Michigan Blueberry Facts

MICHIGAN STATE UNIVERSITY

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Contents

CROP STAGES

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In Van Buren County, Jersey in Covert and Blueray in Grand Junction are at fruit coloring, and in Grand Junction, Bluecrop is within one week of first harvest. In Ottawa County, Blueray in Holland, and Rubel and Bluecrop in West Olive are at fruit coloring.

Bluecrop almost ready for harvest in Grand Junction (left), and Jersey at fruit coloring in Covert (right).

WEATHER NOTES

Mark Longstroth
Michigan State University Extension

Complete weather data for your area can be found at enviroweather.msu.edu.

The past two weeks had highs in the low 70s to mid 80s and lows in the 50s and 60s. Rainfall ranged from about ¾ " in the south to 2" in the northern portion of the southwest district. Precipitation totals (from January 1) range from approximately 13 inches in Berrien County to about 22 inches in Fennville. This week, expect above normal temperatures with above normal precipitation. Expect scattered showers across the blueberry-producing region through Wednesday. Thursday should be dry across the state. Friday there is a chance of showers, especially further north. Active weather patterns bring a chance of widespread rain across the state on late Saturday and Sunday.

DEGREE DAYS		
GDD (from March 1)	**Base 42**	**Base 50**
	Van Buren County	
6-30-08	1606	1007
7-7-08	1795	1140
Projected for 7-14-08	1998	1287
	Ottawa County	
6-30-08	1423	852
7-7-08	1601	974
Projected for 7-14-08	1805	1122

INSECT UPDATE

Keith Mason and Rufus Isaacs
Department of Entomology, Michigan State University

Left: Single berry damage. Note the characteristic darkening of the fruit.

Right: Cluster damage from Cranberry fruitworm.

Cherry fruitworm flight is over, and cranberry fruitworm moth flight continues to decrease. No fruitworm eggs were found during scouting, but fruitworm damage is becoming more evident in some fields. Single berry damage (indicative of cherry fruitworm feeding or early cranberry fruitworm feeding) was observed at all four farms and this type of damage has increased slightly over the past week. Cluster damage (characteristic of advanced cranberry fruitworm feeding) was observed in Grand Junction and Covert. Click here for more info and photos of cranberry and cherry fruitworm. We expect cranberry fruitworm flight to continue to decrease, and we do not expect to find any freshly laid fruitworm eggs. However, berry damage and cluster damage will likely increase over the next week as some larvae develop inside fruit. Growers and scouts should continue monitoring cranberry fruitworm traps and inspecting berry clusters until harvest. See the June 10th issue of the Michigan Blueberry IPM Update for fruitworm scouting methods.

No blueberry maggot flies were caught at any of the four farms. Growers and scouts should continue checking blueberry maggot traps at least once per week from now through harvest.
See the June 24th issue of the Michigan Blueberry IPM Update for more information on Blueberry maggot fly.

All four farms were scouted for Japanese adults, and low numbers of beetles were observed in Grand Junction and Covert. Very little Japanese beetle feeding on leaves or fruit was seen at either of these farms. Growers and scouts should be checking fields for these beetles from now through harvest. See the July 1st issue of the Michigan Blueberry IPM Update for more information including scouting methods for Japanese beetles.

Aphids were found at all farms except in Covert, and mid-sized colonies (5 to 20 individuals) were seen. No parasitized aphids were seen. Continue scouting for aphids, particularly on farms with varieties that are susceptible to shoestring virus.

Leafroller feeding was not seen at any of the farms, and tussock moth larvae were not observed, but growers and scouts should still be on the lookout for these pests.

Van Buren County						
Farm	Date	CBFW moths per trap	CFW moths per trap	BBA % infested shoots	BBM adults per trap	JB per 20 bushes
Covert	6-23	41	0	5%	0	
	6-30	6	0	20%	0	0
	7-7	1	0	0%	0	4
Grand Junction	6-23	9	0	40%	0	
	6-30	8	0	20%	0	0
	7-7	11	0	50%	0	7
Ottawa County						
Farm	Date	CBFW moths per trap	CFW moths per trap	BBA % infested shoots	BBM adults per trap	JB per 20 bushes
Holland	6-23	63	0	5%	0	
	6-30	2	0	5%	1	0
	7-7	4	0	25%	0	0
West Olive	6-23	1	0	15%	0	
	6-30	0	0	20%	0	0
	7-7	0	0	40%	0	0

DISEASE UPDATE

Timothy Miles and Annemiek Schilder
Department of Plant Pathology, Michigan State University

This week all scouted blueberry plots were 5-25% ripe and extreme periods of wetness have been seen this week resulting in increased susceptibility to a number of plant pathogens (Figure 1). Mummy berry shoot strike symptoms were no longer visible within the field as old infections have dried down and deteriorated. Twig blight symptoms have also not increased much in any of our scouted plots. Furthermore, mummy berry infected fruit were seen in all scouted plots by cutting open a small number of berries at each site.

Figure 1. Berry wetness increases the infection risk of immature blueberries (observed in Holland, MI on 7-4-08).

Fruit rots

Scouting for fruit rots is nearly impossible during this time of year in blueberries because immature blueberries are usually asymptomatic. Occasionally, when green berries get damaged, some sporulation of *Colletotrichum acutatum* (orange spore masses) or *Botrytis cinerea* (fuzzy gray mold) may be seen. In Michigan, most fruit rots are primarily a post-harvest problem caused by a variety of fungal pathogens (Figure 2). However, as berries ripen is still possible under humid weather conditions to see fungal sporulation in the field. Of note, berries tend to be more susceptible as the season progresses, meaning subsequent harvests of the same field tend to be more susceptible to infection. As fruit begins to ripen, growers should scout for rotting berries and visible signs of sporulation; and determine the best course of action to protect their crop.

Cultural practices like well-timed irrigation and rapid cooling of fruit after harvest, and a spray program with effective fungicides from pink bud or bloom onwards can be effective in preventing fruit rots. However, even if sprays were not applied in previous weeks, a spray before harvest or between harvests can provide additional protection against post-harvest fruit rots. Healthy berries that are in close proximity to or in contact with sporulating berries can become infected during rain events before harvest or even after harvest in the harvester and on the sorting line. Scouting for fruit rots in the field can give growers an idea as to whether fungicide sprays are still needed. Effective fungicides against anthracnose fruit rot are Cabrio, Abound, Pristine, and Switch. Alternaria fruit rot is best controlled with Switch, Aliette, or Pristine.

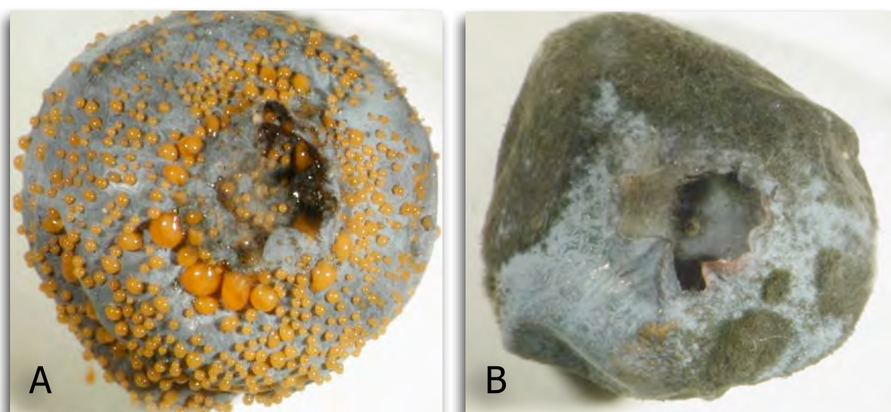

Figure 2. Post harvest incubation of ripe fruit reveals a number of diseases including; A) Anthracnose and B) Alternaria fruit rot.

Farm	Date	Average number of mummy berry shoot strikes*	Average number of blighted twigs per bush**	Blueberry Shoestring Virus***	Presence of mummy berry infected fruit****
Van Buren County					
Covert	6-19	0.5	9.9	0	-
	6-27	0.0	9.2	0	Not present
	7-4	0.0	9.6	0	Present
Grand Junction	6-19	9.2	3.3	0	-
	6-27	0.9	2.9	0	Present
	7-4	0.0	2.5	0	Present
Ottawa County					
Holland	6-19	3.0	1.8	4/50	-
	6-27	0.0	2.8	3/50	Present
	7-4	0.0	2.7	3/50	Present
West Olive	6-19	3.7	1.2	0	-
	6-27	0.0	1.8	0	Present
	7-4	0.0	2.1	0	Present

*Average number was calculated for ten bushes.

**Blighted twigs may be caused by various fungi, incl. *Phomopsis vaccinii*, *Colletotrichum acutatum* and *Botrytis cinerea*.

***Number of bushes showing blueberry shoestring virus symptoms (50 bushes were scouted)

****Fruit were sampled by cutting open a small number of berries and checked for the indicative white mycelial star pattern

PEST OF THE WEEK – FRUIT ROTS

Annemiek Schilder
Department of Plant Pathology, Michigan State University

Anthracnose – *Colletotrichum acutatum* (fungus)
Alternaria fruit rot – *Alternaria tenuissima* (fungus)
Botrytis fruit rot – *Botrytis cinerea* (fungus)

The majority of fruit rot in blueberries is caused by three different pathogens *Colletotrichum acutatum*, *Alternaria tenuissima*, and *Botrytis cinerea*. In previous issues we separately discussed these three pathogens in moderate detail. However, it is often beneficial to group them because like other fungi they thrive on ripe to overripe fruit and high humidity. Furthermore, each can cause significant post harvest fruit losses. In Michigan, these pathogens can be seen as pre-harvest diseases (especially anthracnose); however, the majority of losses are incurred after harvest and during storage.

Symptoms
Immature green berries are generally asymptomatic for any sort of fruit rot, however the fungal infection can and likely occurs during this growth stage. The infection remains latent and fruit rot symptoms will not appear until the berries start to ripen. For anthracnose, berries will have sunken areas and start to shrivel, and under humid conditions, support copious orange, gelatinous spore masses (Figure 1A). *Alternaria* can cause sunken areas near the calyx cup eventually leading to a dense amount of dark green fungal mycelium covering the fruit surface (Figure 1B). After harvest, *Alternaria* is most commonly found as spreading, greenish gray fungal growth around the fruit scar. *Botytris cinerea* or gray mold, is uncommon in the field, however, it is characterized by gray fluffy hyphae covering the surface of the berry (Figure 1C).

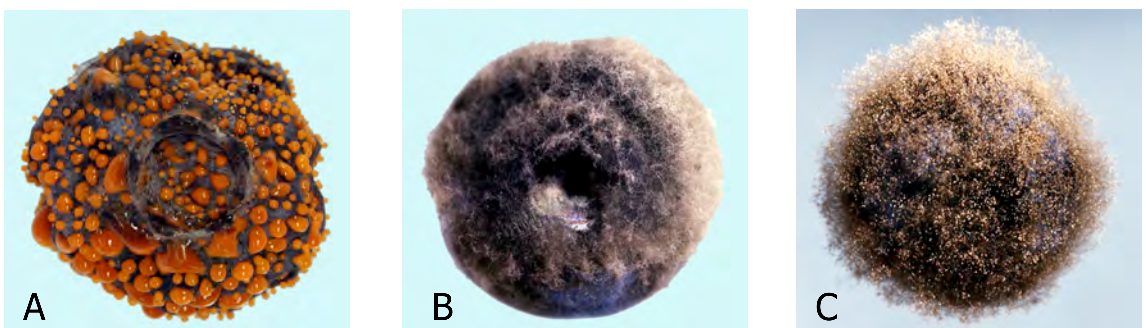

Figure 1. Advanced fruit rot symptoms on ripe blueberries kept under high humidity.
A) Anthracnose B) Alternaria fruit rot C) Botrytis fruit rot.

Scouting
In terms of scouting for fruit rots, each of these pathogens can be distinguished from each other in the field and should be treated differently when applying control measures. In the summer of 2007 we made an effort to validate scouting for pre-harvest fruit rots to determine the risk of post-harvest losses, we collected healthy-looking fruit from all of the scouted plots. The fruit was then returned to MSU and placed under 100% humidity for a period of ten days. Figure 2 represents pre-harvest anthracnose incidence observed in the field and how it correlates to post-harvest rot levels in the lab. These data demonstrate that the higher the incidence of pre-harvest rotting observed in the field, the more significant the risk of post-harvest crop losses. Growers can do a rot test by placing ripe berries on a moist paper towel in a container with a lid, making sure that the berries do not touch each other and that the towel remains moist (but there is no standing water) for 10-14 days.

Management
Since these diseases do not often manifest themselves until harvest, preventative measures are necessary. If fruit rot problems were experienced in previous years, it is fair to assume that there will be disease pressure this year. A fungicide spray program from pink bud to harvest will aid in preventing fruit infections from occurring. The 2008 Fruit Management Guide lists several fungicides that are effective against fruit rot diseases. Captan, Abound, Cabrio, Pristine, and Switch are effective against anthracnose; Switch, Aliette, and Pristine are quite

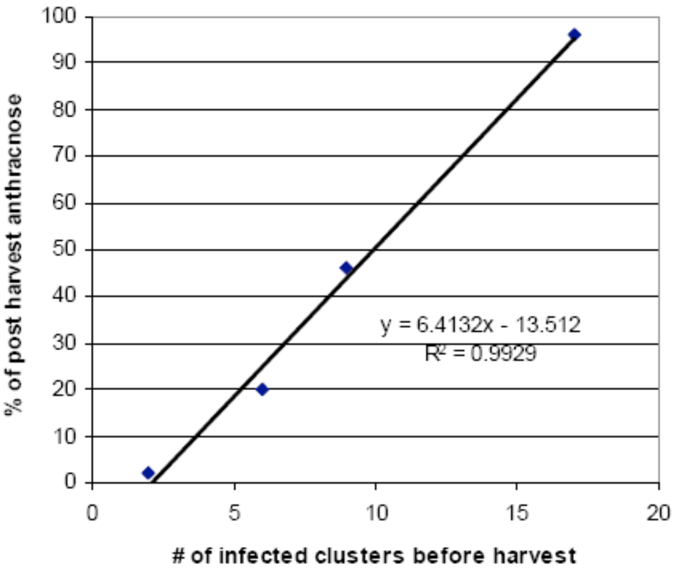

Figure 2. Pre-harvest anthracnose incidence correlated strongly with post-harvest rot incidence in 2007 in the four scouted blueberry fields in Michigan.

effective against Alternaria rot; and Switch, Elevate, and Captevate are effective against Botrytis gray mold. Do consider the pre-harvest interval as well as fungicide resistance management and systemicity in your choice of fungicides.

Cultural control measures should be aimed at making the environment less conducive for pathogen growth and development, e.g., by pruning bushes to create an open canopy (this will also allow better spray penetration), good weed control, and timing of overhead irrigation to allow rapid drying of leaves and fruit. Timely harvests and rapid cooling and processing of fruit can reduce post-harvest losses. In the long term, pruning out of old or infected canes and twigs can be effective at eradicating or reducing overwintering inoculum. Another option is to plant resistant cultivars.

Figure 3. Michigan State University spore trap (Sporomatic 2000 Deluxe) designed to collect rain water and spores of rain-splash-dispersed fungi. The aluminum foil is to protect the sample from heating up due to sunlight.

Future Options

Currently, Michigan State University is developing a predictive disease model based on weather information, which considers how much fruit wetness duration is required for infection at what temperature. In addition, we also would like to be able to predict when spores are spread through a field. To construct this model, rain water has been collected every week for a number of years from different blueberry fields and the number of spores present in the water counted under a light microscope (Figure 3). Weather data from stations of the Michigan Automated Weather Network will be used to analyze spore release patterns.

WATCH OUT FOR HARVEST-SEASON INSECT PESTS

Rufus Isaacs
Department of Entomology, Michigan State University

With blueberry harvest underway, regular scouting of fields is critical to ensure that harvested berries are insect-free. Four key insect pests can infest blueberries during harvest and management of these should be the focus of insect IPM programs until harvest is complete. These insect pests are cranberry fruitworm, Japanese beetle, blueberry maggot, and tussock moth.

Cranberry fruitworm. This pest is usually out of the fruit before harvest of most fields, but early varieties are the most at risk. This is because larvae not controlled after bloom can still be developing in the fruit when these early varieties are harvested. Regular field inspections, especially alongside woods or tree lines, are recommended to avoid harvesting infested fruit. If any berries are detected with the characteristic premature color change, and especially if larvae are found inside, growers may consider skipping the edge of the field to avoid harvesting these berries. While the window for fruitworm management is closing for 2008, take good notes now and make sure fields that were not well protected from this pest are given extra attention in 2009.

Japanese beetle. Beetle emergence has begun for 2008. Adult beetle densities are generally low still, but we expect more emergence over the coming weeks. Preventing beetle contamination of blueberries is essential during harvest, so many growers adopt a cycle of management for this pest that follows the following sequence: harvest, irrigate, scout fields, apply insecticide only if needed. This is repeated through each of the harvests. There are a number of registered insecticides that provide very effective protection against Japanese beetle, and you can view last week's article for detail on this topic.

Blueberry maggot. Flies are emerging from their overwintering stage, and monitoring traps are catching them in many parts of southern Michigan. Using yellow sticky traps baited with attractive odor is a key component of blueberry IPM, as this allows growers to decide whether there is any risk to the field from blueberry maggot. Traps should be checked a few times each week through harvest so decisions can be made to not treat or treat depending on the number of flies detected. It is critical that accurate identification is made of flies trapped, and the photo below helps show the differences between blueberry maggot (fly on the left) and the native cherry fruit flies that can be around blueberry fields on wild cherry (fly on the right). The cherry fruit fly does not infest blueberries and its wing pattern is different from blueberry maggot. Most insecticides that are active on Japanese beetle will also control blueberry maggot.

Tussock moth. In early July the eggs from the second generation of tussock moth hatch and the larvae crawl into the bushes to feed on leaves, preferring the darker, shady parts of the bush. As they grow, these larvae move higher in the canopy and can become mature, large, colorful (yellow, white, black, and red) larvae as the later ripening varieties mature. The key to preventing problems with this pest at harvest is good management of the first generation; tussock moth tend not to be a pest in fields that receive good control of fruitworms around bloom time when the early tussock moth generation larvae are out. If larvae are present now there are many broad-spectrum insecticides that will control this pest. Various selective insecticides can work too if they are applied early enough: B.t (Dipel, Javelin) or the growth regulators Confirm or Intrepid are effective at controlling younger larvae of tussock moth. Larvae must eat these insecticides for them to work, so covering the inside of the bush is essential. This goes for the broad-spectrum products too - because the larvae can be down in the bush canopy getting product to the center of the bush is needed if tussock moth is to be controlled.

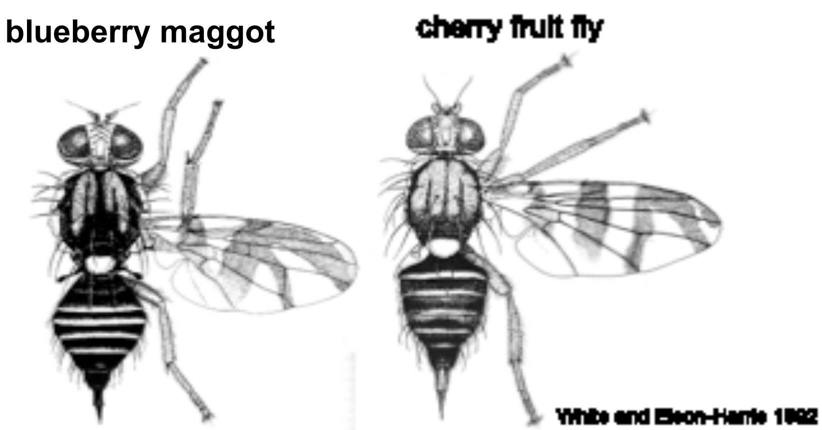

Figure 1. *Rhagoletis* fruit flies that may be caught on yellow sticky traps

MSU BLUEBERRY TEAM PROFILE

John Wise
Associate Professor, MSU Department of Entomology
Research and Extension Coordinator, MSU Trevor Nichols Research Complex

John Wise is an associate professor in the Michigan State University Department of Entomology and the Research and Extension Coordinator of the MSU Trevor Nichols Research Complex (TNRC). His primary research interest is to describe the critical performance characteristics of new insecticide chemistries for control of fruit insect pests. Wise manages insecticide performance trials at the TNRC, serves as a Field Research Director for an IR-4 GLP field residue program, and runs the Applied Insecticide Toxicology lab on the MSU campus. Wise took lead in developing a series of fruit IPM scout training programs, including the bi-lingual blueberry IPM program that has been held annually at the TNRC since 2004.

John demonstrating to blueberry growers how to scout for cranberry fruitworm.

Current research studies include:
1. Optimization of Sprayer Technology and Operational Parameters for Pesticide Performance in Blueberries.
2. Spanish Translation of IPM Pocket Guides: Delivery to Hispanic/Latino Farming Communities of MI.
3. Screening Pipeline Insecticides for Potential IR-4 Registration in Blueberries.
4. Determination of the Impact of Precipitation on Grape Insecticides.
5. Determining the Curative Activity if Insecticides on the Plum Curculio in Cherries.
6. Testing for Codling Moth Resistance to Insecticides in Apples.
7. Use of C-14 Radio-labeled Insecticides to Determine Fruit Penetration Characteristics of Insecticides.

I have worked at the Michigan State University (MSU) Trevor Nichols Research Complex (TNRC) for over seventeen years, first as a research assistant, in 1997 as the research and extension coordinator of the TNRC, and then in 2003 I was appointed as an assistant professor in the department of entomology. The mission of the TNRC is to provide effective integrated pest management strategies for Michigan's fruit industry, and serve as an extension information hub for pest management decision-makers. The TNRC has over one hundred planted acres of various fruit orchards, including apples, cherries, peaches, pears, blueberries, and grapes available for research. One key research activity that is directly related to this mission is conducting field efficacy trails for the wide range of insecticides either registered or soon to be registered for use in commercial fruit production. I currently host at the TNRC one of the largest field efficacy programs for fruit crops in the nation. The information from these insecticide performance trials is used extensively for my extension activities and also serve as the primary basis for recommendations in the MSU Fruit Management Guide (Extension Bulletin E-154).

Even though the applied data coming from these trials are highly valued by fruit growers in terms of telling them "what works", it has long concerned me that they teach us very little about "how the job gets done". I have also had the opportunity to be involved in more fundamental research that has the advantage of highly controlled laboratory environments, and allowing researchers to address more focused questions. Even though the resulting data are often far more robust, I have been equally concerned that these results are often so dis-attached from the "real world" that their relevance is lost. Frustration with the limitations of traditional laboratory-based research as well as those of the squirt-and-count efficacy trials led me to search for a research methodology that would help bridge the gap between these two ends of the research spectrum.

Reaching back largely to the systems science training that I received from my graduate studies at MSU I developed a new research approach based on the idea that to fully understand insecticide performance, the interaction of three critical elements – the plant (P), the insect (I) and the chemistry (C) must be considered. Without all of the PIC-Triad elements (Fig. 1) we lack vital information regarding how a specific chemical will perform against a pest on a particular crop. The PIC-Triad approach focuses on capturing both the spatial and temporal dimensions of the interface between plant, insect and the chemistry within an ever-changing environment. To do this a spectrum of research tactics are employed, including laboratory-based bioassays to determine a compound's acute and sub-acute effects on a pest, field-based residual bioassays to capture the temporal dimension of insecticidal activity as residues age and plants grow, and residue profile analysis to understand the contribution of surface and sub-surface residues to the modes of insecticidal activity. No single component alone provides sufficient information to fully describe the natural interactions between pest, crop, and insecticide. My research henceforth has focused on harnessing the PIC-Triad to further describe and understand the performance mechanisms of new insecticide chemistries on fruit insect pests in hopes of making a significant contribution to twenty first century IPM.

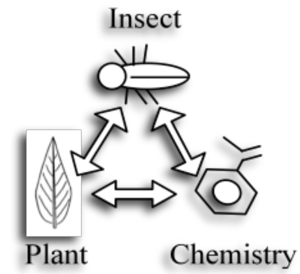

Figure 1. The PIC-Triad (by E. Hoffmann and J. Wise)

It has once been said "if a tree falls in the forest and nobody is there to hear it, did it make a sound?". I have a similar perspective when it comes to the importance of delivering research-based knowledge through extension education. Besides my participation in the wide array of traditional extension venues (i.e; MSU CAT-Alerts, E-154 Fruit Management Guide, county and regional grower meetings, and TNRC field-days), I have placed particular focus over the last eight years in developing a series of modern IPM training programs. In 2003, along with several key members of the MSU Fruit AOE (Area of Expertise) team, I launched a series of fruit IPM training programs, introducing an innovative model of education to pest scouts and fruit growers of Michigan. For these programs, curriculum was designed in modules of progressively increasing depth, so that participants begin with the fundamentals of IPM before being progressively exposed to more complex concepts. This allows for advanced topics and additional crop specific components to be readily added, while building upon the same core fundamental materials. Under this training model education does not end with classroom lectures. The IPM training programs also include experiential hands-on training sessions, which provide participants with the opportunity to apply what they had learned in lectures to the real world. To do this the programs make use of the TNRC orchards to allow participants to practice scouting techniques and learn how to use pest monitoring equipment. To date I have developed IPM training curriculum and have held programs in apples, cherries, blueberries, and grapes.

MEETINGS AND ANNOUNCEMENTS

After today's issue (July 8, 2008), this newsletter will be updated every two weeks for the remainder of the season. Look for updates on July 22, August 5, and August 19.

MSU BLUEBERRY TEAM

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Mark Longstroth, Van Buren County Extension
Carlos Garcia, Ottawa County Extension
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IN UPCOMING ISSUES…

Oriental beetle
Irrigation and water needs for blueberry
Post harvest issues
Blueberry tip borer
Late-season diseases

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