

Berry Notes

Prepared by the University of Massachusetts Fruit Team

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CROP CONDITIONS:

Strawberries are in early stages of bloom in most areas, with those that were under row cover being more advanced. Frost protection is of primary concern during the bloom period so keep an eye on weather forecasts and be prepared to frost protect if it is needed. More on this below. Tarnished Plant Bug and Clipper are being reported in some areas and more information about these pests is found in this newsletter. High numbers of Two-Spotted Spider Mite were reported under row covers in one location and growers should be sure to check plants carefully for this pest where row covers were used. Bloom begins the primary infection time for Botrytis Gray Mold so close attention should be paid to weather conditions, especially where high levels of infection were found last year. New fields have been planted and are beginning to show good growth. **Brambles:** Some varieties are showing significant winter injury while others are not. Leaves are expanding and some flower clusters are visible but not yet expanding. Primocanes are growing vigorously and reaching 12 inches in height. **Blueberries** are in bloom and close attention should be paid to see if mummyberry strikes are being found in the planting (see April Berry Notes for more information on ID of mummyberry stages. If strikes are found, consider fungicide application to prevent blossom infection phase of this disease. Botrytis, Anthracnose and Phomopsis may also be active now, especially if wet weather prevails. **Grapes** are growing vigorously with the return of warm sunny weather. Varieties differ in how much growth is seen but it ranges from 1 – 5 or 6 inches. Flea Beetle and cutworm may become active soon and growers should scout vineyards for these pests. Phomopsis, Powdery Mildew and Anthracnose can become active now and vineyards with a history of these diseases may need to apply a cover spray at this time. See the New England Small Fruit Management Guide for recommended materials.

ENVIRONMENTAL DATA

The following growing-degree-day (GDD) and precipitation data was collected for an approximately 1 week period, May 8 through May 14. Soil temperature and phenological indicators were observed on or about May 14. Total accumulated GDDs represent the heating units above a 50° F baseline temperature collected via our instruments for the 2014 calendar year. This information is intended for use as a guide for monitoring the developmental stages of pests in your location and planning management strategies accordingly.

Region/Location	GDD (1-Week Gain)	GDD (Total 2014 Accumulation)	Soil Temp (°F at 4" depth)	Precipitation (1-Week Gain in inches)
Cape Cod	73	168	59	0.35
Southeast (Wareham)	60	118	55	0.11
Southeast (Hanson)	75	197	68	0.10
East	75	173	61	0.11
Metro West	49	121	54	0.25
Central (Boylston)	54	136	49	0.65
Pioneer Valley	88	162	49	0.65
Berkshires	39	91	56	0.18
AVERAGE	64	146	56	0.30
n/a = information not available				

(Source: UMass Landscape Message #9, May 16, 2014)

STRAWBERRY

Irrigation For Frost Protection Of Strawberries

Pam Fisher and Rebecca Shortt – Ontario Ministry of Agriculture Food and Rural Affairs

Summary

- Frost injury can cause significant damage to strawberry plants, especially open bloom, but also to unopened buds if it is cold enough.
- Strawberry fields are often colder at ground level than the weather forecast suggests.
- Irrigation for frost protection works because heat is released as water freezes.
- Irrigation rates must be adjusted to account for evaporative cooling due to winds and relative humidity. More water is required on windy nights.
- Failure to apply enough water can result in greater damage than no irrigation at all.
- When to start up the irrigation is critical. Two tools can determine the optimum time for starting frost protection: dew point, and wet bulb temperatures. Use the dew point and table 5 to determine the temperature at which to start irrigation. Alternatively measure the wet bulb temperature; irrigation should start before the wet bulb temperature reaches the critical temperature (table 1).
- Dew point is also useful in predicting the lowest expected temperature, and how quickly the temperature will drop.

- In general, the start temperature for frost protection is higher when the humidity is low; the start temperature for frost protection is lower when the humidity is high.
- Where row covers are used, irrigation can take place over the cover. Information on temperatures under the cover can be determined by using digital thermometers and thermocouples.

Introduction

There's nothing colder than a strawberry field on a frosty spring night. Strawberry plants bravely bloom in early spring, often before the last frost. The blooms are close to the ground, and the ground, covered with straw, doesn't provide much heat. That's why many strawberry growers pull a few all-nighters each spring to run the irrigation system and use a thermodynamic principle to protect their crop from frost injury.

This paper will describe types of frost, frost injury, and how irrigation can be used to protect strawberry plants from frost injury.

Symptoms of Frost Injury

Frost occurs when the temperature around the plant drops below 0°C (32°F). At this temperature, pure water forms

ice crystals on surfaces which have fallen below the freezing point of water.

Plant sap is not pure water; therefore strawberries have a lower freezing point than 0°C (32°F). When the critical temperature (Table 1) is reached, crystals form and damage cell membranes allowing cell fluids to leak out.

Frost can kill flowers outright, or injure them enough to cause misshapen berries. When a flower is injured by cold, the pistils are killed first. If killed after pollination, then embryos do not develop. A seedy spot on the berry forms, with hollow seeds. Sometimes fruit cracks at the bottom. Leaves can also be injured by the frost, especially when they are growing vigorously and very tender. The edges or tips of leaves blacken, and then dry out.

Frost usually damages the biggest and earliest bloom. This represents the best and most lucrative part of the berry crop, because prices are highest at the beginning of the season. Further, the first flowers to open produce the largest fruit. If 5 percent to 7 percent of the flowers are lost, and these flowers are mostly king bloom, the total crop will be reduced by 10 to 15 percent.

Critical Temperatures for Frost Injury

Bloom and flower parts are most susceptible to freezing temperatures.

Table 1. Critical temperatures of strawberries based on stage of development (Perry and Poling, 1985)

Stage of Development	Approximate Critical Temp. °C (°F)
Tight bud	-5.5 (22 F)
"Popcorn"	-2.2 (26 F)
Open blossom	-1.1 (30 F)
Fruit	-2.2 (28 F)

These temperatures are tissue temperatures, and a degree or two lower than the critical air temperature in the plant canopy. There are many variables that affect the actual critical temperature for a given plant and the amount of injury.

- Duration of cold
- Growing conditions prior to the cold event
- Cultivars: (because of plant habit, or avoidance, rather than genetic differences)
- Stage of development
- Super cooling (in the absence of ice nucleation points, plant sap can cool below the freezing point without forming ice crystals)
- Soil type and condition (moist dark soil holds more heat than dry light soil)



Figure 1: Frost-injured strawberry bloom



Figure 2: Misshapen berries resulting from blooms which are partially damaged by frost



Figure 3: Frost injury on strawberry leaves

Understanding Heat Transfer

Cold conditions occur when heat is lost. Cold can not be added, only heat can be removed.

Heat can be transferred by:

- **Conduction:** transfer of energy within an object or system. Metal is a good conductor, water is a good conductor, but air is a poor conductor of heat. Ice is a good conductor.
- **Convection:** Transfer of heat by movement and mixing of liquid or gas. Most air is warmed by convection.

- **Radiation:** Is the transfer of energy through free space without a transporting medium. We receive energy from the sun by radiation. Objects on earth also radiate energy back to space.
- **Changes in state:** When water molecules change state, from gas to liquid to ice, heat is released. This potential energy is called latent heat. It is not measured by a thermometer, until it is released by a change in state of the water.

When water condenses, cools or freezes, the temperature around the water rises as latent heat is released. Water changing to ice on the surface of a plant will add heat to that plant. Conversely, when ice melts, or water evaporates, the temperature around the water is cooled, as heat moves to the water. Water evaporating from the surface of a plant will draw heat from that plant.

Table 2. Heat exchange due to changes in state: Positive signs indicate the water is cooling or freezing and air is warming. Negative signs indicate water is warming or evaporating and air is cooling

Change in state	Heat exchange (calories/gram)
Water freezes at 0°C (32°F)	+79.7
Water evaporates at 0°C (32°F)	-597.3
Water condenses at 0°C (32°F)	+597.3

Energy Budgets

During the day, the sun warms the soil and solid objects, i.e. crops. When these objects become warmer than the air, they pass heat to the air by conduction. This warm air is less dense, and rises, and is replaced by cooler air from above. This mixing of air is how the lower atmosphere is warmed. Normally, air near the surface of the earth is warmer than the air above it. Crops also radiate heat to outer space. Some of this energy is reflected back to the earth by clouds and CO₂ in the atmosphere.

At night, there is no incoming radiation from the sun. If the atmosphere is clear, there is little heat reflected back to earth. The soil and crops continue to radiate energy out to space. Temperatures drop near the earth's surface, forming a layer of air that is colder at the bottom and warmer at the top. If a wind or breeze is present, the warm air and cooler air are mixed. But on a still night, especially when the air is dry, the air temperature at

ground level is coolest, and the temperature increases with height up to a certain level. Because this situation is the opposite of normal daytime conditions, the term inversion is used to describe these conditions.

Objects can radiate heat faster than the air around them. Frost can form on the roof of a building or the hood of a car when air temperatures are still a degree or two above zero. Strawberry blooms can also radiate heat quite quickly on a clear night.

Important Facts about Weather

Although the terms "frost" and "freeze" are used interchangeably, they describe two distinct types of cold events.

An advective, or windborne freeze, occurs when a cold air mass moves into the area, and brings freezing temperatures. Significant wind occurs as the cold front moves in. the thickness of the cold air layer is 500-5000 feet deep. It is difficult to protect crops from frost injury when these conditions occur.

A radiation frost, occurs when a clear sky and calm winds allow an inversion to develop and temperature near the surface of the earth drop below freezing. The thickness of the cold air inversion is 30-200 feet (with warm air above).

Microclimate monitoring

Air temperatures referred to in weather reports and forecasts are measured 5 feet above the ground. Temperatures can be much colder at ground level and even colder in the low parts of the field. Cloud cover and wind speeds are also important factors to consider when determining the risk of frost.

Use max/min thermometers to monitor the low temperatures in your fields. Compare these to the forecast lows. In cloudy breezy weather, forecast lows are likely to be similar to the observed low in a region. On clear calm nights, especially in a strawberry field, the observed low can be much lower than the forecasted low.

You can also use max/min thermometers to compare the temperatures at several locations on your farm on a given night. After several observations you will know just how much colder each field is compared to your back yard. A frost alarm can be installed in a convenient location if you know how much colder it gets in the field.

Table 3. Characteristics of a radiation frost and an advective freeze

Radiation frost	Advective freeze
Calm winds (less than 5 mph)	Winds above 5 mph
Clear skies	Clouds may exist
Cold air 30-200 feet deep	Cold air mass 500-5000 feet deep
Inversion develops: air next to the ground is cooler than air above it.	Protection success limited
Cold air drainage occurs	-
Successful frost protection likely	-

Factors affecting the risk of frost

Cold air is heavier than warm air, and it sinks and flows across a field like water. It also piles up where obstructions block its flow to a lower area. Road banks, hedge rows, berms are examples of obstructions to cold air flow. Cold air will drain from elevated areas, to lower storage areas, such as a large body of water. Strawberry fields on sloping fields, or in generally elevated areas, are less prone to frost damage. Be aware of frost pockets within the field.

Remove obstructions at the lower end of the field to improve air drainage. Windbreaks should be designed to slow the wind, not block all air movement. To allow air drainage through a windbreak about 50% air space at the bottom of the windbreak is recommended.

Soil moisture and compaction can have a significant effect on temperature. A moist compact soil will store more heat than a loose dry soil and therefore has more heat to transfer to the crop at night. Cultivation just before a frost can increase the risk of injury, because the soil is looser and drier after cultivation. Soil under a grassy cover crop will hold more heat if the grass is mowed short.

Irrigation for Frost Protection

Most growers rely on sprinkler irrigation for frost protection. When water from sprinklers turns to ice, the heat released protects the plant from injury. As long as a thin layer of water is present, on the bloom or on the ice, the blossom is protected. (This is important. It's not the layer of ice that provides the protection. It's the water constantly freezing that keeps the temperature above the critical point.)

System specifications

- Make sure the sprinkler irrigation system has the capacity to irrigate the whole field at one time.
- Use sprinkler heads designed for frost protection. These have low output nozzles, made of metal rather than plastic, and the spring is covered to prevent freeze-up. Sprinkler rotation should be rapid, at least 1 revolution per minute. The back nozzle should be plugged (Figure 4).
- Spacing of risers should not exceed 30-60% (depending on wind conditions) of the area wetted by each sprinkler. Generally an off-set pattern provides more uniform coverage than a square or rectangle, but this really depends on the nozzle and sprinkler you are using. The Center for Irrigation Technology has developed a program called SPACE, which predicts the distribution of water from the sprinklers, and calculates the efficiency of different designs. Tools like this are used by irrigation supply specialists who can help design your system.

- Traditional spacing is 60' by 60', not as many sprinklers required, but it takes longer for sprinklers to cover area. In areas where many advective freezes occur, with winds, a spacing of 30' x 30' is recommended.
- Need enough water on hand to irrigate for several nights in a row.

For example: For 1 acre, you need about 60 gallons per minute, to irrigate 0.125 inch/acre/hr. This is 3600 gallons per hour. If irrigation is required for 10 hours, you need 36000 gallons per night. Plan to irrigate for several nights in a row.



Figure 4: Sprinkler used for frost protection with back nozzle plugged

How much water to apply

The amount of water applied per hour is based on the amount of wind and the temperature (Table 4). Higher water application rates are required on windy nights, or when humidity is low because considerably more energy is removed when a gram of water evaporates than is added when a gram of water freezes (Table 2). A rate of 0.1 inch/hour is considered adequate to protect to -4.4°C (24°F) with no wind. When the water is frozen on the plant the ice should be clear, which indicates that there was enough water applied. If the ice is cloudy or milky white, the water application rate is not fast enough to protect the flower (Figure 5). In this case you can increase the water application rate by reducing the sprinkler spacing or changing to higher flow rate nozzles. At wind speeds above 16 km/hr or at temperatures below -6.7°C (20°F) sprinkler irrigation can do more harm than good because of rapid freezing.

When to start irrigation

To successfully use irrigation for frost protection, growers need information about the dew point. Dew point is especially important in determining the irrigation start-up point.

The dew point

The dew point is the temperature at which moisture condenses from the air to form dew. The dew point is related to relative humidity: when the air is humid the dew point occurs at a higher temperature than when the air is dry. Once dew begins to form, the air temperature begins to drop more slowly. When temperatures reach freezing, the dew turns to frost.

Dew points are available from agricultural weather forecasts, e.g.

- Environment Canada - provides current dew points and other current weather conditions, for certain locations
- Farmzone.com - provides forecasted dew points



Figure 5: Strawberry bloom coated in clear ice

What is the significance of dew point?

Growers can use dew points to estimate how quickly the temperature might drop in any given night. Once dew begins to form, the air temperature drops more slowly because heat is released. Frequently, the nighttime temperature drops to the dew point, but not much below it. Sometimes the dew point is referred to as the basement temperature.

If the air is dry, then the dew point will be low. If the dew point is below 0°C (32°F), frost forms instead of dew. Black frosts occur when temperatures are below freezing but above the dew point. Don't wait for frost to form before starting the irrigation system (especially when the humidity is low).

Wet bulb temperature

Sometimes the term wet bulb temperature is used to determine when to start up irrigation systems. The wet bulb temperature represents the temperatures a wet surface will cool to as the water evaporates. A wet bulb thermometer is covered with clean muslin soaked in distilled water. Air is passed over the bulb; the water evaporates, reducing the temperature around the thermometer.

If wet bulb temperatures are available, these can be used directly to determine when irrigation should begin, and when the system can be shut off. Start irrigation just before the wet bulb temperature reaches the critical temperature (Table 1).

Table 4. Inches of Water/Acre/Hour to Apply for Protection at Specific Air Temperatures and Wind Speeds (Martsoff and Gerber, Penn State University)

Wind speed at crop height (km/hr)	-2.8°C (27°F) air temperature at canopy	-4.4°C (24°F) air temperature at canopy	-6.7°C (20°F) air temperature at canopy	-7.8°C (18°F) air temperature at canopy
0-2	0.10	0.10	0.16	0.20
3-6	0.10	0.16	0.30	0.40
7 – 14	0.10	0.30	0.60	0.70
15 – 19	0.10	0.40	0.80	1.00
20 – 35	0.20	0.80	-	-

Table 5: Suggested starting temperatures for irrigation, based on dew point. The lower the dew point, the sooner you should start to irrigate.

Dew Point	Suggested starting air temperature
-1.1°C (30.2°F)	0°C (32.0°F)
-1.7°C (28.9°F)	0.5°C (32.9°F)
-2.8°C (26.9°F)	1.1°C (34.0°F)
-3.8°C (25.2°F)	1.6°C (34.9°F)
-4.4°C (24.1°F)	2.7°C (36.9°F)
-5.5°C (22.1°F)	3.3°C (37.9°F)
-6.7°C (19.9°F)	3.8°C (38.8°F)
-8.3°C (17.1°F)	4.4°C (39.9°F)

When to stop irrigation

Irrigation can be stopped when ice on the plants begins to melt, usually after sunrise. Monitor carefully to make sure that the ice continues to melt and the temperature remains above freezing. Changes in wind speed could change temperatures near the plant surface. Irrigation should be started up again if water begins to freeze.

Ice does not have to be completely melted. The plant temperature will warm up as the sun rays hit the field. When the ice can be sloughed off the plant, you know that plant temperatures are above freezing and the water next to the plant has started to melt. At this point, you can turn off the irrigation water, usually around 7:30 or 8 am.

The best way to know when to turn off the irrigation is to monitor plant tissue temperatures beneath the ice. Digital thermometers, attached to thermocouples inserted into the plant tissue can indicate when plant temperatures begin to warm up above the critical temperature.

Negative side effects

One negative side effect of irrigation for frost protection is increased potential for disease outbreaks. Angular leaf spot is a bacterial disease that is spread by splashing rain or irrigation, and seems to get established in frosty conditions. Anthracnose, which can cause fruit rot, generally likes warm humid weather. However, even during cool periods, it will spread by water splashing on the plants and, after establishing itself, it will thrive when warm weather arrives (Figure 6).

Root rots, such as red stele, thrive in saturated soil conditions. Outbreaks of red stele and other root rots have occurred after long periods of irrigation for frost protection. The sites most suited for frost protection by irrigation are well drained sites with sand or sandy loam soils.



Figure 6a: Angular leaf spot



Figure 6b: Anthracnose fruit rot

Figures 6a, 6b: Splashing water can spread diseases like angular leaf spot and anthracnose fruit rot



Figure 7a: Standing water and water-saturated soil in a strawberry field



Figure 7b: Water-saturated soils favor root diseases such as red stele.

Disease and fungus can be limited by reducing the water applied. Water volumes can be reduced by:

- Low application rates / nozzles
- Stopping when ice begins to melt, not when all the ice is melted.
- Monitor the weather to irrigate only when needed.
- Using row covers. This can delay the start up time for irrigation by several hours.

Row Covers

Row covers reduce evaporative cooling and the rate of cooling under the cover. According to vendor's information, the heavier weight covers (1.5-2 oz/yd²) can protect 4-6 degrees, but this varies both with the weight and between manufacturers. They do buy time on a frosty night.

When frost protecting with irrigation and row covers, you need to know plant temperature under the cover. Start when temperatures under the cover drop to 0.6 - 1.1°C. Irrigate right over the cover. Stop when plant temperatures start to climb. Digital thermometers attached to thermocouples, inserted in the flower buds before the frost event, are necessary for successful protection with covers.

Research suggests that 2 layers of 1 oz cover provide more protection than 1 layer of 2 oz material. Research on the use of low impact sprinklers, i.e. mini-wobblers, is in progress. These sprinklers, widely used in the ornamental industry, wet a smaller diameter, use lower pressures, and are less prone to freezing. By using irrigation and row covers it may be possible to frost protect in adverse conditions.

Related Links

- Environment Canada
- Farmzone.com
- Frost/Freeze Protection for Horticultural Crops, North Carolina State University Horticulture Information, Leaflet 705
- Rainbird Agricultural Irrigation - Technical resources, specifications
- Center for Irrigation Technology Technical resources, SPACE program
- Biometeorology Program, Atmospheric Science, University of California - web site with tables, theory, course on biometeorology
- Berry agent, North Carolina State University

(Source: OMAFRA Factsheets at:

www.omafra.gov.on.ca/english/crops/facts/frosprot_straw.htm)

Bloom Is A Critical Time For Control Of Botrytis Gray Mold In Strawberries

Annemiek Schilder, Michigan State University Extension

Botrytis gray mold, caused by the fungus *Botrytis cinerea*, is one of the most important fruit rot diseases affecting strawberries. Typical symptoms include a spreading brown rot and fuzzy gray mold on ripening berries. Wet weather and moderate temperatures are conducive to development of this disease. The bloom period is the most important time for control of gray mold, since primary infections take place almost exclusively through the blossoms. The infections then remain dormant until the berries start to ripen. As gray mold develops on infected berries, these become sources of inoculum secondary infections of adjacent berries. Ripe and overripe berries in particular are very susceptible and gray mold can spread rapidly at that time.

The gray mold fungus overwinters on old leaves and plant debris and can sporulate profusely on dead and decaying plant material. The spores are airborne and are usually

plentiful in strawberry fields. If the bloom period is dry or good fungicide coverage is maintained, incidence of gray mold at harvest will be low. However, if primary infections get established, it will be harder to control the disease both before and after harvest. Where possible, remove sporulating berries from the field and destroy them to limit inoculum availability.

There are a number of excellent fungicide choices for gray mold control in strawberries: **Switch** (cyprodinil and fludioxonil) and **Pristine** (pyraclostrobin and boscalid) provide excellent control; both have two different active ingredients – one of which is systemic – that broaden their spectrum of activity. Pristine also provides outstanding control of fungal leaf spots and anthracnose fruit rot. **Elevate** (fenhexamid) is a locally systemic fungicide with good to excellent activity against gray mold. **Captevate** is a pre-mix of captan and fenhexamid and has a broader

spectrum of activity than Elevate alone as it also protects against anthracnose and leaf spots. **Scala** (pyrimethanil) is a newer fungicide labeled for Botrytis gray mold control in strawberries and is similar to one of the active ingredients in Switch. **Rovral** and **Iprodione** (both iprodione) are older fungicides with good activity against Botrytis gray mold, but they can only be applied once and not after first fruiting flower. Also, their activity is enhanced by adding a spreader-sticker.



With respect to older fungicides, a tank-mix of **Topsin M** (thiophate-methyl) and **Captan** (captan) has good activity against a broad spectrum of fungi, including gray mold. Adding **Kocide** (copper hydroxide) or **Cuprofix** (basic copper sulfate) can help tackle angular leaf spot as well. **Thiram** (thiram) is a broad-spectrum fungicide with fairly good efficacy against gray mold as well, but is strictly a protectant.

Just as a reminder, **Cabrio** (pyraclostrobin) and **Abound** (azoxystrobin) are **NOT** suitable for gray mold control, but are effective against anthracnose and other fruit rot and leaf spot diseases. All fungicides mentioned above have a zero-day pre-harvest interval, except Topsin M (one day), Scala (1 day) and Thiram (3 days). Copper products have a 24-hour re-entry interval. Remember to alternate fungicides in different fungicide classes for resistance management purposes. A table showing fungicide classes is available in the [2012 Michigan Fruit Management Guide](#) (E-154) [Ed Note: Also in NE [Small Fruit Pest Management Guide](#)].

Be careful using older fungicides like Captan, Rovral and Thiram when bees are foraging as these fungicides may be toxic to the brood when they are carried back into the hive by the worker bees. Some other fungicides may have toxicity in combination with certain insecticides or adjuvants. It would be best to spray in the evening during dry conditions or to avoid using these materials altogether. (*Source: MSU Fruit News, May 15, 2012*)

Tarnished Plant Bug

Sonia Schloemann, UMass Extension

ID/Life Cycle: The tarnished plant bug (TPB) is a small bronze colored insect with a triangular marking on its back. It is a ‘true bug’ with piercing/sucking mouthparts. The immature stage, or nymph, is smaller and bright green, resembling an aphid, but much more active. TPB is a ubiquitous feeder with a wide host range.

Tarnished plant bug overwinters in protected areas such as leaf litter, plant debris, hedge rows and brush piles. Adults become active and lay eggs in grasses, broadleaf weeds, and in strawberries in early to mid-May. The eggs hatch to nymphs in 7-10 days depending on the temperature. The nymphs may be present on the plants as early as the second week of May. The first observation of nymphs usually occurs during full-bloom period of mid-season flowering cultivars. Nymphs undergo 5 stages of development. There are several generations per year.

Damage: This is the most significant insect pest in strawberries. Both adults and nymphs feed on the developing flowers and fruit, sucking out plant juices with straw-like mouth-parts. This results in deformed fruit: typically “cat-faced” berries, also called nubbins or button berries. Such fruit are generally unmarketable. Damage can cause significant crop loss.

Management

Monitoring: Monitor for TPB nymphs by shaking flower trusses over a white surface and counting the number of

nymphs present. At each of five sites per field, shake 10 flower clusters over a white pan or paper to dislodge the nymphs. The action threshold for nymphs is 0.15 nymphs per blossom cluster. At this level, control measures can be applied to maintain berry quality and yield before too much damage occurs. White sticky traps are available for monitoring tarnished plant bug adults. These traps are used as an indicator of plant bug activity in the spring and a relative indication of their abundance, not as an indication of when to control this insect.

Control strategies

Cultural/Biological:

- Control weeds in and around the planting to reduce populations of this insect.
- Avoid mowing nearby fields during bloom or early fruit development.
- Avoid planting strawberries near alfalfa, which attracts high populations of TPB.
- Preserve natural enemies whenever possible by selecting spray materials that are less toxic to beneficials.

Chemical:

- Apply recommended insecticides if threshold levels are exceeded.

- DO NOT APPLY INSECTICIDES DURING BLOOM.
- If repeat applications are needed, rotate insecticides from different IRAC groups to reduce the chance of resistance development in the pest. Group designations can be found on product labels or by going to

Conventional

- Assail SG acetamiprid @ 4.0-6.9 oz/A**
- *Brigade WSB bifenthrin @ 16-32 oz/A**
- *Danitol EC fenprothrin @ 10-2/3 fl oz/A**
- Malathion 57 EC malathion @ 1.5-3.0 pt/A**
- *Dibrom 8EC naled @ 1 pt/A**
- Pyrethron crop spray 0.5EC pyrethrin @ 2-12 oz/A**
- *Actara thiamethoxam @ 4 oz/A (suppression only)**
* restricted use material

Organic

- Aza-Direct azadirachtin @ 1-2 pt/A**
- Mycotrol O Beauveria bassiana strain GHA @ 0.25 to 1 qt/A**
- PyGanic 1.4 EC_{II} pyrethrin @ 16-64 fl. oz/A or**
- PyGanic 5.0 EC_{II} pyrethrin @ 4.5-18.0 fl. oz/A**
No product endorsement over like products intended.
Always read the label prior to use.



(TPB nymphal instars. Photo from Ontario Crop IPM website at www.omafra.gov.on.ca/IPM/english/index.html)



(Sampling for TPB nymphs. Photo from Ontario Crop IPM website at www.omafra.gov.on.ca/IPM/english/index.html)

Click [here](#) for more excellent images of TPB from Ontario.

Strawberry Bud Weevil or Clipper

Sonia Schloemann, UMass Extension

ID/Life Cycle: This insect is a very small beetle with a copper-colored body and a black head with a long snout.

Strawberry bud weevils overwinter as adults in protected areas such as fence lines, hedgerows and woods. They migrate into the strawberry field from overwintering sites in early spring when flower buds are visible and beginning to extend from the strawberry crown. After mating, the female deposits an egg inside an unopened flower bud and partially cuts off the blossom stalk. This is where the common name the "Clipper Weevil" comes from. The damaged bud will not open. It wilts, turns brown and dries up, providing a place for the egg and larva to develop. New adults emerge in mid-summer, feed on pollen from flowers and weeds until the fall, and seek out overwintering sites. They have only one generation per year. A resident population (one that becomes established inside the strawberry field) may develop in plantings older than 3 years.

Damage: Damage is caused by the clipping of flower buds, which then fail to develop as fruit. High levels of injury can lead to significant yield impact. However, some varieties seem to be able to compensate for lost buds by producing larger berries from remaining buds, a thinning effect. Infestations tend to be concentrated near the hedgerows, woods, and stonewalls that border strawberry fields.

Management

Monitoring: Early detection of clipper activity is important. Watch for clipper adults and damage when flower buds start coming out of the crown and when temperatures approach 65°F. Check a 2 ft section of row at each of 5 sites per field. Sampling should be most intensive along field edges near woods or hedgerows or where weeds are heavy. The action threshold is 13 clipped buds per 2 ft of strawberry row.

If king blossoms are open, look for shot-holes in flower petals caused by females searching for pollen to feed on. This is an easy symptom to see.

Control strategies

Cultural/Biological:

- Rotate strawberry fields to alternative cash or cover crops for at least 3 years before replanting to strawberries to disrupt pest buildup.
- Locate strawberry plantings away from woodlots and hedgerows that harbor this insect through the winter.
- Planting 2 or 3 rows of an early cultivar as a trap crop around the perimeter of each field to reduce overall damage or to concentrate the adults for control by use of an insecticide only in the trap crop.

Chemical:

- Apply recommended insecticides before bloom if threshold levels are exceeded.
- If infestation is limited to border rows, a border spray can be employed to avoid spraying rows where control is not needed.
- DO NOT APPLY INSECTICIDES DURING BLOOM.
 - If repeat applications are needed, rotate insecticides from different IRAC groups to reduce the chance of resistance development in the pest. Group designations can be found on product labels or by going to

Conventional

***Brigade WSB**, *bifenthrin* @ 6.4-32 oz/A

***Danitol 2.4EC**, *fenpropathrin* @ 16-21oz/A

***Lorsban 4EC**, *chlorpyrifos* @ 1qt/A

Molt-X, *azadirachtin* @10oz/A (plus 0.25 to 1.0% non-phytotoxic crop oil)

* *restricted use material*

Organic

Aza-Direct *azadirachtin* @ 1-2 pt/A

Mycotrol O *Beauveria bassiana* strain GHA @ 0.25 to 1 qt/A

PyGanic 1.4 EC *pyrethrin* @ 16-64 fl. oz/A

No product endorsement over like products intended.

Always read the label prior to use.



(Strawberry Bud Weevil (Clipper) adult. Photo: Ontario Crop IPM website at www.omafra.gov.on.ca/IPM/english/index.html)



(Strawberry Bud Weevil damage; clipped buds. Photo: Ontario Crop IPM at www.omafra.gov.on.ca/IPM/english/index.html)

RASPBERRIES/BLACKBERRIES

Cane Damage, What to do?

Gina Fernandez, North Carolina State University

This year we have seen damage to canes and buds....here are some suggestions on how to manage the crop for this upcoming growing season.



Protecting blackberries from winter cold with straw mulch. Photo credit: unknown at this time

If you have CANE Damage:

First, determine extent of the injury to your canes.

If canes are completely killed to ground, remove them as they will be sites for disease infection. Once they are removed, you will need to manage the emerging primocanes. There will likely be lots of them and they will grow quickly. Tipping may be needed more frequently.

If canes are damaged on the upper portions, remove the damaged portions, as they will be sites for disease infection. This is of course dependent on if you have labor and how much time it will take to remove the damaged portions of the cane.

If canes are damaged in spots, the plant will have reduced capacity to provide nutrients to the developing laterals, because of damage to vascular tissue (see figure 3 in the previous blog post). I talked to Dr. Bernadine Strik, OSU Berry Crop Extension Specialist, and this was her suggestion:

" If canes or the bud base are damaged and there is lateral growth, these laterals may "collapse" – grow well and then wilt. While it's hard to deal with bud base damage, if there is partial cane damage, foliar fertilization to support lateral growth with the cambium of the cane has time to repair can work. We have resisted putting specific recommendations of foliar feeding during delayed dormant and fruiting lateral development stages, because it would be possible to do "too much" and burn the young leaves. This would be a concern. Also, foliar feeding will not "solve" problems with poor bud break or "fix" canes that are damaged. It's not a miracle cure. With that said, if there is partial cane damage and the cane is thus limited on translocation of mobile nutrients, foliar feeding would help get the laterals through the early development period. I would recommend a low foliar rate of N (e.g. 5% urea) as well as Ca. It's hard to mix Ca with K, but K might be needed also (caution on not applying too high a rate as this will burn leaves). I would apply a foliar every 2 weeks until first bloom."

For management of diseases, make sure you stick to the recommended spray program and watch out for grey mold (botrytis). (**Source:** *Team Rubus Blog April 22, 2014*)

BLUEBERRY

Managing Mummy Berry Shoot Strike Infections

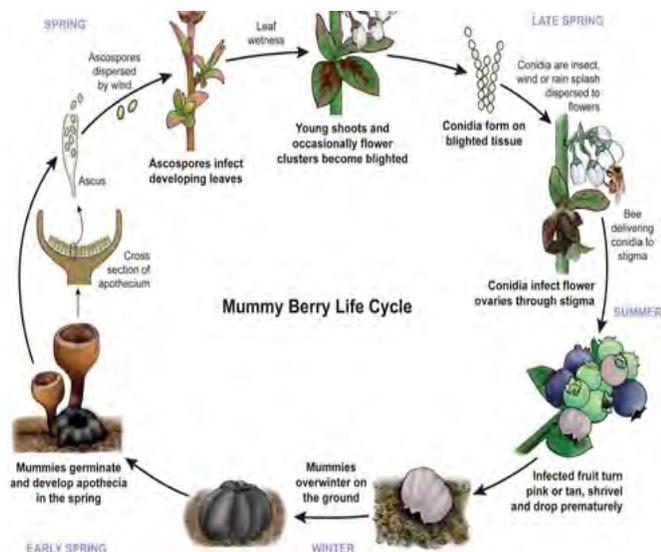
Mark Longstroth, and Annemiek Schilder, Michigan State University

With spring, a blueberry grower's thoughts turn to preventing mummy berry. Warm weather has blueberries growing rapidly and leaf tissue is quickly emerging. This young tissue is susceptible to infection by [mummy berry](#) (*Monilinia vaccinii-corymbosi*).

Mummy berry needs to infect blueberries twice every year to survive. Spores from overwintering mummies need to infect the new growing shoots. This primary phase of the disease is commonly known as shoot strike. Early disease control is focused on preventing shoot

infections. Infected shoots die and spore from these infections are spread to the flowers during bloom.

Mummy berry apothecia, called trumpets or mushrooms, have emerged from the mummies in southwest Michigan. Mushroom numbers so far are low to moderate, perhaps due to drier conditions since mid-April. Rains may result in a second or third flush of apothecia. If apothecia are present as well as green leaf tissue, blueberry growers need to protect against mummy berry.



The primary phase of mummy berry (shoot strike) is on the left side of this diagram of the mummy berry life cycle. Source: Michigan Blueberry Facts: Mummy Berry (F2846)

As the leaf buds expand, the exposed leaves are susceptible to infection by ascospores from the apothecia. Ascospores are often discharged in the morning when relative humidity drops and the wind speed picks up. Ascospores are dispersed by the wind and can move a good distance from the apothecia. Spores can blow in from neighboring fields or from volunteer or wild blueberry bushes around the field. Growers should monitor their fields for mummy berry trumpets and watch the weather to anticipate disease infection periods.

The ascospores need water to germinate. For an infection to occur, the leaf tissue must be wet long enough for the fungal spore to germinate and infect the young tissue. Paul Hildebrand of Ag Canada in Nova Scotia has determined the infection conditions necessary for shoot infection in lowbush blueberry; these seem to hold up for highbush blueberry as well. At 57°F (14°C) with adequate moisture, infection occurs in five to six hours. At 36°F (2°C), 10 hours of leaf wetness are required for infection. The warmer the temperature, the shorter the wetting period required for infection. The optimum temperature for infection is about 68°F. Over 80°F, conditions are less favorable for fungal growth and the fungus needs longer wetting periods for successful infection.

Table 1. Mummy berry shoot infection conditions.

Wetness	Average temperature (F) during wet period				
	36	43	50	57	65
Duration (h)	36	43	50	57	65
2	0	0	0	0	0
4	0	0	0	0	0
6	0	Low	Low	High	High
8	0	Mod	High	High	High
10	Mod	High	High	High	High
15	Mod	High	High	High	High
24	High	High	High	High	High

Source: Paul Hildebrand, Ag Canada, Nova Scotia

Growers can use Table 1 to estimate risk in their blueberry fields. You can also use Michigan State University's [Enviro-weather](#) website to monitor for mummyberry infection conditions. There is no specific mummy berry model, but blueberry growers can use the [Multi-Crop Disease Summary](#) tool in the fruit section of [Enviro-weather](#). This tool reports the hours of wetness and the average temperature during a wetting period for all the stations in the region. The columns for duration and average temperature are located near the middle of the table. This tool can be used to estimate the risk on your farm by comparing similar or nearby stations. This allows growers to determine the disease risk during or soon after wetting events. In 2014, we plan to have a mummy berry model available for Enviro-weather.

Another important disease control decision is what fungicides to use in your mummy berry control program. Some of the more effective mummy berry fungicides are shown in Table 2. Some materials work well against both phases of the disease, but most are better against one or the other. Fungicides that are effective at preventing shoot strike are materials that are good at protecting young leaf tissue, usually under cooler spring temperatures. The table groups materials by whether they are systemic or protectant fungicides.

Table 2. Fungicide efficacy against mummy berry in blueberries

Fungicide		Specific infection controlled	
Trade Name	FRAC Code	Shoot strike (primary phase)	Fruit rot (secondary phase)
<i>Systemic fungicides</i>			
Indar	3	+++	+++
Quash	3	+++	+++
Orbit	3	+++	++
Omega	3	++	++/+++
Pristine	11/7	++	+++
Quit Xcel	11/3	++	++

<i>Protectant fungicides</i>			
Serenade + Nu-Film	44	++/+++	++
Sulforix	M2	+++	++
Bravo	M5	++	+
Ziram	M3	++	++

Protectant fungicides are deposited on the surface of the plant and kill fungal spores as they germinate. Protectant materials need to be applied before the infection event to be effective. Systemic materials are absorbed into the plant and kill the fungus as it tries to penetrate the plant. The table also shows the FRAC (Fungicide Resistance Action Committee) code. The FRAC code indicates the mode of action of the fungicide. To reduce the risk of fungicide resistance in the mummy berry fungus, it is a good idea to use fungicides with more than one mode of action to control mummy berry. This can be done by alternating materials with a different mode of action (FRAC code) between sprays or mixing materials with different modes of action.

The new fungicide Quash is as effective as the current grower standard Indar. Quash has a seven-day PHI (Indar and Orbit have a 30-day PHI) and has excellent activity against phomopsis and moderately good activity against anthracnose fruit rot. Quash, Indar and Orbit all belong to FRAC group 3, meaning they are sterol inhibiting (SI) fungicides and have the same mode of action. There are minor differences between the compounds in the same group, so some are more effective than others against the same disease.

The SI fungicides are readily absorbed into the leaves and kill the fungus as it penetrates the leaves. This group of fungicides moves throughout the leaves where they were applied and provides protection until the growth of the leaf dilutes the fungicide concentration, making it no longer effective. This period of protection is about four to five days or less, depending on the rate of growth of the plant. The SI fungicides can kill the fungus soon after the initial infection while the fungus is still small. This ability to kill the fungus after the initial infection gives these

materials back action of about 24 hours. This gives growers the ability to wait for an infection period before applying a fungicide control.

FRAC group 11 comprises the strobilurin fungicides (e.g., Abound, Pristine). These materials are absorbed as well, but are generally weaker at killing fungi after an infection, i.e., they have less post-infection activity, and [Michigan State University Extension](#) recommends they only be used as protectant fungicides and should be applied before, not after, infection periods.

FRAC group 11 fungicides tend to have a strong affinity for the waxy layer on the plant surface and are less susceptible to wash-off from rain. However, they have a high risk of fungicide resistance development and a lower efficacy against mummy berry shoot strike. These products are recommended for application at or after bloom, when they also control other diseases such as phomopsis and anthracnose.

Finally, there are the true protectants such as Ziram and Bravo. FRAC codes beginning with M denote that the group has multiple modes of action and are less susceptible to fungicide-resistance problems. Protectant materials remain on the plant surface and are often tank-mixed with systemic materials. The advantage of mixing two materials with different modes of action is that it reduces the risk of fungal resistance to a specific group of fungicides and mode of action and giving a longer period of control with a protectant material on the outside of the plant.

An effective mummy berry control strategy requires that growers understand the disease and the strengths and weakness of the control products available to them. (*Source: Michigan Fruit IPM Update, May 3, 2013*)

Trapping for Fruitworm Pests as Part of Your Blueberry IPM Program

Rufus Isaacs, Michigan State University

The warm, spring weather heralds the start of blueberry [integrated pest management](#) (IPM) programs. Some of the most important early-season pest insects are cherry and cranberry fruitworms. These can cause fruit infestation that can reduce yield in severe cases and cause fruit contamination, especially in the earlier-harvested varieties. Future [Michigan State University Extension](#) articles will focus on the management of these with biological and chemical methods, but given the early phase of the season, this article will highlight use of

monitoring traps to detect these pests and help growers know when to protect their crops.

All insects, and blueberry bushes, develop based on heat accumulation, and this can be tracked with growing degree days (GDD). The table below shows the approximate growing degree days for Van Buren and Ottawa counties in Michigan for when various crop growth stages occurred, as well as key fruitworm pest events. This also shows the average growing degree days

at two different base temperatures (42 and 50 degrees Fahrenheit) when these events occurred. The information was summarized from a four-year research project in Michigan blueberries.

Approximate dates and growing degree day (GDD) timings for key activity events in the lifecycle of cherry and cranberry fruitworms in Michigan blueberries

Event	Date first seen		GDD 42	GDD 50
	Van Buren Cnty	Ottawa Cnty		
Growth stages				
Bud break	April 17	April 18	224	108
Bloom	May 14	May 15	591	310
Petal fall	May 27	May 28	768	407
First harvest	July 15	July 15	2,060	1,313
Cherry fruitworm moths				
First	May 10	May 10	511	262
Peak	May 28	May 30	804	431
End	June 12	June 16	1,180	683
Cherry fruitworm eggs				
First	June 1	June 2	872	472
Peak	June 9	June 9	1,074	612
End	June 21	June 18	1,337	797

Cranberry fruitworm moths				
First	May 24	June 1	758	412
Peak	June 16	June 17	1,267	747
End	July 17	July 11	2,018	1,285
Cranberry fruitworm eggs				
First	June 6	June 11	1,235	732
Peak	June 9	June 13	1,264	776
End	June 19	June 15	1,401	856

This information can help you time when it is appropriate to place monitoring traps for fruitworms into blueberry fields, and we recommend that traps for cherry fruitworm are placed in fields this week to be sure to get one or more zero counts before the moths emerge. This helps you identify the start of flight, and this can be used to time cherry fruitworm control treatments that should be started at 100 GDD (base 50) after the first moths are trapped. If this pest has been causing significant damage in recent years, an application of Intrepid at 8 ounces per acre timed to coincide with early egg laying is an effective way to reduce this pest. Intrepid, as well as B.t. formulations such as Dipel, Javelin, etc., can control fruitworms without any risk to bees.

Moths of cherry and cranberry fruitworm as seen trapped in monitoring traps. Note the contaminant moth pictured in the upper right that can be confused with these fruitworm pests. It is an early-active moth that is attracted to the cherry fruitworm traps, but causes no economic injury to blueberries.



Left, male cherry fruitworm moth on trap. Right, male cherry fruitworm moth on trap (top) with contaminant moth below. Moth = 8-10 mm long.



Left, male cranberry fruitworm moth with wing opened. Right, male cranberry fruitworm moth on trap. Moth = 15-18 mm long.

To determine the start and activity periods of these two pests, each species can be monitored using a specific pheromone lure placed inside a monitoring trap. Use a pheromone trap with a sticky surface and place the lure inside the trap, ideally mounted on a pin to suspend it from the inside of the trap roof. Place the traps in the top third of the bushes and at field borders next to woods for the best chance of trapping the pests. Adding traps inside fields can help tell you whether they are abundant only at the field border. Traps of the two species should be placed at least three rows apart to separate the pheromones.

Check the traps weekly at a minimum and count and record the number of the target moth species detected. We

typically keep records in a notebook, but the number and date can also be recorded on the bottom of the trap. During warm periods of the spring, more regular checking can help you get a more accurate handle on the first activity of the moths.

Lures and traps for these pests can be purchased from many suppliers, but a good local supply for these is [Great Lakes IPM](#), 10220 E. Church Road, Vestaburg, MI 48891, telephone 1-800-235-0285. (*Source: Michigan Fruit IPM Update, May 7, 2013*)

GRAPE

Critical Periods for Fungicide Applications on Grapes

Mike Ellis, The Ohio State University

There are five major grape diseases that need to be dealt with on an annual basis in the upper Midwest and eastern United States. All of them have the capability of causing serious damage to the crop and even destroying it under the right environmental condition. They are Phomopsis Cane and Leaf Spot, Black Rot, Downy Mildew, Powdery Mildew and anthracnose. These diseases need to be controlled simultaneously in the vineyard and will probably require some level of fungicide use annually in order to provide sufficient control. Another important fungal disease on tight clustered varieties is Botrytis Bunch Rot. Fungicides are a major component of the integrated disease management program. I wish it were not so, but I strongly believe that most vineyards in the Midwest and upper Midwest will not be successful unless they have an effective fungicide program and use good cultural practices for disease control.

There are many things to consider in developing an effective fungicide program. Most currently used fungicides do not have a spectrum of activity that will control all of the diseases simultaneously. Therefore tank mixes using more than one fungicide are often required. Growers need to know what diseases a fungicide will control in order to select the appropriate materials. You also need to learn when to apply the fungicide in order to get effective control. This is called fungicide timing. I cannot overemphasize the importance of early season fungicide applications for effective disease control. It is important to realize that all four major diseases (Phomopsis Cane and Leaf Spot, Black Rot, Downy Mildew and Powdery Mildew) can get established in the vineyard very early in the growing season. Therefore, early season disease control is absolutely critical. At times, less experienced growers may not see powdery mildew, downy mildew or black rot until later in the

growing season (post bloom). There is tendency to think that these are summer diseases that develop later in the growing season; however, infections by all of the pathogens can become established in the vineyard very early (pre bloom). Often when you see the disease post bloom, it may be too late to get it under control. I will discuss the environmental conditions required for infection in my presentation. Research in New York has shown that primary infections by the powdery mildew fungus can occur with .01 inch of rain at 50 Fahrenheit and downy mildew infections can occur after 4 inches of new cane growth with 0.4 inches of rain and 50 Fahrenheit. Obviously, these conditions can occur very early in the growing season. This allows the diseases to get established. You may not see them because they are there at low levels. Under the proper environmental conditions later in the growing season, these low levels of disease can blow up into full-scale epidemics before you can react to them. For this reason, it is important to maintain an effective fungicide program throughout the entire season with emphasis on early season disease control. The most destructive phase for all of these diseases is fruit infection. Research in New York has shown that the most critical period for fruit (cluster) infection by powdery mildew, downy mildew and black rot is the period from immediate pre bloom through 4 -5 weeks after bloom. At 4 to 5 weeks after bloom (probably earlier on some varieties) the fruit develops resistance (ontogenic resistance) to infection by all of these diseases.

Thus, fungicide protection for the fruits and rachises (the cluster) is absolutely critical during this period. If you go out into the vineyard post bloom and see that your clusters are covered with downy or powdery mildew, there is little or nothing you can do at that point. Under the proper environmental conditions you may have lost the entire crop. If you do a good job of controlling the diseases through the critical period, the crop is set and the fruit is now resistant to infection.

It is important to remember that the rachises (cluster stems) remain susceptible to infection through out the growing season. In addition, leaves and young cane tissues remain susceptible. Therefore, it is important to maintain a good fungicide program through out the season. The amount of fungicide protection required throughout the remainder of the season (past the critical period) will depend largely upon environmental conditions. If it is dry, less fungicide will be required and you can focus on powdery mildew control. Powdery mildew is a dry weather disease that requires high relative humidity to infect and does not require free water. If it is wet, the threat of late season downy mildew infection (which can defoliate the vine) will probably require a

more intensive fungicide program through harvest. One of the main points I want to make is that if you do not control fruit (cluster) infections during the critical period (early in the season), the late season fungicide application are not going to save you. A sad fact is that if you do lose your crop to early season cluster infections, you will probably still have to spray the vines later in the season to control the build up of powdery and downy mildew in the vineyard. In wetter growing seasons, late season downy mildew epidemics can rapidly become very severe resulting in premature defoliation of the vines. If vines are prematurely defoliated, they will not harden off (become winter hardy) as they normally would and serious winter injury can occur leading to long term damage to the vine. This probably applies to the more winter hardy varieties as well.

Growers need to develop a fungicide program that controls all of the major diseases during three main periods of the growing season: **the pre bloom period** (1 to 3 inch shoot growth through immediate pre bloom), **immediate pre bloom through 4 to 5 weeks after bloom** (the most critical period for fruit infection) and **the late season period** (4 to 5 weeks after bloom through harvest). I have a handout titled "developing an effective fungicide program for Wine grapes in Ohio" that summarizes my fungicide recommendations.

As mentioned previously, selection of the proper fungicides for use during these periods is extremely important. Most currently used fungicides do not have a spectrum of activity that will control all of the diseases simultaneously. Therefore, tank mixes using more than one fungicide are often needed. It is important to know what diseases a fungicide will control in order to select the appropriate materials. Recently, I was in a 7-acre 'Chardonnay' vineyard that had 100% cluster infection from powdery mildew. The fruit were a total loss. In reviewing the growers spray program, applications were made at appropriate times, yet disease destroyed the fruit. The reason for the control failure was that the grower was using only Mancozeb fungicide in the tank through all of the early season sprays. Mancozeb provides excellent control of Phomopsis, downy mildew and black rot, but provides no control of powdery mildew. Thus powdery mildew came in and wiped out the crop. Had the grower tank mixed Mancozeb with a fungicide that would control powdery mildew (such as sulfur or several other materials) the crop would probably have been saved. I also have a handout describing the currently available fungicides for grape disease control. (*Source: Ohio VegNet, Vol. 21 No. 10, May 15, 2014*)

Bud Swell is Time to Monitor Vineyards for Cutworms and Flea Beetle

Rufus Isaacs, Michigan State University

With warm weather returning to the region, the early growth of vines will start and we will move into the budswell growth stage. This is a time when growers should monitor for cutworms and flea beetles, two early season pests that can feed on buds and limit crop yield. It is interesting to note that in 2012 I was writing a similar article at the end of March, having seen the first grape flea beetle (steely beetle) on March 19th. This is a different spring, but the later vine growth is expected to line up with later insect development so that we should still expect these pests during bud swell. There are good rules of thumb for deciding whether damage from these insects warrants control, and information on scouting and other management components is provided below.

Cutworms



<http://www.grapes.msu.edu/cutwm.htm>

The term cutworm covers many species in the moth family Noctuidae, and as their name suggests, these insects are nocturnal. Vineyards on light-textured soils are often the most heavily infested. Both the adults and the larvae are only active at night, and the larvae can climb up onto vines during very cool night-time conditions. During the day, cutworms hide in the soil or leaf litter, and can be found in the top layer of soil. Many of these insects feed on weeds, but some climb the stems of plants to feed on buds and other young foliage. These climbing cutworms are the ones causing damage to grapevines. Direct observation of feeding by the larvae requires a late-night trip to the vineyard, but their damage is quite easy to see. In Michigan vineyards, the spotted cutworm, *Amathes c-nigrum*, is our main pest species, and the larvae feed on buds and may also feed on leaves until the shoots are 10

to 15 cm long. However, it is the feeding on small buds that has the greatest potential for economic damage.

Cutworm feeding on a bud can reduce the crop by 1-2 clusters so the high potential for rapid damage by cutworms requires that growers make good management decisions. Even 2% percent bud injury is an action threshold for an insecticide treatment to prevent further damage, so vineyards should be scouted during the period of bud swell to identify regions with cutworm pressure (see below).

Flea beetle (Steely beetle)



Flea beetle on Concord. Photo: Diane Brown.

<http://grapes.msu.edu/fleabeetle.htm>

This insect attacks buds of both wild and cultivated grape, and is another early season grape pest. The adult insects move to the vines at bud swell, and usually are localized within the vineyard. Sites near overwintering habitats such as woods or abandoned vineyards are especially at risk. Beetles are most easily seen during warm sunny weather when they tend to be on the top of vines, usually mating or feeding on canes and buds.

Adults are shiny blue, about 4-5 mm long, and have strong hind legs that enable them to jump if disturbed (hence the name). The overwintering adults cause the greatest damage by boring into the developing bud and hollowing out the inside, while the larvae and summer adults feed on leaf tissues. Bud feeding is similar to that caused by cutworms, with similar effects to the vine (see above cutworm description).

Wherever possible, cleaning up overwintering sites (wasteland and woodland) near to vineyards can help combat grape flea beetle.

Scouting for bud damage. Growers should watch for damage by cutworms and flea beetle, especially if the vines remain in the susceptible bud swell stage for a while with cooler weather. Cutworms tend to be more of a problem in sandy sites, so these should be prioritized for scouting. Both cutworms and steely beetle can cause damage quickly if the temperatures warm up, and since they are difficult to catch “in the act,” regular scouting for

the first signs of damage is essential to prevent significant bud loss.

An action threshold of 2% damaged buds is recommended in juice grapes, and this can be determined by sampling 10 buds on each of 10 vines spread through the vineyard. Thresholds in winegrapes may be lower due to the higher value of the crop, but there has been little formal research on this topic. Still, it is clear that the potential damage justifies scouting and management if cutworm damage is detected. As mentioned above, once the shoots get past bud burst and into the 1-3 inch range the danger from flea beetles and cutworms is diminished significantly.

Cultural control. Vineyards that are weedy tend to have more cutworm problems, presumably because the larvae have more places to hide and conditions are better for them. Weedy vineyards also provide more places for the cutworms to hide from sprays applied for their control, so improving weed control is one component of an IPM program to reduce cutworm damage.

Leaving some extra buds is a potential strategy for hedging your risk against cutworm (and frost) injury. Scouting is still required though to make sure the damage doesn't exceed the number of extra buds left behind.

Chemical control. An appropriate insecticide application should be considered if scouting shows significant damage is occurring, and assessments of damage should include wooded borders where flea beetle pressure may be higher, and areas where cutworms have been a recurring problem.

Lorsban Advanced is labeled for cutworm at 1 quart per acre, in at least 50 gallons of water per acre. Delegate is a reduced risk option registered for cutworm control (3-5 oz/acre). There are also a number of pyrethroid insecticides registered for use against cutworms including Mustang Max (2-4oz/ acre), Danitol (10.6oz/acre), and Brigade (3.2-6.4oz/ acre) that provide excellent control of cutworms and flea beetle. Sevin is also registered for use against flea beetles and has performed very well in observations of treated vineyards at 2 qts/acre.

Recent research in Washington State vineyards has shown excellent protection against cutworms using only trunk sprays of a pyrethroid. This approach targets the spray to the trunk surface, and larvae have to climb up through the residue to reach the buds. This significantly reduces the cost of application, but it is important to realize that this will not protect the upper canopy from flea beetle feeding. (*Source: Michigan Grape & Wine, May 7, 2013*)

GENERAL INFORMATION

Hops Downy Mildew Management in Ohio

Sally Miller and Fulya Baysal-Gurel, The Ohio State University

Symptoms and signs of the hops downy mildew typically observed in spring include shortened internodes on spikes and black sporulation on the lower surface of the leaves (see photos).

Early spring pruning is essential to reduce primary inoculum of the downy mildew pathogen, and pruned leaves and shoots must be destroyed to prevent survival and movement of spores. Later on, lower leaves should be removed to promote airflow. Several fungicides are effective against downy mildew. Be sure to note label restrictions on application intervals, maximum number of applications per season, and pre-harvest intervals, which may range from 7-45 days after application (see table).

Growers interested in confirming hops downy mildew can submit a sample to the Vegetable Pathology Lab at The Ohio State University (http://www.oardc.ohio-state.edu/sallymiller/t08_pageview3/Diagnostics_Services.htm) [Or the UMass Plant Diagnostic Clinic at <http://ag.umass.edu/diagnostics>]

Product group	FRAC Code	Pre-harvest Interval	Notes
Copper octanoate, copper sulfate, copper hydroxide and cuprous oxide	M1	0 days	Over-application may result in copper accumulation in the soil, contamination of runoff water, and toxicity to non-target organisms.
Folpet	M4	14 days	Maximum four applications per season at 28-day intervals
Metalaxyl	4	45 days	Apply as a drench to the crowns after pruning but before training (when shoots are <6 inches). Foliar applications should be in combination with a copper fungicide registered for hops.
Phosphorus acid mono- and di-potassium salts	33	0 days	Apply on 2-3 week intervals.
Cymoxanil	27	7 days	Maximum four applications per season.
Dimethomorph	40		Maximum three applications per season; 10 day-intervals.
Mandipropamid	40	7 days	Addition of a spreading/ penetrating adjuvant such as a non-ionic surfactant or blend is recommended. Do not apply more than 24 fl oz. of product/A/season.
Ametoctradin plus Dimethomorph (Zampro)	45+40	7 days	Addition of a spreading/penetrating adjuvant is recommended. Maximum three applications per season; not more than two sequential applications before alternating with a labeled fungicide with a different mode of action.
Pyraclostrobin + boscalid (Pristine)	11+7	14 days	Suppression of downy mildew. Apply on 10-21 day intervals. Maximum three applications per season; not more than two sequential applications before alternating with a labeled fungicide with a different mode of action.
Biorational products: Actinovate, Sonata, Regalia, Armicarb	-	0 days	OMRI approval status is available at http://attra.ncat.org/attra-pub/biorationals/ .

(*Source: The Ohio VegNet, Vol. 21, No. 9. May 8 2014*)

UPCOMING MEETINGS:

May 21, 2014 - *UMass Extension Fruit Team Twilight Meeting*, 5:00 – 8:00, Alyson's Orchard, 57 Alyson's Lane, Walpole, NH. In cooperation with U. of New Hampshire Extension. 2 pesticide credits will be offered. Refreshments/snack will be served. Contact: George Hamilton, 603-641-6060 For more information go to: <https://extension.umass.edu/fruitadvisor/events/fruit-twilight-meeting-5>.

May 22, 2014 – *UNH Drip Irrigation Meeting*, 4:30 – 8:00. Broodkale Fruit Farm, 36 Broad St. Hollis, NH. 2 Pesticide Recertification Credits. For more information contact George Hamilton at George.Hamilton@unh.edu or go to http://extension.unh.edu/events/index.cfm?e=app.event&event_id=37173.

May 29, 2014 – *Weed Walkabout*, 5:00 – 7:00. Elm Bank Reservation, 900 Washington St., Wellesley MA. Correct weed identification is an important first step in the development of an effective weed management program. Join Randy Prostack, Extension Weed Specialist, for a walk through the landscape for an up-close look at weed problems of woody ornamental plantings. This workshop is held rain or shine. Preregistration required as space is limited; the cost is \$50 or \$45 per person for three or more registrations from the same company (10% discount). For more information see: <http://ag.umass.edu/events/weed-walkabout>.

June 7, 2014 – *Massachusetts Cultivated Blueberry Growers' Summer Meeting*. 12:00 – 3:00. Turkey Hill Farm, 380 Middle Rd., Haverhill, MA 01830. This meeting will feature Dr. Alan Eaton from the University of New Hampshire who will provide the most updated information on the identification and management of the new invasive fruit fly pest, Spotted Wing Drosophila. Cost: Free to members; others \$10 payable at the meeting. For more information contact Pat Concree at theblueberryfarm@comcast.net. 1 pesticide credit is approved for this meeting.

June 10, 2014 – *CT Pomological Society Fruit Twilight Meeting*. 5:30-8:30pm Belltown Hill Orchards, 483 Matson Hill Rd., South Glastonbury CT. Don and Mike Preli, growers of table grapes, blueberries, stone fruits and apples, will provide a tour of the farm. In addition there will be a pest, disease & thinning update, CT Pomological Society update and dinner. A great evening visiting with old and new friends. For more information contact Mary Conklin at mary.concklin@uconn.edu.

June 10, 2014 – *Broadleaf Weed Identification Workshop*. University of Massachusetts French Hall, 230 Stockbridge Rd., Amherst MA. 9:00 – 3:00 Correct weed identification is an important first step in the development of an effective weed management program. Using a classroom presentation, potted weed herbarium and weed walk, UMass Extension Specialist Randy Prostack will help participants enhance their broadleaf weed identification skills. Feel free to bring a weed or two to identify. Workshop held rain or shine (lunch not provided). Grassy Weed Identification will be offered next in 2015. Registration: Cost \$95 per person (pre-registration is required). 5 pesticide contact hours for categories 36, 37 and Applicators License available; valid for equivalent categories in all New England states For more information and to register, go to: <https://extension.umass.edu/vegetable/events/broadleaf-weed-identification-workshop>.

June 10, 2014 – *UMass Extension Fruit Team Spotted Wing Drosophila Management Update Meeting*. 5:00 – 7:30. Nourse Farms, 41 River Rd. Whately, MA. For more information on this meeting contact Sonia Schloemann at sgs@umext.umass.edu.

July 12, 2014 – *Essex County Fruit Growers' Meeting*. 5:30 – 8:00. Russell Orchards, 143 Argilla Rd., Ipswich MA 01938. This meeting will feature discussion of how to manage Spotted Wing Drosophila in susceptible crops this year. For more information contact Pat Kriksceonaitis at kfamily13@verizon.net. 1 Pesticide Credit is approved for this meeting.

July 9, 2014 – *Annual Summer Meeting of the Massachusetts Fruit Growers' Association*. 10am – 3pm, UMass Cold Spring Orchard, 391 Sabin St., Belchertown MA. Details will be available soon at <http://extension.umass.edu/fruitadvisor/>.

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