Blueberries

Wednesday morning 9:00 am

**Moderator:** Kurt Weber, MSHS Board Vice President, Expo President

9:00 a.m.  Blueberry Production in China: What is the Potential?

   Eric Hanson, Horticulture Dept., MSU

9:20 a.m.  Managing Phomopsis and Cane Diseases

   Annemiek Schilder, Plant Pathology Dept., MSU

9:40 a.m.  Irrigation Scheduling: How Much Water do Blueberries Really Need?

   Mark Longstroth, Van Buren Co. MSU Extension

10:00 a.m.  Cover-crop Options for Blueberries

   Dale Mutch, W. K. Kellogg Biological Station, MSU

10:20 a.m.  Producing Organic Blueberries in New Jersey: Progress and Challenges

   Dean Polk, Fruit Research & Extension Ctr., Rutgers Univ.

10:40 a.m.  Taking Advantage of the Environmental Quality Incentives Program (EQIP)

   Michael Brewer, IPM Program, MSU
Blueberry Production Potential in China

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China is quickly reforming its economy to encourage entrepreneurial activity and exports. The impact that China can have on international markets is huge. A recent example is the enormous effect of Chinese apple exports on international markets. With the strong international demand for blueberries, it is no surprise that the Chinese are considering blueberries as a new crop. The following information was compiled from a visit I made to northern China in 2004, and input from colleagues and some published reports.

Progress by Region

Jilin Province, just north of North Korea, is the most northern area of China being considered for blueberry production. Winters are very severe, with absolute minimum temperatures of –40°F. Work began at Jilin Agricultural University in the early 1980’s to introduce blueberries. Dr. Li Yadong, from the University has worked with blueberries for about 10 years. His group claims to have 1-2 million plants to sell to farmers. Only lowbush and hardy half-high varieties are recommended, but winter injury is still a problem. There were an estimated 35 acres of blueberries here in 2005. A second blueberry effort began in the early 1990’s at the Jilin College of Forestry, under the leadership of Dr. Wu Banghua. They established field trials and propagation facilities. Trials include northern highbush, but large plantings of lowbush blueberries are also being attempted.

Liaoning Province, northeast of Beijing and borders North Korea, had an estimated 35 acres of blueberries in the ground in 2004. Dr. Lijia An, at Dalian Institute of Technology, has been investigating the potential for blueberry production in this area, and believes a 60 by 120 mile area between the cities of Dalian and Dandung is very suited. Typical soils are acidic (pH 5.5 to 6.5), and although not as sandy as traditional areas in Michigan or New Jersey, they appear adequately drained for blueberries. Well water is slightly acidic and plentiful.

Winter injury is the greatest obstacle to growing blueberries here. Although minimum winter temperatures are not excessively low (-10 °F most years, -15 °F once in five years), the combination of cold, low humidity, strong winds, and open soils results in severe injury to even the hardiest highbush and half-high varieties. Young plants can be protected from winter injury by laying down and burying shoots with soil. However, another protection method is needed once bushes are older and canes can no longer be bent to the ground. Dr. An plans to fabricate A-frame structures for test next winter.

Professionals and growers in this area have extensive horticultural skills. This is clear from the magnitude and diversity of crops grown in this region. Over 20,000 acres of strawberries are grown in the field and in greenhouses in this province alone. Dr An has propagated about 800,000 blueberry plants in the last 2 years from tissue culture. These include highbush (Toro, Bluecrop, Elliott, Patriot, Brigitta, Nelson), half-highs (Northcountry, Northsky, and Northblue) and lowbush cultivars (Brunswick, Blomidon). He established a Blueberry Experiment station and private company to sell plants.

This region has an extensive food processing and storage infrastructure developed for seafood and agricultural commodities that could accommodate blueberries. Japanese investors have built freezing facilities in the city of Dandung for bulk and IQF freezing of strawberries and seafood. Transporting blueberries from the field to refrigeration may be challenging, since many roads are poor and slow. This may be a problem if berries are to be marketed fresh, but less of an issue if berries are frozen.
Shandong Province, on the coast southeast of Beijing, is estimated to have about 50 acres of planted blueberries. This region has a moderated climate and produces huge quantities of tree fruits and grapes. The frost-free season is 250 days. There are no reports of winter injury to northern highbush or even rabbiteye varieties that have been tested. Soils typically are higher in pH and clay content.

Southern China. Blueberries are being tested and commercially planted in some lower latitude, humid regions of China. Estimates in 2005 are that Jiangsu, Zhejiang, and Guizhao Provinces each contained about 75 acres of blueberries, Chongqin Province had 50 acres, and Yunnan, Fujian, Anhui, and Sichuan Provinces each contained a few acres. Climate is similar to the Southeastern U.S. Winter temperatures seldom drop below 10 °F (Jiangsu Province) to 14 °F (Guizhou Province). There are apparently vast areas of acidic soils in these Provinces, but most appear to be heavier textured soils with high clay contents. Rabbiteye and some southern highbush cultivars are being tried in these areas. Rabbiteye varieties tested in Jiangsu Province reached full production of 8,000 to 24,000 lb/acre after five years in the field. Bushes in a similar planting in Guizhou Province were 3 to 5 feet tall and yielded 1.5 to 3 lb in the third season.

Economics:

Cost of agricultural labor in China is about $3.00 per day, or 5% of that in the U.S. As a result, practices such as burying canes for winter protection, hand weeding, which are cost prohibitive elsewhere, are economical in China. Low labor costs also allow for hand harvesting and sorting, so growers need not invest in mechanization necessary in the U.S. Prices of some conventional agricultural chemicals and fertilizers appear to be similar to or lower than those in the U.S. Blueberry plants are being sold to farmers for less than half the price in the U.S. Because most traditional crops (corn, soy in northern areas) offer very low returns, farmers have keen interest in alternatives even if returns are modest by U.S. standards. Dr. An speculated a gross income of $1,200 per acre would attract many farmers to blueberries, since the cost to establish a planting is only be about $600/acre, and production costs are perhaps 20% of those in the U.S. He noted that fresh blueberries from Chilean are sold in urban grocery stores for $2.50/pt, and expects significant volumes of domestic fresh blueberries could be sold for $1.00/lb. Even low yields of 1,000 to 2,000 lb per acre might make blueberries an attractive alternative for these poor farmers. There is considerable interest in foreign investment that may allow for larger acreages that would facilitate production and marketing.

Summary

Although acreage is difficult to assess precisely, China appears to have 400 to 600 acres of blueberries in 2005. Expansion of acreage in northern areas will likely occur at modest rates, since consistency of yields need to be demonstrated in these harsh winter locations. Although I have not visited rabbiteye and southern highbush blueberries in southern China, reports suggest this appears poised to develop more rapidly. A critical issue for U.S. producers is the export of Chinese blueberries. An optimistic view is that domestic demand for blueberries will grow as the affluent population expands, and China could consume much of its domestic production and perhaps become an important market for U.S. blueberries. China imported a few million pounds of U.S. blueberries in 2004. I think a more realistic assumption is that Chinese production will grow at a moderate rate, and that frozen and processed blueberries from China will gradually impact international markets. The Chinese are likely export to Japan, which now utilizes 10-14 million lbs of U.S.-produced blueberries.
Managing Phomopsis and Cane Diseases in Blueberries

Annemiek Schilder
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Introduction
There are several cane diseases that can affect blueberries. These can reduce the productivity and longevity of plantings. In severe cases, bushes cannot produce new canes to keep up with the ones that are killed, and start to decline. The most common cane disease in Michigan is Phomopsis canker, caused by the fungus *Phomopsis vaccinii*. Cankers caused by this fungus can eventually girdle canes, resulting in a symptom called ‘flagging’ (sudden wilting and death of the canes where the leaves turn reddish brown and remain attached). Flagging is often most apparent in early to midsummer. This fungus also causes a twig blight, which results in direct yield losses as entire fruit clusters are killed along with the twig. Severe outbreaks of twig blight are more sporadic. Another, less common cane disease of blueberries is Fusicoccum canker, caused by the fungus *Fusicoccum putrefaciens (=Godronia cassandrae)*. In general, symptoms are fairly similar to Phomopsis, except that the cane lesions are more sharply delineated and have a bull’s eye pattern. Since *Fusicoccum* is a cold-loving fungus, it tends to be more severe in northern Michigan and is actually a limiting factor to blueberry production in the Upper Peninsula. More recently, we discovered *Colletotrichum acutatum* (the anthracnose fruit rot fungus) attacking blueberry canes in some blueberry fields in Michigan and Ontario. Anthracnose cane infections are not as common and seem to be prevalent after very wet summers (e.g. the summer of 2004). This fungus can also cause twig blight. Cane diseases may predispose bushes to winter injury.

Disease biology
*Phomopsis vaccinii* overwinters in infected canes and twigs and sometimes in live buds. In the spring, spores are dispersed from flask-shaped fruiting bodies by rain splash and irrigation. The fungus can produce spores from April to September, with a peak in May-June. Young canes and twigs can be infected directly if they are wet for a long period, but the fungus can also enter the canes through wounds caused by harvesting equipment or pruning activities. Reddish-brown lesions develop at the tip of or along green stems, eventually becoming flattened and up to several inches long. Brown, spreading lesions also develop on twigs and can kill entire flower and fruit clusters. The centers of cankers eventually turn gray and may contain small black pimples (fruiting bodies). It appears that herbicide injury, particularly Gramoxone, may predispose young canes to infection.

*Fusicoccum putrefaciens* overwinters in cankers on canes and produces fruiting bodies (pycnidia) from which spores are released during rain events from April until early leaf drop in the fall. Wounding is not required for infection. On wet canes, infection occurs within 48 hours at 50-70°C. Small reddish lesions become visible on 1- and 2-yr-old stems in the fall and expand into sharply delineated, reddish brown cankers up to 4 inches in length. The cankers usually center on a leaf scar and have a “bull’s eye” pattern. Most cankers are near ground level, but some occur as high as 1 m above the ground. Affected canes wilt in summer and die with the leaves still attached.

*Colletotrichum acutatum* overwinters in remnants of old fruiting twigs and infected canes. In spring and summer, fruiting bodies (acervuli) release spores which are dispersed by rain. The spores usually infect the berries, but can also infect young twigs and canes. On young canes, lesions are dark brown with
fruiting bodies in concentric circles. On twigs, dark-brown lesions may originate from infected buds and kill all or part of the twig. Frequent precipitation and warm temperatures favor the disease.

Management of cane diseases

The management suggestions below apply to Phomopsis canker as well as the other, less common cane diseases. The key is to be patient, as cane diseases are usually well-ensconced in the field and hard to root out. Often, there is a year lag period between infection and the first signs of flagging, which complicates control. A hard winter with lots of winter injury may also make the bushes suddenly appear worse. While it may be impossible to eradicate these diseases, they can be brought down to levels that will minimize economic losses.

1) Buy healthy planting material. In most cases, Phomopsis and other cane pathogens come into new fields with the plants, since they cannot travel very far on their own. Dead twigs on young plants are often mistaken for winter injury and help to establish the disease in new plantings.

2) Prune out dead and diseased canes and twigs, including green canes with lesions. Don’t try to save green canes, prune them to the ground. If the bushes look very bad, mow them off entirely and let new canes come up. Use fungicides to protect new canes from infection.

3) Destroy diseased canes. Ideally, they should be removed from the field and burned. However, because of the labor involved, most growers just bush-hog the canes and leave the remnants lying in the row middle. This is probably not a big concern, because spores are mostly dispersed by rain splash and consequently won’t go very far (usually within a few feet of the source). It may be a problem, however, if the canes are lying close to or are left in the bush. While the canes are a potential source of spores, if they break down quickly, cane-infecting fungi will also be destroyed. So the better they are chopped up and in contact with the soil, the quicker Phomopsis and other cane pathogens will be gone.

4) Avoid herbicide injury or other wounds (e.g., from a harvester or other equipment) which may predispose canes to infection.

5) Create open canopy and control weeds to speed up drying of canes and reduce infection after rain or irrigation.

6) Protect canes and twigs with effective fungicides on a regular schedule (e.g. every 10-14 days) from early pink bud through pea-size fruit, which is the period that Phomopsis spore release usually peaks. Excellent fungicide options are: Topsin M + Captan or Ziram, Indar, and Pristine. Bravo is also a good protectant, but can't be sprayed after bloom. Cabrio is also a decent choice but Abound is only fair against Phomopsis.

7) Dormant sprays of lime sulfur can be put on in the fall after leaf drop and/or at before budbreak in the spring. Dormant sprays reduce inoculum by roughly 50%, therefore they should not be considered as stand-alone treatments. We are currently investigating dormant sprays of liquid sulfur and copper, which are much less expensive than lime sulfur.

8) Don’t feel discouraged if you do not start seeing results immediately. The offensive needs to be kept up for several years, because it may take a year for existing infections to show. A hard winter with lots of winter injury may also make the bushes appear in worse shape.

9) If you are not sure what is going on in your field, send in a sample to the MSU diagnostic lab for a proper diagnosis.
Irrigation Scheduling: How Much Water Do Blueberries Really Need?

Mark Longstroth
District Extension Educator for Horticultural & Marketing

Why Irrigate Blueberries

• Plant Growth is Dependent on Water.
  – Shoot Growth
  – Fruit Growth
  – Fruit Set for Next Year
• Blueberries do not manage water well.
• Moist soil is a requirement for good blueberry growth.

Blueberry sites

• Porous soils with high water tables.

Drought Stress
Drought

- Lack of water reduces photosynthesis and causes wilting
- Reduced growth and reduced food reserves available for growth
- Available reserves are shifted to the roots.
- Fruit compete for available reserves

Irrigation

- How much water is the plant using?
- How much water can the soil hold?
- How much water can you apply?
- How much rain have you received?

- Soil should be recharged when soil water is 50% of capacity.

Water Management

- Sandy soils do not hold much water
- Smaller more frequent irrigations that do not over fill the soil are better than heavy irrigation cycles that may wash nutrients from the soil.
Blueberry Water Use

- Plants use little water if they have no leaves.
- As the leaves grow water use increases (Photosynthesis, transpiration).
- Organs grow by expansion.
- Pumped up by water.

Water Use in Blueberries

<table>
<thead>
<tr>
<th>Month</th>
<th>Monthly Use</th>
<th>Weekly Use</th>
<th>Daily Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>May</td>
<td>0.48</td>
<td>0.12</td>
<td>0.02</td>
</tr>
<tr>
<td>June</td>
<td>2.87</td>
<td>0.72</td>
<td>0.10</td>
</tr>
<tr>
<td>July</td>
<td>5.09</td>
<td>1.26</td>
<td>0.17</td>
</tr>
<tr>
<td>August</td>
<td>2.13</td>
<td>0.53</td>
<td>0.07</td>
</tr>
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</table>

Soil Water Holding Capacity

<table>
<thead>
<tr>
<th>Soil Texture</th>
<th>in/in</th>
<th>In/ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>0.07 - 0.10</td>
<td>0.84 – 1.20</td>
</tr>
<tr>
<td>Sandy Loam</td>
<td>0.09 - 0.15</td>
<td>1.08 – 1.80</td>
</tr>
<tr>
<td>Loam</td>
<td>0.14 - 0.19</td>
<td>1.68 – 2.28</td>
</tr>
</tbody>
</table>

Most Blueberry soil in Michigan are sands or sandy loams that hold 1 to 1.5 inches of water per foot of soil.

Blueberry Root Zone

Root Zone Soil Water Capacity

<table>
<thead>
<tr>
<th>Soil Texture</th>
<th>In/ft</th>
<th>in/18 in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>0.84 – 1.20</td>
<td>1.26 – 2.40</td>
</tr>
<tr>
<td>Sandy Loam</td>
<td>1.08 – 1.80</td>
<td>2.16 – 3.60</td>
</tr>
<tr>
<td>Loam</td>
<td>1.68 – 2.28</td>
<td>3.36 – 4.56</td>
</tr>
</tbody>
</table>

If the root zone of blueberries is 18” then the soil can hold 1 to 3 inches of water in the root zone. In most blueberry fields this is probably about 2” of available water and should be replenished when soil moisture is about 1 inch.

Irrigation in Blueberries

<table>
<thead>
<tr>
<th>Month</th>
<th>Weekly Use</th>
<th>Soil holds 1 in</th>
<th>50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>May</td>
<td>0.12</td>
<td>8 weeks</td>
<td>4 weeks</td>
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<tr>
<td>June</td>
<td>0.72</td>
<td>10 day</td>
<td>5 days</td>
</tr>
<tr>
<td>July</td>
<td>1.26</td>
<td>5.5 days</td>
<td>2.5 days</td>
</tr>
<tr>
<td>August</td>
<td>0.53</td>
<td>13 days</td>
<td>1 week</td>
</tr>
</tbody>
</table>
Water Deficit

- Soil Water Storage
- Plant Water Use
  - Evapo-transpiration
- Precipitation
- Irrigation

Water Management

- Sandy soils do not hold much water
  - 1 to 2 inches
- Irrigation should be about half of soil capacity.
- Continually recharge as soil gets to 50% of soil moisture.

Irrigation in Blueberries

<table>
<thead>
<tr>
<th>Month</th>
<th>Weekly Use</th>
<th>50% recharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>May</td>
<td>0.12</td>
<td>Every other week</td>
</tr>
<tr>
<td>June</td>
<td>0.72</td>
<td>Every 5 days</td>
</tr>
<tr>
<td>July</td>
<td>1.26</td>
<td>Every 3 days</td>
</tr>
<tr>
<td>August</td>
<td>0.53</td>
<td>Every week</td>
</tr>
</tbody>
</table>
Cover crop options for blueberries

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3 Todd E. Martin, Research Technician, Kellogg Biological Station

Situation

Most of Michigan’s 18,500 acres of blueberries are grown on specialized soil types that are high organic, acidic sands with a shallow water table. Nearly half of Michigan’s blueberries are more than 30 years old (Kleweno and Mathews, 2004) and many younger fields were replanted on older blueberry sites. Continuous blueberry culture over many years may contribute to several soil-related problems. Cover crops may help alleviate some of the soil limitations by creating a more diverse microbial community associated with organic matter (OM). Cover crops can be a useful tool in sustaining soil health and productivity (Anonymous, 1998). Michigan blueberry growers have used combinations of perennial grass sods and annually seeded cereal rye between blueberry rows to add OM to soils and to keep fields accessible to equipment during wet weather. The spread of Japanese beetle, *Popillia japonica* through southwest Michigan over the past 10 years has resulted in a dramatic shift to clean cultivation because grass ground covers are an important stimulus for Japanese beetle egg laying, and lead to increased beetle populations (Isaacs et al., 2004a). There is zero tolerance for the presence of insects in marketed fruit, and the stringent quality standards have forced growers to consider alternative ground covers that are not attractive to Japanese beetles. Although cultivation reduces beetle numbers, these fields become muddy and inaccessible to equipment for management, and can create dust problems during harvest.

Blueberry growers need cover crop alternatives that do not attract Japanese beetle and help to encourage a more biologically rich microbe, insect and plant community. Promising candidate plant species have been identified in recent research at the Trevor Nichols Research Complex that are tolerant of blueberry soils (aslike clover) and that cause reduced abundance of Japanese beetle grubs (buckwheat) (Isaacs et al., 2004b). In addition to the direct benefits of pest suppression, provision of cover crops may improve biological control of Japanese beetle and other insect pests. Recent research at MSU has shown that increased ground beetle activity/density leads to increased removal of blueberry maggot pupae from under blueberry bushes (O'Neal et al., in press), and one way to increase ground beetle activity/density is to provide cover crops (Isaacs et al., 2004; O'Neal et al, in press). We have also recently shown in laboratory trials that carabid beetles are voracious predators of Japanese beetle eggs and blueberry maggot pupae (R. Isaacs and J. Asteriou, unpublished), suggesting that ground covers may provide pest suppression through direct and indirect means, in addition to the horticultural benefits.

Blueberry fields are challenging environments for cover crops because soils are typically very acidic, sandy and wet, and mature blueberry canopies provide heavy shade to much of the soil surface. The purpose of this project is to identify cover crop species that establish well in commercial blueberry environments and help maintain soil health while creating a suppressive environment for Japanese beetles.
Methods

**Cover crop screening:** Two screening trials were seeded in Sept. 2004 on Double R Blueberry Farm in West Olive, Mich. Plots are 5 x 75 foot strips between adjacent rows. The following eight treatments were replicated three times in a randomized complete block design in a field of younger 3-4 foot tall “Elliott” bushes on a light sandy soil, and in an older field of 6-7 foot tall “Jersey” bushes on a heavier, high OM soil: crimson clover, short white clover, aslike clover, red clover; buckwheat, oriental mustard, annual cereal rye and a clear cultivated control. The buckwheat plots were seeded in June 2005.

Cover crop biomass and percent of the ground covered will be assessed in May (fall-seeded plots) and August (all plots) by visually estimating percent of ground covered, then harvesting above- and below-ground tissues from two 1000 cm² sections per plot.

Results

The older “Jersey” bushes on a heavier, higher OM soil resulted in poor cover crop establishment with the exception of rye (Graph 1). This could have been a result of shading, too much moisture or late seeding of the cover crops. The younger, shorter “Elliott” blueberries resulted in much better cover crop growth. All cover crops reduced weed populations as compared to the control (Graph 2). Crimson clover biomass was significantly higher than all other cover crops compared, producing almost 2,400 lbs./A of biomass (Graph 2). Other legume cover crops produced approximately 1,000 lbs./A of biomass. We would expect white aslike and medium red clover to produce higher biomass in 2006 since they are perennial cover crops. Crimson clover is an annual red clover cover crop that reseeded itself in 2005.

R. J. and Judy Rant are very excited about crimson clover. We have seeded a planting date trial on their farm in 2005 with crimson clover.

Graph 1

![Graph 1](image1)

**Older Blueberries (Jersey)**

![Graph 2](image2)

**Young Blueberries (Elliott)**
Methods
Cover crops were seeded with a Brillion drill in the row middles of “Duke” young blueberries on August 31, 2005. Cover crops were seeded on both sides of the blueberry row in 10 x 150 foot plots. In this experiment we are comparing annual cover crops crimson clover and rye to perennial cover crops white clover and medium red clover.

Results
Unfortunately, this year’s seeding did not establish well enough in all the row middles. We plan to reestablish this site in the spring. We believe lack of moisture and high temperatures may have desiccated the small germinated cover crop seedlings this fall.

Literature cited

This research was funded through a USDA/CSREES special sustainable agriculture grant. We would like to thank R. J. and Judy Rant and Karlis Galen for their cooperation and support to this project.
Producing Organic Blueberries in New Jersey  
Progress and Challenges

Dean Polk, Statewide Fruit IPM Agent, Rutgers Fruit R&E Center, 283 RT 539, Cream Ridge, NJ 08514

Introduction

Integrated Pest Management (IPM) is a set of practices, which use all available means to manage pests below economically damaging levels. Some workers have extended the definition to an integrated whole crop production method, or Integrated Crop Management (ICM). Nowhere is this more apparent than in organic production of horticultural crops. While conservative practices may permit crop production without the use of IPM methods, and IPM growers may be able to reduce pesticide usage and not be “organic,” an organic grower must use IPM practices. IPM practices are constantly changing as new materials and practices become available. Some of these practices have become known as Reduced Risk (RR), using Reduced Risk materials, a newly classified EPA standard for some of the new, “softer” pesticides. As industry and researchers address requirements set forth by the Food Quality Protection Act (FQPA), RR practices will become integrated into grower pest management programs. Some of these same practices are also classified as “organic,” using OMRI certified materials or practices. IPM practices, which can be used in organic production, include the use of pest monitoring, the use of insect traps, timing treatments according to insect phenology models, treating only when needed according to action thresholds, the use of pest resistant varieties, and the use of cultural practices such as mulching and regular pruning. The use of RR methods can include the use of spinosad (Entrust), and the use of mating disruption for various pests and crops.

I would like to summarize the state of organic blueberry production in New Jersey by:
1) Outlining existing grower practices
2) Summarizing some current RR work that can be used in organic blueberry production
3) Listing some of the principal materials that may be used by organic growers, and
4) Outline some of the “rules” and resources one most follow to maintain organic status.

Grower Practices

While only a few growers produce organic blueberries, they use similar methods. Fertilizer usually consists of composted chicken manure, applied in either 1 or 2 applications, starting at first bud break. Chicken manure may have analyses of 3-2-2, 4-3-3, 4.5-2.7-1.4, or similar. When using a manure product, always have an analysis done, so you can calculate exactly what nutrients are being applied. Soil conditioning, water conservation, and weed control: After plants are established growers will use decomposed hardwood chip mulch about 5-6” deep. In some cases, mulch is applied only after the first 1 or 2 years. In some fields intensive hand labor is used to hoe out weeds during the first 1-2 years of establishment.

Insect Management: Growers either monitor the fields themselves, or have them monitored. While there are numerous pests that attack blueberries, a few are especially problematic. Cranberry fruitworm is targeted with sprays of Bt. and/or Entrust. Blueberry maggot is sprayed with Entrust or Pyganic. Other pests are tolerated at low levels, or have not been a problem. For example, various species of aphids are regularly sprayed for in many commercial plantings, but have not been an issue in organic fields. This is
probably due to 1) lower fertility and less vigorous plant growth, and 2) high numbers of parasites and predators.

**Disease Management:** There are few disease management tools available for organic blueberry production. The 3 most important and commonly used practices are: 1) Lime sulfur, sprayed 2 times at bud swell, just prior to bud break, and then again in the fall after about 2/3 of the leaves have dropped. The treatment is normally used for control of Phomopsis twig blight, but may also help with black shadow and aphid control. 2) Cultivation and mulch – cultivation will not only control weeds, but will bury overwintering fruit mummies, breaking the life cycle for mummy berry. Timely application of mulch late in the fall (and after row middles are cultivated) will also help prevent spring infections of mummy berry. 3) Pruning – Good pruning practices help control Phomopsis, stem blight, botrytis, and anthracnose, (and scale and bud mites). These diseases overwinter on twigs, canes and bud scales. Pruning out old canes minimizes overwintering inoculum, and helps provide good air circulation in the summer to minimize infection. Old neglected plantings will usually have high disease pressure. Never try to start organic production by trying to revive an old neglected field.

**New Reduced Risk Strategies for Organic Production**

Two strategies currently in the research/demonstration phase are 1) Mating disruption for control of Oriental beetle, and 2) Border bait sprays for control of blueberry maggot.

**Mating disruption of Oriental beetle (OB):** Oriental beetle is a scarab beetle, similar in size and life history to Japanese beetle. Oriental beetles are not a foliar pest, but larvae do feed on blueberry roots. In some fields 1-2 dozen or more larvae have been found on root systems, enough to kill a 3-4 year old plant. Work started by Dr. Sridhar Polavarapu in 2002 showed that OB could be controlled with mating disruption, but at fairly high rates of active ingredient, or about 20g/ac. During the last 2 years we have shown that mating can be disrupted with reduced pheromone rates. During 2005 we used 3 rates plus an untreated control (1). All mating disruption plots contained plastic ‘bubble’ dispensers (ChemTica Internacional TA, San Jose, Costa Rica), loaded with .5 or .1 g of oriental beetle sex pheromone (Bedoukian Research Inc., Danbury, CT). Plots were 1 ha each (2.47 ac), with 3 treatments (plus untreated control) of 1) Low - .1g ai/dispenser with 20 dispensers per acre (2g ai/acre), 2) Medium - .1g ai/dispenser with 40 dispensers per acre (4g ai/acre), and 3) High - .5g ai/dispenser with 20 dispensers per acre (10g ai/acre). Plots were replicated 3 times in a randomized complete block design, which included untreated buffer rows of at least 200’ between treatments, and 500’ or more between blocks. Dispensers were attached to an outside blueberry cane, within the row orientation, with a wire twist tie, about 20 cm above the soil surface. The adult flight was monitored with Japanese beetle can traps (Great Lakes IPM, Vestaburg, MI), baited with 300µg of (Z)-7-tetradec-2-one lures, placed 3 traps per plot to monitor trap shut-down. Traps were placed on wire hangers so the bottom of the can was just off ground level. Traps were placed in plots on 6/6 with pretreatment counts taken on 6/13 and 6/16. Pheromone dispensers were placed in plots on 6/16 just after traps were monitored. Traps were monitored once per week until 8/25, and lures were changed on 7/15. Successful trap shut-down is the
first measure of success in a mating disruption program, since this data mimics the success or failure of males finding unmated females. Traps placed in a mating disrupted area should catch no to very low levels of the target insect. The 2005 data (Figure 1) indicates that all treatments were equally effective in maintaining trap shut-down.

Virgin females were also placed in potted cages and deployed 4 times during peak adult flight. For each plot, 2-3 virgin females were placed in each of 4-5 cage-pots, located near the center of each plot, and were retrieved after 1-3 days. Cages were placed on July 6, 12, 19, and 22. After retrieval, cages were returned to the laboratory where data was taken to include: the number of females recovered, and the number of males per cage. Individual females were placed in 1oz plastic cups with moist soil and checked for eggs once per week for 3 weeks. Egg viability from all females was recorded. While one male was found in one treatment cage, for all practical purposes fertile females were found only in the control cages, with mating occurring only in the non-treated areas.

**Bait Sprays for Blueberry Maggot:** Blueberry maggot fly adults usually disperse into blueberry fields from wild and abandoned berries. On well managed farms, fly pressure is low and usually found along fields bordering wooded areas first. The Dow product, GF-120 Fruit Fly Bait, is a proprietary mix of sugars and attractants mixed with spinosad, the active ingredient in Entrust. The bait has been successfully used for control of other fruit flies. We are attempting to use border sprays of GF-120 for control of blueberry maggot fly adults in NJ. When compared to a standard broadcast commercial insecticide program, sampled fruit showed no maggot infestations in either treatment during 2005.

**Principal Materials Allowed in Organic Blueberry Production**

A partial list of insecticides allowed under organic standards include oils used for scale control, the organic version of spinosad – Entrust, natural pyrethrums such as Pyganic, various neem products, including AzaDirect, and Neemix, and numerous B.t. products such as Dipel, Javelin and Xentari. Disease management materials are more limited, Coppers are permitted, but show little practical application in blueberries, while various formulations of lime sulfur are permitted and can be useful. Lime sulfur is very caustic and should be used with caution. Hydrogen peroxides have also been used but are short lived.

**The OMRI Lists**

The following is taken directly from the OMRI Web site (2): “The Organic Materials Review Institute (OMRI) is a 501(c)(3) nonprofit organization that specializes in the review of substances for use in organic production, processing, and handling. OMRI's Board of Directors is broadly representative of the industry segments with members distributed among certifiers, farmers, suppliers, processors, handlers, consumer organizations, and animal welfare and environmental groups. OMRI's services are directed to all aspects of the organic industry with a primary focus on the decision makers who deal with the compliance status of generic materials and brand name products. With the OMRI Generic Materials List and OMRI Brand Name Product List, OMRI provides guidance on the suitability of material inputs under the USDA National Organic Program standards.” Growers interested in organic production should reference both the OMRI Brand Name Products List (BNPL) and the OMRI Generic Materials List for those materials that are permitted for use and meet National Organic Standards.

**References**


Taking Advantage of the USDA Conservation Programs: the Environmental Quality Incentives Program and the Conservation Security Program

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Growers are very much aware and have been affected by environmental issues as identified and enforced by federal and state agencies. However they may not be aware that the 2002 Farm Bill increased federal conservation program support for growers to meet environmental challenges on their lands in production, with a substantial increase in funds authorized. Also as stated in the Farm Bill, environmental and farm health should be compatible goals of USDA conservation programs. Along with other purposes, the Farm Bill and legislative conference report encourage program funds to be used to assist specialty crop grower conservation needs and their pest and nutrient management challenges. We describe here The Conservation Programs and how they can be useful to growers, give information on the Successful Use of the Programs, provide information on The Application Process for those without experience in dealing with Farm Bill programs, and list Additional Contact Information and Web-Resources as you consider if these programs are right for you.

The Conservation Programs: USDA NRCS has established two voluntary federal conservation programs that are designed to assist growers with conservation on lands in production. The Environmental Quality Incentives Program (EQIP) was established in 1996. It is designed to assist growers with the expense of initiating conservation practices, like pest and nutrient management, to address important resource conservation concerns on the farm (such as groundwater and surface water protection, and air quality). And as a result of continued use of these practices, EQIP aims to curb the need for regulatory program enforcement to meet conservation goals. Growers can benefit from the program by obtaining funds to implement practices like pest management, nutrient management, cover crop and field border plantings, irrigation water management, and plant residue management, and make structural improvements like agricultural chemical containment facilities. The practices adopted must address one or more identified resource concerns, such as groundwater protection (do you have leachable soils?) and riparian protection (do you have potential for agricultural water runoff?). Local district conservationists (they are your local representatives of USDA NRCS) may be especially helpful in this area. They are well aware of their district’s resource concerns, and they can help identify practices that can address key resource concerns and aid your farm’s economic outlook. EQIP is available in all counties in the United States each year. For program information, go to http://www.mi.nrcs.usda.gov/programs/eqip.html (Michigan site) or contact your local NRCS office.

The Conservation Security Program (CSP) was established in 2002. CSP assists growers already using conservation practices with the expense of their continued use and provides additional financial incentives to increase conservation efforts. This includes maintaining ongoing IPM and nutrient management efforts and implementing additional techniques. CSP is available on a watershed rotation basis each year. For the 2006 program year, CSP comes to the Maple River watershed and the Boardman/Charlevoix River watershed of Michigan. These watersheds include portions of Antrim,
Charlevoix, Cheboygan, Grand Traverse, Leelanau, Otsego, Clinton, Gratiot, Ionia, Montcalm and Shiawassee counties. For more information, go to http://www.mi.nrcs.usda.gov/programs/csp.html (Michigan site). Watersheds in the program in other states can be found by visiting the state’s home NRCS web page.

**Successful Use of the Programs:** In Michigan, the MSU IPM Program and affiliated departments and MSU Extension units, commodity groups, and agricultural consultants worked together to help increase use of these programs by growers interested in pest and nutrient management. First, proposals designed to enhance program usefulness in implementing pest and nutrient management, with a focus on IPM implementation, were presented to the NRCS advisory committees. As a result:

Beginning the 2004 EQIP program year, IPM tactics sponsored in the NRCS pest management standard can be used to address ground water, surface water, air quality, and soil health concerns (previously, only the first two concerns were recognized). This will strengthen growers’ applications to obtain EQIP financial incentives to use IPM.

Beginning program year 2005, financial incentives available in EQIP to sponsor grower adoption of IPM increased substantially: $60/acre for fruit/nursery/Xmas tree/sod, $30/acre for vegetables, $4/acre for field crops (previously, $20, $10, and $3/acre). Beginning program year 2006, another IPM financial incentive to remove neglected orchards will be implemented: $250/acre for removal of neglected planting (current language allows for apple orchard removal). Nutrient management assistance is $10/acre for specialty crops.

For CSP, pest management and nutrient management were adopted as two of the practice enhancements. The pest management enhancement in CSP contains 9 separate parts, each with its own financial incentive: manage field border and strips for beneficial organisms ($35 to 55/acre), conservation crop rotation to break pest cycles ($8/acre), use reduced-risk pesticides on fruit, vegetables, and other specialty crops ($20/acre), use precision pesticide application technologies ($3/acre), enhance pest management record keeping ($3/acre), manage pests by non-chemical or pest avoidance means ($5/acre). There are also 9 separate pars to nutrient management which capture a broad range of applications for specialty crops.

Second, in five Michigan counties (Oceana, Grand Traverse, Leelanau, Antrim, and Ottawa) NRCS, MSUE, and agricultural consultants worked together to assist fruit, vegetable, and nursery growers to participate in the programs. Consultants actively worked with growers and NRCS staff to collect farm data, and to determine if conservation efforts through implementing IPM and other NRCS practices were needed (data included pesticide and fertilizer application history, farm lay outs, pest history). As a result: In 2004, 46 EQIP applications were submitted in our pilot counties through the private consultant/MSU/NRCS teams and all were approved: more than double the number of contracts approved in 2002. About 10% of funds released will support IPM implementation in the pilot counties (see table). In 2005, 73 EQIP applications were approved in our pilot counties. About 15% of funds supporting IPM implementation in pilot counties (see table). We saw growers adopting a variety of IPM tactics (see next section). For CSP, Oceana County was selected as one of the counties to participate in the program in 2005. About 102 applications were approved, which was approximately one-third on all contracts in 14 counties in the 2005 program.

**Table.** Funding patterns in EQIP. Beginning in 2003, we proposed program modifications to make the program more attractive to growers and worked in local teams in Oceana, Grand Traverse, Leelanau, Antrim, and Ottawa MI counties to encourage grower participation. There has been an over 5-fold increase in funds devoted to IPM implementation statewide from when the project started. Grower requests for IPM support now represents about 15% of funds in a contract in our pilot counties compared to about 1% statewide in 2002. The ag chem. containment facility practice is also shown, the facilities are used to store pesticides and fertilizers.
Overview of basic steps

1) Contact your NRCS office in your local USDA Service Center
2) Work with NRCS to complete a site specific conservation plan for your farm
3) Complete the application
4) Submit application to NRCS

Step One – Contact your county NRCS office and tell them you want to apply for EQIP. They will schedule a time for you to meet with NRCS staff to start your application. The application process is confidential. As part of this initial step, the NRCS District Conservationist or a conservation planner will help you fill out a pre-application form to see if you are eligible for the program. The pre-application form asks basic questions about your farm. You fill in your name, county and the date. Then you circle the correct answers to the seven questions on the form. Be sure to submit the pre-application form directly to the District Conservationist as soon as possible, because the date of submission will be used as part of the selection process if more funds are requested than are available.

Step Two- Work with NRCS to complete a site-specific plan for your farm. The District Conservationist or a conservation planner working with the District Conservationist will come to your farm to help you identify practices that are eligible for EQIP or similar programs. You and the planner will develop a plan outlining conservation practices to implement. The goal is to work together to design a plan that makes sense for your farm, both for resource conservation and maintaining farm production. For your meeting you will want to have available:

- Pesticide and nutrient management records from the past three years
- A farm layout or aerial photo of the farm
- A list of areas where you have conservation concerns
- A list of crops and rotation schedules, if applicable

The District Conservationist will help you identify practices that make sense for your farm and will help you identify which resources (such as soil, water, air, etc.) those practices will address. In doing so he or she will also help you determine whether your application is likely to have priority for funding under EQIP. As a general rule, growers who are able to apply multiple practices that improve more than one resource have a higher priority for funding. Here are some practices in small fruit production to consider for your conservation plan. You may think of other practices that will also qualify.

Small fruit production

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<th>Practice</th>
<th>Critical area planting</th>
<th>Heavy use area protection</th>
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<tr>
<td>Pest management</td>
<td>Critical area planting</td>
<td>Heavy use area protection</td>
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<tr>
<td>Nutrient management</td>
<td>Shelterbelt establishment</td>
<td>Cover crops</td>
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<td>Ag chemical containment facility</td>
<td>Windbreak renovation</td>
<td>Riparian buffer/Filter strips</td>
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<td>Field border</td>
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For pest management, many IPM tactics can be supported by the financial incentives available in EQIP and CSP. For EQIP, the following IPM techniques may qualify for EQIP financial incentives ($60 per acre) to improve ground and surface water protection and air quality protection:

- Adding electronic canopy sensing technology to sprayers and use of shielded sprayers to reduce drift potential.
- Conversion from chemical weed control to flamer/steamer weed control.
- Conversion or elimination of pesticides with high to moderate potential for ground or surface water contamination to pesticides with low risk potential.
- Removal of wild host plants adjacent to bushes.
- Utilize disease inoculum reduction strategies.
- Provide nesting structures for insectivorous birds, bats and other predators.
- Pesticide resistance management, including incorporation of neonicotinoids and pyrethroids into programs for control of insect pests.
- Use of organic mulches beneath bushes to suppress weeds and reduce herbicide use.
- Use of rotary hoeing beneath bushes to reduce weeds and reduce herbicide use.

For nutrient management, the following techniques may qualify in EQIP and CSP to address ground and surface water protection (consult with your NRCS district conservationist for details):

- Tissue analysis and soil testing to monitor nutrition.
- Split applications of nitrogen to improve use efficiency.
- Use of manure, compost, or other organic nutrient sources.
- Cover crop establishment in row middles to promote soil health.
- Legume establishment in row middles to supply nitrogen.

**Step Three - Complete the application**
Once you have developed the conservation plan for your farm, you and the District Conservationist will complete your application. If you are a Limited Resource Producer or Beginning Farmer you are eligible for higher payments.

**Step Four - Submit the application to NRCS**
Once you have completed your application, it will be ranked with other applications in the state based on the number of points it has received. The NRCS District Conservationist will contact you about whether or not your application is funded. If your application has been accepted, you will complete and sign a contract stating the payments and your obligations.

**Additional Contact Information and Web-Resources:** Personnel with the USDA NRCS are stationed at USDA Service Center offices throughout Michigan and other states. In Michigan, An NRCS staff and office directory is available on the Michigan NRCS website at: [http://www.mi.nrcs.usda.gov/contact](http://www.mi.nrcs.usda.gov/contact). Click on "Find a Service Center" on the left side of the web page. USDA Service Centers for other states can be found at your state’s NRCS web site, and your local USDA Service Center NRCS field office is also listed in the government section of most telephone directories. The complete ‘How to’ guide that can be found at: [http://www.ipm.msu.edu/farmbill/start.htm](http://www.ipm.msu.edu/farmbill/start.htm).

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