Michigan Blueberry I.P.M. Update

June 5, 2007 Volume I, No. 8

Contents

The Blueberry IPM Update is a weekly publication produced by Michigan State University Extension. To receive a copy of this newsletter, send an email to masonk@msu.edu.
Also available online through blueberries.msu.edu and at:
www.isaacslab.ent.msu.edu/blueberryscout/blueberryscout.htm

CROP STAGES

In Van Buren County, Jersey in Covert are at green fruit. Blueray and Bluecrop are also at green fruit in Grand Junction.

In Ottawa County, Blueray are at green fruit in Holland. Rubel and Bluecrop are both at green fruit in West Olive.

Berries are sizing up well at all our scouting locations.

Bluecrop at green fruit in Grand Junction.

Editor's Note:

We hope you find the information in this newsletter useful in guiding what to look for as you scout your own farm. The scouting data shown in the Disease and Insect Updates below are taken from four Michigan blueberry farms. As conditions are different from farm to farm, we must stress that the information in this newsletter should not be used as a substitute for scouting your own fields. Your spray decisions should be made based on what is seen on your own farm.

Please use this newsletter to determine when and how to look for certain pests, identify potential pest problems, and to get information on the biology of pests and other aspects of integrated pest management. See the Insect and Disease Updates below for descriptions of some scouting methods that can be used on your farm. These scouting methods will also be demonstrated at the Blueberry IPM Scouting Workshops on June 13:

BLUEBERRY IPM SCOUTING WORKSHOP
June 13, 2007

10-12am at the Bodtke Farm in Grand Junction

3-5pm at Carini Farms in West Olive

DEGREE DAYS AND WEATHER NOTES

Weather Forecast: Temperatures will generally be in the 70's to low 80's this week. Chance of showers and thunderstorms Thursday and Friday. By 6-11 GDD_{50} will increase by ~160, and GDD_{42} will increase by ~100. Complete weather summaries and forecasts are at available enviroweather.msu.edu

GDD (from March 1)	Base 42	Base 50
	Van Buren County	
5-21	826	465
5-29	1030	606
6-4	1218	746
	Ottawa County	
5-21	725	387
5-29	790*	435*
6-4	1092*	655*

* enviroweather data for the West Olive station is missing some dates, so data from Hudsonville was substituted for missing values.

BLUEBERRY SCORCH, SHOCK AND SHEEP PEN HILL VIRUS QUARANTINE

Annemiek Schilder
Plant Pathology

In 2002, the Michigan Department of Agriculture (MDA) established a quarantine for blueberry planting material to prevent the introduction into Michigan of **blueberry scorch virus** (BlSV), **blueberry shock virus** (BlShV), and **Sheep Pen Hill virus** (BlSV-NJ). These viruses are known to infect blueberries in Oregon, Washington, New Jersey, and British Columbia (Canada). Cranberry plants can also be infected by blueberry scorch virus. Recently, blueberry scorch virus was also found in highbush blueberries in Connecticut and Massachusetts. These viruses spread from one geographic location to another over long distances through infected planting stock. To date, these viruses have not been found in Michigan and it is therefore very important that we are vigilant and keep them out as they can wreak havoc on our blueberry industry.

Fig. 1. Blighting of flower clusters on blueberry plant infected with blueberry scorch virus (BlSV).

Fig. 2. Necrosis of blueberry flower clusters and leaves due to blueberry scorch virus (BlSV).

Blueberry scorch is caused by the blueberry scorch virus (BlSV) and has a devastating effect on blueberry plants. In spring, young flower clusters and shoots suddenly turn brown and die (Figs. 1, 2). Blighted flower clusters and shoots can be confused with mummy berry and Botrytis blight. The disease starts on one or two branches before it spreads to the whole bush in succeeding years. The symptoms are expressed in infected plants every year and plants do not recover. The production begins to drop off rapidly and the bush eventually dies. Neighboring bushes often appear healthy. Some cultivars also show marginal leaf chlorosis (Fig. 3). The Sheep Pen Hill virus is a strain of blueberry scorch virus that occurs in New Jersey (BlSV-NJ). Symptoms are similar for both strains, except that a red line pattern is sometimes seen on leaves of bushes infected by the Sheep Pen Hill Virus (Fig. 4). The disease can spread rapidly throughout a planting due to movement of aphids which transmit the virus. Aphid transmission occurs over relatively short distances (less than a mile). All cultivars can be infected by BlSV, but some do not show symptoms. Symptom-less infected bushes can still serve as a source of infection for surrounding bushes and fields.

Fig. 3. Marginal chlorosis of blueberry leaves infected with blueberry scorch virus (BlSV).

Fig. 4. Red line patterns in blueberry plant infected with Sheep Pen Hill virus (New Jersey strain of BlSV)

Blueberry shock, caused by the blueberry shock virus (BlShV) is very similar to blueberry scorch in its symptoms, including a sudden blighting of blossoms and leaves (Fig. 5). However, the plant then apparently recovers and produces a second flush of leaves. By the end of the season, the bush looks normal except for the absence of fruit. The plant may exhibit this “shock” reaction for 1 to 3 years and may be symptom-free thereafter but will carry the virus. All cultivars are susceptible. Blueberry shock virus is pollenborne. Transmission of the virus occurs when pollinators, especially honeybees, transfer infected pollen to flowers on healthy plants.

Fig. 5. Sudden blighting of young shoots of blueberry plant infected with blueberry shock virus (BlShV).

The MDA quarantine regulations stipulate that no plants, buds, vegetative cuttings or any other blueberry planting material should be brought into Michigan from regulated areas (WA, OR, NJ, BC) unless it has been certified virus free by a virus-free certification program recognized by MDA. Planting material shipped into Michigan must be accompanied by a State Phytosanitary Certificate or Certificate of Quarantine Compliance, indicating its point of original propagation or production and labeled or stamped to show compliance with terms of this quarantine. Violations of the quarantine regulations can lead to fines and destruction of uncertified or virus-infected plant material as well as revocation of the special permit to ship to Michigan. Anyone who plans to import plants from regulated areas into Michigan must contact their regional MDA inspector prior to importation and be sure to follow Quarantine regulations.

PEST OF THE WEEK

Viruses and Virus-like diseases

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

Blueberry Shoestring (virus)

Blueberry shoestring is a widespread disease of blueberry, especially in eastern North America, and is caused by the blueberry shoestring virus. Shoestring disease is common in many older Michigan blueberry fields, particularly in 'Jersey' but has also started to spread to 'Elliott'. Shoestring virus is spread from plant to plant by the blueberry aphid (*Illinoia pepperi*) (Figure 1).

Symptoms

Common symptoms include: elongated reddish streaks (3 to 20 mm long) on green stems, especially on the side exposed to the sun; and red or purplish, elongated, strap-like leaves (Figure 2). In addition, leaves may become cupped if one side of the leaf fails to develop. Flowers often can become reddish and fruit may be reddish purple instead of blue at during ripening.

Disease cycle

Blueberry shoestring virus is transmitted by the blueberry aphid (*Illinoia pepperi*). The aphids pick up the virus while feeding on infected plants and then transmit the virus while feeding on healthy plants. Transmission starts in the spring when aphids emerge, and ends in the fall just before leaf drop. Aphids slowly move from infected bushes to neighboring healthy ones as they feed and are also commonly transported down rows by mechanical harvesting equipment.

Management

Destroying infected bushes is recommended but may not be commercially feasible on a large scale. However, old infected 'Jersey' fields should be removed and replaced with new varieties where possible. Spread of the disease may be reduced by controlling the vector, the blueberry aphid. A well-timed insecticide, starting in late May or early June as the aphid population begins to be build up, has been shown to be highly effective. Also washing the harvester between fields to rid the equipment of aphids is recommended. Furthermore, when planting new fields, growers should use virus-tested planting stock as a preventative measure.

Figure 1. Adult blueberry aphid (*Illinoia pepperii)*

Figure 2. A) Reddish strap-like leaves caused by blueberry shoestring virus. B) Overall stunting effect of shoestring virus after several years of infection in Holland, MI (right bush).

Blueberry Stunt (phytoplasma)

Blueberry stunt is a serious and widespread disease of blueberry caused by the blueberry stunt phytoplasma (this is a microorganism related to bacteria and is not a virus). The disease has been found in Michigan and has also been reported to occur in New Jersey, North Carolina, Massachusetts and New York.

Symptoms

Blueberry plants with stunt have bushy branches due to a shortening of the internodes between the leaves (Figure 3). In addition, the leaves are often cupped slightly downward and have chlorotic edges that will turn red in fall. Infected plants may produce fruit with lower than normal sugar content that ripen late or not at all.

Disease cycle

The blueberry stunt phytoplasma overwinters in the vascular tissue of infected stems and roots. In the spring and early summer, as leaves and shoots develop, the stunting and leaf symptoms become apparent. Stunt is transmitted by sharpnosed leafhoppers. Therefore, infections usually coincide with peaks in leafhopper activity.

Management

Once a plant is infected it is infected for life. Infected plants should be removed and destroyed to prevent them being sources of infection for nearby plants. As with insect-vectored viruses the best control strategy is to apply well-timed insecticides to control leafhopper activity.

Figure 3. A) Shoots with blueberry stunt, showing cupped leaves with light-green to yellow edges and interveinal areas. B) Bushy, stunted shoots of plant infected with blueberry stunt.

Blueberry Leaf Mottle (virus)

Blueberry leaf mottle has only been reported to occur in Michigan and is caused by the blueberry leaf mottle virus.

Symptoms

Leaves show a mottling pattern and may be malformed or straplike. Severely infected Rubel bushes have dead stems, a small amount of regrowth near the crown area, and little to no crop. Jersey or Blueray plants may be stunted and have small, pale, rosetted terminal leaves (Figure 4).

Disease cycle

The virus spreads via infected pollen carried by honeybees from diseased to healthy bushes up to 1 mile. Symptoms do not become apparent until 3 to 4 years after infection.

Management

Testing and removing infected bushes that show disease symptoms can decrease the risk of disease spread. Other tips are to ensure that virus-tested planting stock is being used when planting a new field. In addition, if a field is known to have a leaf mottle virus problem do not move bee hives from that area to another healthy field. Place beehives as far as possible from infected areas.

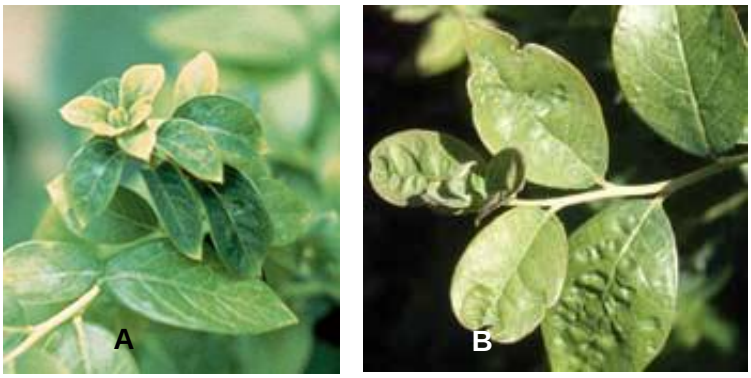

Figure 4. A) Field symptoms of blueberry leaf mottle virus in Jersey plants showing a terminal rosette of leaves. B) Mottling pattern seen in a Michigan blueberry field.

Blueberry Mosaic (unknown, but most likely a virus)

Blueberry mosaic has been observed in most blueberry-growing regions of the United States and Canada. Mosaic spread is probably the result of diseased planting stocks, which are mainly responsible for introducing mosaic into commercial plantings.

Symptoms

Leaves will exhibit a dull to brilliant mottle or mosaic pattern that varies from yellow, pink, or yellow-green (Fig. 5). Symptoms are not always produced every year, and sometimes symptoms depend on sunlight intensity. Fruit on diseased bushes ripens late and is of poor quality.

Disease cycle

No causal organism has been identified, however, a virus is suspected due to the apparent spread from bush to bush.

Management

The main strategy for mosaic disease control is to remove infected plants from field.

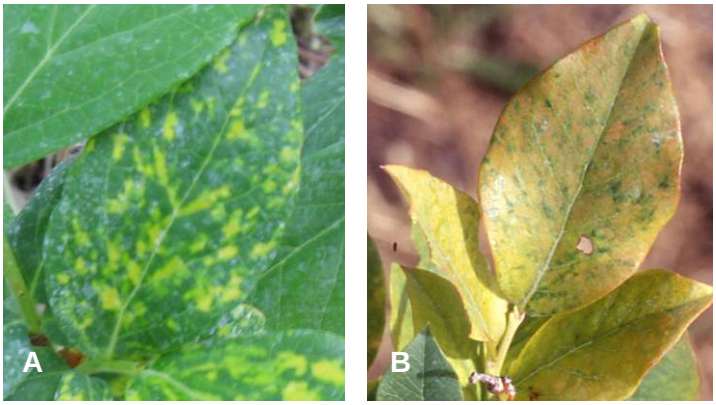

Figure 5. A) Field symptoms of blueberry mosaic (May 2007 Grand Junction, MI). B) Severe yellow mosaic pattern due to blueberrv mosaic.

Tomato Ringspot (virus)

Tomato ringspot is caused by the tomato ringspot virus. It primarily is a problem in the pacific blueberry-growing regions of the United States including Oregon, and Washington. However, it has been reported in Michigan as well, alone or in combination with tobacco ringspot virus.

Symptoms

Infected leaves are often malformed with numerous circular spots that range from 2 to 5 mm in diameter (Fig. 6A). These necrotic spots can also occur on canes. Symptoms are variable within the same plant. Frequently infected plants will be defoliated during harvest and eventually die. This disease spreads slowly in the field, and after several years a large area of weak or dying plants may develop.

Disease cycle

The virus is transmitted by the dagger nematode (*Xiphinema americanum*) (Fig. 7) which has a wide host range, including dandelions, apples, grapes, and raspberries. Tomato ringspot can also be seed-borne. Plants that are produced from these seeds can act as a reservoir of virus for nematodes feeding on

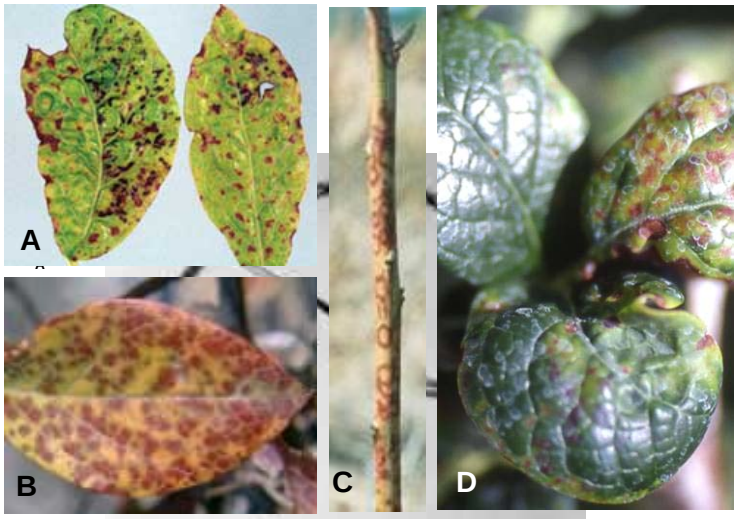

Figure 6. A) Foliar symptoms of tomato ringspot virus showing necrotic circular spots. B) Symptoms of red ringspot virus on leaves in the field. C) Symptoms of red ringspot virus on cane. D) Misshapen leaves that have small necrotic spots indicative of tobacco ringspot virus.

Necrotic Ringspot (virus)

Necrotic ringspot is caused by the tobacco ringspot virus and occurs sporadically in the northern United States and Canada. This disease has been seen in Michigan blueberry fields in the past.

Symptoms

Leaves are misshapen, crinkled and covered with small necrotic spots that may cause small holes (Fig. 6D). Some cultivars show rosetting of terminal leaves or stem dieback. In all cultivars, infected bushes will slowly decline in growth and yield.

Disease cycle

The disease often times originates from infected planting stock. In the field, it is transmitted by the dagger nematode (*Xiphinema americanum*). The disease spreads about 1 m per year. Infected bushes can be found in a roughly circular pattern from the infection source.

Management

Before planting, test soil for the presence of dagger nematodes and fumigate if the test is positive. When planting, ensure that stock is virus tested. Other important control approaches include: maintaining good weed control, planting resistant cultivars, and removing plants that are symptomatic for tobacco ringspot virus.

Figure 7. Dagger nematodes (*Xiphinema americanum*) which can transmit tomato and tobacco ringspot viruses (picture from Oregon State University Extension).

Blueberry Red Ringspot (virus)

Blueberry red ringspot is caused by the blueberry red ringspot virus and primarily occurs in the eastern United States. It has also been found in Michigan blueberry fields.

Symptoms

Ring-like red spots (4-6 mm in diameter) first appear on green stems earlier in the season (Fig. 6C). Also, reddish-brown circular spots appear on the upper surfaces of older leaves during mid to late summer (Fig. 6B). These spots are approximately 3-5 mm in diameter. Symptoms can often be mistaken for powdery mildew. Furthermore, circular, light-colored blotches can also develop on infected fruit.

Disease cycle

Evidence suggests that mealybug is the probable vector of blueberry red ringspot virus. As the disease progresses the infection becomes systemic throughout the plant's tissues. The plant will be infected for life and will serve as a source of infection for nearby bushes.

Management

Some options include planting virus-tested, clean stock and testing and removal of diseased plants from the field. Finally, planting moderately resistant cultivars like 'Bluecrop' and 'Jersey' can be effective at limiting the occurrence of blueberry red ringspot.

DISEASE UPDATE

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

Mummy Berry

This week all scouted blueberry plots were at the early green fruit stage. Also, the number of shoot strike infections per bush has dramatically decreased compared with previous weeks. Notably, all shoot strikes that were seen in the field were at an extremely late stage of infection (Figure 1). Since blossoms are almost gone, bees will soon be removed and infection risk will decline. However, if some blossoms are still open, shoot strikes that remain in the field can still produce spores that can cause mummy berry fruit infection. Therefore, shoot strikes and crop stages should be actively scouted to determine if fungicide treatment is still necessary. Fungicides labeled as good to excellent at controlling mummy berry shoot strikes include Indar and Pristine.

Figure 1. Late-stage shoot strike symptoms (Holland, MI)

Farm	Date	Mummy berry shoot strikes per bush	Blighted blossoms per bush *	Phomopsis twig blight per bush	Blueberry hoestring virus**
Van Buren County					
Covert	5-21	3.4	1.2	0.4	0
	5-28	3.7	1.8	1.9	0
	6-4	2.7	1.8	2.5	0
Grand Junction	5-21	37.3	0.4	0.2	0
	5-28	28.1	1.0	1.2	0
	6-4	13.7	0.3	2.2	0
Ottawa County					
Holland	5-21	15.2	1.2	0.4	2/50 bushes
	5-28	11.0	1.4	2.2	2/50 bushes
	6-4	5.8	1.4	3.0	2/50 bushes
West Olive	5-21	17.7	1.0	0.4	0
	5-28	11.8	1.6	4.6	0
	6-4	5.2	1.5	5.2	0

* Blighted blossoms may be symptomatic of mummy berry, Phomopsis, Botrytis or anthracnose.
**Number of bushes showing blueberry shoestring virus symptoms (50 bushes were scouted)

Phomopsis blossom and twig blight

This week, the number of blighted twigs and blossoms per bush increased slightly compared to last week, although incidence has remained relatively low. Most of the blighted twigs are caused by the fungus *Phomopsis vaccinii*. *Phomopsis* can infect the blossom and then colonizes the twig, consequently killing the blossom (Fig. 2). In addition, twig lesions may originate from infected buds which subsequently die. To scout for Phomopsis, look for recent browning and death of young twigs and collapsing flower/fruit clusters. If scouting reveals a moderately high incidence (>20 blighted blossoms/twigs per bush) consider applying a fungicide, especially if rain is in the forecast. Several fungicies are good to excellent at controlling Phomopsis, including Indar, Topsin + Captan, and Pristine. In addition, there are several cultural control strategies that can be employed: when plants are dormant, prune out infected canes and avoid wounding the canes. Furthermore, to reduce the spread of Phomopsis spores and infection, minimize overhead irrigation or time irrigation to coincide with natural dew formation to reduce the availability of moisture for infection.

Figure 2. A) Blossom blight symptoms caused by *Phomopsis vaccinii*. B) Phomopsis twig blight symptoms (Grand Junction, MI).

INSECT UPDATE

FRUITWORMS

Insect activity has continued to increase over the last week. The number of cranberry fruitworm moths has increased and we are likely near the peak of the flight. Cherry fruitworm moth flight has slowed at the Van Buren County farms, but they are still flying at the Ottawa County farms. Cherry fruitworm egglaying, egg hatch and feeding damage were observed at the Covert and Grand Junction farms. Cranberry fruitworm eggs have been observed at other sites in Allegan County. In the next week, we expect cherry fruitworm and cranberry fruitworm moth captures to continue, and we expect an increase in cherry fruitworm and cranberry fruitworm egglaying. If either of these moths have been trapped on your farm, you will likely need to apply insecticides postbloom to protect the fruit against fruitworm infestation. See the article below on post-bloom fruitworm management for some insecticide options.

Fruitworm entry hole. Note the characteristic darkening around the hole.

BLUEBERRY APHID

Aphids were detected on all farms except in Covert. The percentage of infested shoots has increased and aphid colonies are getting larger (5-10 aphids). No parasitized aphids were found. You should be scouting your bushes for the presence of this pest (see below for methods). If aphids are found on varieties that are susceptible to shoestring virus, the use of insecticides for control may be needed.

TUSSOCK MOTH

No tussock moth larvae were observed. It is likely that sprays targeting fruitworm are controlling this pest.

LEAFROLLERS

We are still seeing a few leafroller larvae. Continue to scout your bushes for these larvae and their damage. Click here for more information on Obliquebanded leafroller.

Farm	Date	CBFW moths per trap	CFW moths per trap	Blueberry aphid % infested shoots	Blueberry maggot per trap	Japanese beetle per 20 bushes
Van Buren County						
Covert	5-21	1	2	0		
	5-29	7	2	0		
	6-4	13	0	0	trap set	
Grand Junction	5-21	1	0	0		
	5-29	35	0	15%		
	6-4	87	0	10%	trap set	
Ottawa County						
Holland	5-21	0	0	0		
	5-29	4	2	25%		
	6-4	37	1	45%	trap set	
West Olive	5-21	0	3	0		
	5-29	1	16	5%		
	6-4	0	7	25%	trap set	

MONITORING FOR FRUITWORMS

After moths are caught and after petal fall (~5-15 or 5-30) bushes should be inspected for eggs and damage each week for a five minute sampling period. Working in a "hotspot," look at as many fruit clusters as possible on 10 to 20 bushes along the field border. Looking at the fruit clusters can help you find eggs in calyx cup, larval entry holes and damage. When inspecting the fruit grasp the cluster and view with the sun over your shoulder. Carefully turn the clusters over and inspect the bottom of the fruit as well as the top for entry holes and/or frass. Record the number of cranberry fruitworm and cherry fruitworm eggs and the number of berries with damage. **Click here for more info and photos of cranberry and cherry fruitworm.**

SCOUTING FOR APHIDS

Begin scouting for blueberry aphids in early to mid May. Look at 2 shoots of new growth at the base of 10 bushes and check for the presence of aphids on the underside of the leaves. As the season progresses, you should look for parasitized aphids (mummies). Record the number of shoots with aphids on the 10 bushes – 2 shoots per bush (multiply by 5 to get % infested shoots). Do the same for aphid mummies. For more on blueberry aphids, **follow this link .**

POST-BLOOM MANAGEMENT OF FRUITWORMS IN BLUEBERRY

Rufus Isaacs & John Wise, MSU Entomology

With blueberry bloom almost complete in Michigan, grower insecticide options for fruitworm control expand. Monitoring traps have detected increasing catches of cranberry fruitworm in the past week across southwest Michigan, and our scouting on Monday found fresh cherry fruitworm eggs in Van Buren and Ottawa counties. This emphasizes the need for protecting fruit from fruitworm infestation in the weeks after bloom. Once bees are removed from the fields, broad spectrum insecticides can be used.

Guthion, Imidan, Lannate, Asana, Danitol, and Sevin are effective broad-spectrum insecticide options available to blueberry growers. With all these products, maintaining good coverage is still important to get residue to the parts of the berry where fruitworms are found: within the calyx cup where eggs are laid, and also at the stem end where cranberry fruitworm larvae tend to enter berries. Use enough water and consider spray additives to help spread the material across the berry surface.

EPA's phase-out for Guthion will remove this insecticide from blueberry production by the end of 2012. Given the current reliance on this chemical for fruitworm control, it would be wise for growers to start testing alternatives on a few fields this year. This will give time to develop and alternative control program for fruitworms that will be optimized by the time Guthion is completely restricted.

Some selective insecticides might also be useful after bloom. Recent research trials in Michigan have demonstrated that Confirm® applied after bloom to fields with low or moderate fruitworm pressure can also achieve control of these pests. This insecticide has the benefits of minimal negative impact on natural enemies such as parasitic wasps, ladybeetles and lacewings, plus long residual activity because of resistance to wash-off and ultraviolet breakdown.

Correct timing and coverage are critically important for fruitworm control, so regular scouting of fields, use of sufficient spray volume to get good fruit coverage and selecting appropriate spreader-stickers can maximize the activity of most insecticides applied for fruitworm control.

Click here for more info and photos of cranberry and cherry fruitworm.

UPCOMING MEETING ANNOUNCEMENT

MSU TO HOST JUNE 13TH IPM MEETINGS AT BLUEBERRY FARMS

There will be two meetings for Michigan blueberry growers held on June 13th 2007, to update attendees on insect, disease, and weed management. The meetings will highlight scouting blueberry fields for key pests, and will provide results from some of MSU's ongoing blueberry IPM research. Attendees will also be updated on pesticide labels and a new weekly IPM newsletter produced for the blueberry industry.

The meeting will be presented by extension specialists and extension educators in the morning in Van Buren County and in the afternoon in Ottawa County. The morning meeting will be from 10-noon at Cornerstone Ag's farm on 57th Street in Grand Junction. This is north of CR 388 (Phoenix Road), a few miles west of Grand Junction. The afternoon meeting will be held from 3-5pm at Carini Farms, 15039 Port Sheldon St., west of US 31 in West Olive. For both meetings, signs will be provided to guide people to parking off the road.

For more information about these meetings, contact Keith Mason at (517) 242-5909 or masonk@msu.edu. RUP credits have been applied for.

MSU BLUEBERRY TEAM

Horticulture - Eric Hanson
Plant Pathology - Annemiek Schilder
Entomology - Rufus Isaacs
Trevor Nichols Research Station - John Wise
Van Buren Co. - Mark Longstroth
Ottawa Co. – Carlos Garcia
Berrien Co. - Greg Vlaming
Southeast Michigan – Bob Tritten

For more information, see our website at blueberries.msu.edu

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This newsletter is produced by the MSU Blueberry Team with support from MSU Extension and the EPA's Region 5 Strategic Ag. Initiative Program