. Applications within 1-2 weeks of the first harvest can still be beneficial in preventing these late infections. In fact, an additional fungicide application between the first and second harvest may be beneficial under high disease pressure. With anthracnose there tend to be two important periods when the infection risk is high because of peak spore release: 1) From bloom to about pea-size berry (due to overwintering inoculum), and 2) From first blue fruit until the end of harvest (due to sporulating berries that infect surrounding berries). Infection incidence can increase greatly as the harvest season progresses. For Alternaria fruit rot, apply fungicides period between pea-size fruit and harvest.

The strobilurins (Abound, Cabrio, Pristine) are all highly effective against anthracnose, with Pristine having the most broad-spectrum activity since it contains two different active ingredients. However, it is also the most expensive of the three. Pristine will also have excellent activity against Phomopsis, while Cabrio has good and Abound fair activity against this disease. All are supposed to have moderate to good activity against Alternaria fruit rot and become quickly rainfast since they are locally systemic. Switch (cyprodinil and fludioxonil) also has some systemic properties and provides simultaneous good to excellent control of anthracnose, Alternaria, and Botrytis fruit rots. Thus it may be a good choice if several fruit rots are a concern. Captevate (captan and fenhexamid) at the high rate will provide good control of anthracnose as well as Botrytis fruit rot, but the latter disease tends to be less common in Michigan. Omega is a newer protectant fungicide which also has good activity against anthracnose fruit rot. The old stand-by, Captan (captan) is a good protectant against anthracnose fruit as well, but is a suspected carcinogen, so I would not recommend applying it close to harvest. Ziram (ziram) had moderate to good activity against most fruit rots and would be better at the 4-lb than the 3-lb rate. Aliette (fosetyl-Al) is a highly systemic fungicide that provides good control of anthracnose, Alternaria fruit rot, and Phomopsis. ProPhyt and Phostrol have moderate activity against anthracnose fruit rot; be careful applying these products in tankmixes with foliar fertilizers or spray adjuvants, especially at high temperatures as phytotoxicity may occur. Do take note of the pre-harvest intervals for the various fungicides.

2011 Grower Events

Monthly grower meetings are finished for the season.

Great Lakes Fruit, Vegetable, and Farm Market Expo
December 6-8, 2011
DeVos Place Convention Center, Grand Rapids

SW Hort Days
Early February, 2012
Lake Michigan College, Benton Harbor

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