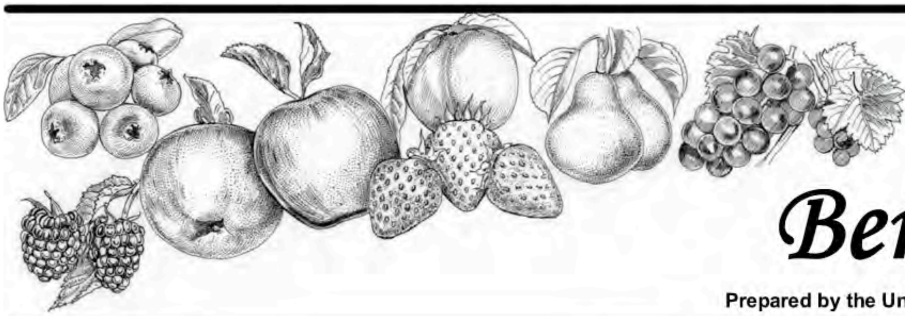

UMassAmherst EXTENSION

Berry Notes

Prepared by the University of Massachusetts Fruit Team

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www.umass.edu/fruitadvisor/berrynotes/index.html

Massachusetts Berry Notes Underwriters:

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IN THIS ISSUE:

Current Conditions:

Strawberries are showing new leaves. New fields are being planted. In established fields, growers are applying row covers and setting up irrigation for frost protection. Preemergent herbicide applications can be made now. See New England Small Fruit Pest Management Guide for materials and rates. **Raspberries** are also beginning to show new growth. Delayed dormant applications of lime sulfur should only be made before bud are ½" long. Most locations were pushed past this quickly with the warm weather last week. Preemergent herbicide applications can be made now. See New England Small Fruit Pest Management Guide for materials and rates. **Blueberry** fruit buds are swelling and leaf buds are beginning to show green tissue. Some locations have flower buds expanding. This means that mummy berry shoot strike infection can occur. Recent dry weather delayed mushroom development but recent rains have reactivated development. The winter moth caterpillars may be active now. They are eyelash size and feeding in the expanding buds of hardwood trees, ornamentals and blueberries. **Grapes** are at budburst to early shoot growth at inland locations. Coastal vineyards are somewhat behind. Some growers have applied dormant sulfur and copper sprays to reduce overwintering phomopsis. Follow-up sprays will soon be needed. Also, scout vineyards for fleabeetle feeding on buds. See New England Small Fruit Pest Management Guide for more information.

Frost/Freeze Damage: See Michigan State University's Critical Spring Temperatures for Tree Fruit and Small Fruit Bud Stages chart at **http://web1.msue.msu.edu/vanburen/crtmptxt.htm** for reference temps for potential frost damage to several fruit crops.

2008 New England Small Fruit Pest Management Guide now available – This guide has been extensively updated and is now available for purchase for $12 plus $4 shipping and handling. Orders (including credit card purchases) can be placed via the UMass Fruit Team website at www.umass.edu/fruitadvisor.

ENVIRONMENTAL DATA

The following growing-degree-day (GDD) and precipitation data was collected for a one-week period, April 16, 2008 through April 22, 2008. Soil temperature and phenological indicators were observed on April 22, 2008. Accumulated GDDs represent the heating units above a 50° F baseline temperature collected via our instruments from the beginning of the current 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	2007 GROWING DEGREE DAYS		Soil Temp (°F at 4" depth)	Precipitation (1-Week Gain)
	1-Week Gain	*Total accumulation for 2008*		
Cape Cod	23	52	55˚F	0.00"
Southeast	29	70	67˚F	0.00"
East	34	67	45˚F	0.00"
Metro West (Waltham)	n/a	32	51˚F	0.02"
Metro West (Hopkinton)	25	45	55˚F	0.00"
Central	27	37	46˚F	0.00"
Pioneer Valley	66	89	48˚F	0.00"
Berkshires	52	72	53˚F	0.00”
AVERAGE	37	58	53˚F	0.00"

n/a = information not available

(***Source***: *UMass Extension 2007 Landscape Message #8, April 24, 2008*)

STRAWBERRY

Frost Protection in Strawberries

*Marvin Pri*tts *Cornell* University

Strawberry growers can ensure a full crop of berries only if they exert some influence on temperature during the year. Temperature control is especially important during the winter and early spring when flowers are susceptible to frost. Excessive summer temperatures inhibit growth as well.

Of all the factors that negatively affect strawberry production, frost can be the most serious. Frost can eliminate an entire crop almost instantaneously. Strawberries often bloom before the last frost free date, and if a frost occurs during or just prior to bloom, significant losses can result. The strawberry flower opens toward the sky, and this configuration makes the flower particularly susceptible to frost damage from radiational cooling. A black (rather than yellow) flower center indicates that frost damage has occurred.

Strawberry growers occasionally delay the removal of straw mulch in spring to delay bloom and avoid frost. Research has demonstrated, however, that this practice also results in reduced yields. Also, applying straw between the rows just prior to bloom will insulate the soil from the air. This will increase the incidence of frost injury as solar radiation will not be absorbed by the soil and re-radiated at night. If additional straw is to be applied between the rows in spring, delay its application for as long as possible before fruit set.

Overhead irrigation is frequently used for frost control because flowers must be kept wet during a freeze in order to provide protection. As long as liquid water is present on the flower, the temperature of the ice will remain at 32F because the transition from liquid to ice releases heat. Strawberry flowers are not injured until their temperature falls below 28F. This 4 degree margin allows the strawberry grower to completely cover a field with ice and yet receive no injury from frost. However, if insufficient water is applied to a field during a freeze event, more injury can occur than if no water was applied.

Several principles are responsible for the ability of ice to protect strawberry flowers from injury. First, although pure water freezes at 32F, the liquid in the strawberry plant is really a solution of sugar and salt. This depresses the freezing point to below 32F. Also, ice crystals need nucleators to allow them to form initially. Certain bacteria serve as nucleators. Sometimes, in strawberry flowers, the bacteria that allow ice to form are absent, allowing the freezing point to be lowered.

The temperature of the applied water is usually greater than the temperature of the plants, so this serves to warm the flowers before heat is lost to the air. As long as liquid water is continually applied to the plants, the temperature under the ice will not fall below 32F. When one gallon of water freezes into ice, 1172 BTUs of heat are released.

Several factors affect the amount of water that is required to provide for frost protection, and the timing of application. At a minimum, apply water at 0.1 - 0.15 in/hr with a fast rotating head (1 cycle/min.) Water must be applied continuously to be effective. A water source of 45 - 60 gal/min-acre is required to provide this amount of water. Choose nozzle sizes to deliver the amount of water required to provide protection under typical spring conditions in your location.

Under windy conditions, heat is lost from the water at a faster rate, so more water is required to provide frost protection. For every gallon of water that evaporates, 7760 BTUs are lost. The application rate then depends on both air temperature and wind speed (Table 1). Under windy conditions, there is less chance of flower temperatures falling below that of the air because of the mixing of air that occurs at the boundary of the flower. Winds are beneficial if the temperature stays above the critical freezing point, but detrimental if the temperature approaches the critical point. Less evaporation (and cooling) will occur on a still, humid night.

Under extremely windy conditions, it may be best not to irrigate because the heat lost to evaporation can be greater than the heat released from freezing.

Table 1. Water application rate (in/hr) for a given humidity and wind speed*

Wind Speed					
Temp (F)	0-1	2-4	5-8	10-14	18-22
Relative humidity of 50%					
27	0.10	0.20	0.30	0.40	0.45
24	0.10	0.30	0.35	0.45	0.60
20	0.15	0.35	0.45	0.60	0.75
18	0.20	0.40	0.50	0.65	0.80
Relative humidity of 75%					
27	0.05	0.10	0.20	0.25	0.25
24	0.10	0.20	0.30	0.35	0.40
20	0.10	0.25	0.40	0.45	0.60
18	0.15	0.30	0.45	0.55	0.70

**FROSTPRO model from North Carolina State Univ.*

Stage of development. Strawberry flowers are most sensitive to frost injury immediately before and during opening. At this stage, temperatures lower than 28F likely will injure them. However, when strawberry flowers are in tight clusters as when emerging from the crown, they will tolerate temperatures as low as 22F. Likewise, once the fruit begins to develop, temperatures lower than 26F may be tolerated for short periods.

The length of time that plants are exposed to cold temperatures prior to frost also influences injury. Plants exposed to a period of cold temperatures before a frost are more tolerant than those exposed to warm weather. A freeze event following a period of warm weather is most detrimental.

Flower temperature. The temperature of all flowers in a field is not the same. Flowers under leaves may not be as cold as others, and those near the soil generally will be warmer than those higher on the plant. On a clear night, the temperature of a strawberry flower can be lower than the surrounding air. Radiational cooling allows heat to be lost from leaves and flowers faster than it accumulates through conduction from the surrounding air.

Soil also retains heat during the day and releases heat at night. It is possible that on a calm, cloudy night, the air temperature can be below freezing yet the flowers can be warm. Wet, dark soil has better heat retaining properties than dry, light-colored soil.

Rules of thumb

- ❖ Store sufficient water for 2 or 3 consecutive nights of frost protection
- ❖ Use small diameter nozzles (1/16 - 3/16 in. diameter)
- ❖ A 30 X 30 ft. staggered spacing of nozzles is preferable
- ❖ Use metal sprinklers to minimize icing
- ❖ Minimum rotation of once per minute

Using row covers. Row covers modify the influence of wind, evaporative cooling, radiational cooling, and convection.

Because wind velocity is less under a row cover, less heat will be removed from the soil and less evaporative cooling will occur. Also, relative humidity will be higher under a row cover, reducing heat loss from evaporation. In addition, convective and radiational heat loss is reduced because of the physical barrier provided by the cover. Plant temperature under a cover may eventually equal that of the air, but this equilibration takes longer than with uncovered plants. In other words, row covers do not provide you with additional degrees of protection, but they do buy time on a cold night as flower temperatures will fall less rapidly inside a cover. Often the temperatures fall so slowly under a row cover that irrigation is not needed. If irrigation is required, less water is needed to provide the same degree of frost protection under a row cover.

Water can be applied directly over the row covers to protect the flowers inside.

Turning on the water. Since cold air falls to the lowest spot in the field, a thermometer should be located here. Place it in the aisle at the level of the flowers, exposed to the sky, and away from plants. Air temperature measured at this level can be quite different from the temperature recorded on a thermometer at the back of the house. The dewpoint temperature measured in the evening is often a good indication of how low the temperature will drop on a clear night, and is related to the relative humidity. Air temperature will fall less if the humidity is high. If the air is very dry (a low dewpoint), evaporative cooling will occur when water is first applied to the plants, so irrigation must be started at a relatively warm temperature.

Most local weathermen can provide the current dewpoint, or it can be obtained from World Wide Web-based weather information services (see article below).

If the air temperature falls below 34F on a clear, calm night, especially before 3 A.M., it would be wise to start irrigating since flower temperatures could be several degrees colder. On the other hand, if conditions are cloudy, it may not be necessary to start irrigation until the temperature approaches 31F. If conditions are windy or the air is dry, and irrigation is not turned on until the temperature approaches 31F, then damage can occur due to a drop in temperature when the water first contacts the blossom and evaporation occurs. Therefore, the range in air temperatures, which indicates the need for irrigation at flowering is normally between 31 and 34F, depending on cloud cover, wind speed and humidity, but can be as high as 40F. Admittedly, these numbers are conservative. Flowers can tolerate colder temperatures for short periods of time, and irrigation may not be needed if the sun is about to rise. Obviously, one does not want to irrigate too soon since pumping is expensive, and excess water in the field can cause disease problems.

Table 2. Starting temperature for frost protection based on dewpoint.

Dewpoint	Suggested starting air temperature (F)
30	32
29	33
27	34
25	35
24	37
22	38
20	39
17	40

Turning off the water. Once irrigation begins, it should not be shut off until the sun comes out in the morning and the ice begins to slough off the plants, or until the ice begins to melt without the applied water.

Waterless frost protection agents. Future solutions to frost protection could lie in waterless methods, such as genetically engineered bacteria that do not promote the formation of ice. However, to date, these materials have not been consistently effective, so they are not recommended as the sole basis for frost protection. (***Source****: New York Berry News, Vol. 5, No. 2, March 31, 2006*)

Frost Protection: Tips and Techniques

Kathy Demchak, Penn State University

Damage from freezes and frost is of concern from bud break in the spring through flowering and fruit set. The blossoms are tender and are the plant part most commonly damaged by low temperatures. Since loss of the blossoms means a loss of fruit for the year, frost protection is of great concern.

Critical Temperatures for Frost Damage

Damage occurs when water in the plants' cells freezes, thus causing the cells or cell parts to rupture. The temperature at which this occurs depends on the water content and concentration of water vs. solutes in the plant tissue. Therefore, the temperature at which damage occurs varies with the crop and growth stage. Table 1 lists commonly-accepted critical temperatures for strawberry and blueberry blossoms at different stages of bud development. These values are not absolute, and within reason, it is better to err on the side of safety when protecting crops from frost damage.

Types of Frosts and Freezes

Radiant frosts and freezes occur on calm, clear nights with no cloud cover. Heat is lost from the soil and plants, and radiates back to the sky. *Advective freezes*, sometimes called windborne freezes, are caused when a cold air mass moves into the region accompanied by with a lot of wind. It is difficult to protect against this type of freeze.

Environmental Factors Affecting Frost Occurrence and Protection

Air temperature is the measurement used for initiating or stopping frost control practices, and can be taken with either a dry-bulb or wet-bulb thermometer. *Dry-bulb temperatures* are the type commonly referenced in literature and in weather forecasts. *Wet-bulb temperatures* are obtained from a thermometer that is covered with a wet wick. Air is moved over the bulb causing evaporative cooling to occur. The wet-bulb temperature is useful because it essentially is what the plant temperature will be once the irrigation is started and evaporative cooling has taken place.

Table 1. Critical temperatures (degrees F) for cold damage of flower buds based on stage of development. Note with blueberries, there is considerable variability in temperatures at which damage was reported for these growth stages.

Strawberries	Critical temp.	Blueberries	Critical temp.
Bud emergence	10˚F	Bud swell	15-20˚F
Tight bud	22 ˚F	Tight cluster	18-23˚F
"Popcorn"	26 ˚F	Separate flowers visible	22-25˚F
Open blossom	30 ˚F	Late closed blossom	25-26˚F
Green fruit	28 ˚F	Open blossom	27˚F
		Petal fall	28˚F

Sources: Strawberry Critical Temperatures - K. Perry and B.C. Poling, North Carolina State Univ.; and Richard Funt, Ohio State Univ.; Blueberry Critical Temperatures - Fruit Crop Advisory Team Alert, Vol. 18, No. 3. "Protecting

Wind speeds of more than a few miles per hour can make frost protection difficult, especially in an advective freeze. Light breezes, however, tend to mix the air and can increase temperatures at ground level in the case of radiational frosts. Temperatures tend to be more uniform even across a distance of miles when windy conditions exist.

The *dew point* is the temperature at which the relative humidity reaches 100% as the air cools. At this point, water vapor in the air condenses into fog or dew, which gives off heat, slowing the temperature drop. The risk of having a frost becomes greater as the dew point becomes lower. If the dew point is below freezing, so that condensation and heat release does not take place until below freezing, temperatures can drop to damaging levels extremely rapidly. In this case, the white crystals typically seen in a frost or freeze may not form, a condition sometimes referred to as a "black frost".

Relative humidity is the amount of moisture contained in the air relative to the maximum amount that could be held. It changes with temperature and can change quickly with the air mass.

Site-Specific Effects on Frosts/Freeze Occurrence

Site selection is the most important step for frost or freeze protection of a small fruit crop. The best site is one downwind from or closely surrounded by a large body of water. Topography also affects frost occurrence. Cold air is heavier than warm air, and therefore flows downhill. Temperatures are often higher at the tops of slopes, while cold air which collects in the lower areas (frost pockets) is often 4° to 5°F lower. Southern slopes are generally warmer than those facing north, but plants on Southern slopes will also come out of dormancy earlier, possibly negating this benefit in many instances.

Soil moisture has an effect. Moist soil holds more heat and radiates heat back to the environment for a longer time than dry soil. If the soil is dry, plantings should be irrigated a day or two ahead of an expected cold snap to allow time for heat to be captured.

Soil texture and compaction are also factors, as heavier soils with more clay retain heat better than sandy soils. Sandy soils are also often lighter in color and hence tend to reflect more sunlight, rather than absorbing it in the form of heat.

Ground cover affects the amount of heat absorbed by and released from the soil. A bare, undisturbed moist soil with no ground cover can release enough heat to raise the temperature 2 to 3 degrees in the plant canopy as compared to a sod-, grass-, or straw mulch-covered soil.

Methods for Protecting Plants from Frosts and Freezes

Floating row covers are useful especially for small acreages of low-growing crops or when water for overhead irrigation is not available. The amount of frost protection obtained varies with the weight and fiber arrangement of the row cover. Usually the amount of protection increases with the weight, though differences in texture make this correlation less than perfect. Row covers weighing 0.6 ounces per square yard typically can give 2° or 3°F protection during a radiational frost, while nursery foam covers or a double layer of row covers can give more than 10°F of protection. Weather conditions prior to the frost affect the amount of protection obtained from row covers, since little or no heat may accumulate under the row cover on cloudy windy days. When row covers are used for frost protection, they should be pulled over the crop during mid-afternoon to allow heating to take place. Row covers can also be used in conjunction with sprinkler irrigation on top of the row cover. Row covers used in this way typically cut the amount of overhead irrigation needed for frost protection by about 50% on average.

Heating or burning is an old method of frost protection, but is not practical for low-growing small fruit crops like strawberries, and is infrequently used. However, if fires or heaters are used, several small ones are better than one large one.

Wind machines work if a temperature inversion occurs (warm air present above a cold layer) and if there is no wind as with radiant-type freezes. They mix the air by pulling down the warm air from above to replace the colder air trapped near the soil surface. They only provide a few degrees of protection, and therefore are sufficient protection primarily for crops that bloom relatively late when frosts are usually less severe.

Sprinkler irrigation works well on all small fruit crops, but needs to be used carefully. Because sprinkler irrigation use can result in the application of large volumes of water to the crop, use should be delayed until greater than 10% of the blossoms are in danger of being damaged. This does not necessarily mean that 10% of the blossoms are open. Sprinkler irrigation for frost protection works because water gives off heat when it changes from a liquid to a solid (i.e., freezes). Frost protection using irrigation works only if the system is fully functional prior to the frost event, so test it to ensure it works.

A common recommendation is to start the system when the temperature at plant level falls to 4°F above the critical temperature (for example, 34°F for open strawberry blossoms). If the dew point is below freezing, irrigation must be started at a higher temperature. Under conditions with wind or low humidity, damage can occur when the air temperature is several degrees above the freezing point because of evaporative cooling. Because of this, the wet bulb temperature is often a better indication of when the irrigation system should be used rather than dry bulb (standard) temperature. Irrigation should be operating by the time the wet bulb temperature equals the critical temperature.

Most overhead sprinkler systems are designed to deliver 0.1 to 0.2 acre-inches of water per hour and are useful for radiant freeze or frost protection when wind speeds are light and temperatures are not below the mid-twenties. Microsprinklers provide more uniform distribution than those having larger droplets and/or those covering a larger area. However, the rate at which water freezes depends on several environmental factors, including air temperature, humidity, and wind speed. When breezy conditions (5 mph) are forecast overnight, water supply lines should be moved closer together. At 5- 10 mph, protection will be spotty. When wind speeds exceed 10 mph, the risks for crop damage from evaporative cooling may outweigh the potential benefits.

Overhead irrigation pipes and sprinklers can be set up on row covers, and irrigation started after the temperature under the row covers drops near the critical temperature. This is the safest way to protect crops in the case of advective freezes, and greatly reduces the amount of water used regardless of the type of frost event. Because of the necessity of and time required for removing and re-applying the row covers (they can just be gathered into the row middles in which the irrigation pipes are located), this method is best suited for small acreage plantings. Be sure to uncover the plants as early in the day as possible so that drying of the foliage and pollination can take place.

Taking Temperature Measurements: Accurately Depicting Crop Conditions

Temperature sensors must be calibrated to be sure the temperature you are reading is correct. Calibrate them by immersing the sensor in a water and crushed ice slurry, gently stirred, which will be at 32°F. Note that with liquid-in-glass min-max thermometers, the top of the thermometer needs to be immersed. Adjust subsequent readings accordingly.

With low-growing plants such as strawberries, the coldest temperature in a field is often near the surface where the strawberry plants grow. Readings should be made at the plant canopy level. In blueberry plantings, several measurements should be taken at different places in the field at the various heights of the plant canopy.

Liquid-in-glass thermometers, usually relatively inexpensive in price, can vary in their readings. However, they usually vary less than dial thermometers, and are a good value. *Thermocouple thermometers* are generally capable of measuring a wide range of temperatures, and have a very good percentage accuracy, such as being within plus or minus 0.05% of the temperatures in their ranges. Because the range can be huge, the accuracy may still only be one or two degrees. The thermocouple probes themselves are quite cheap, but the device to which they connect that produces the readable output can be pricey. *Thermistor thermometers* are probably the best option for accuracy, as they are designed to read a relatively narrow temperature range, and have a good percentage accuracy. There are models that will be accurate to within plus or minus 0.5 degrees F with prices in the moderate range. Calibration is still recommended.

Digital readouts give the impression that, because the reading can be noted to the closest tenth or hundredth of a degree, the device must be accurate. This is not necessarily the case. The reading may be very exact, but also very wrong. Accuracy is how correct the device is. For example, a certain digital thermometer may be advertised as having a resolution of 0.1 degrees, but an accuracy of + or - 2 degrees. Accuracy is the important figure. Sometimes you'll see a notation that a thermometer is accurate to a certain percentage within its range. As an example, if the device is listed as being accurate to within 0.5% in its range, and its range is -60° to 140°F, it would be accurate to within 0.5% of this 200 degree range, or, to within plus or minus 1 degree of any temperature read between -60° and 140°F. This does not mean that it is accurate to within 0.5% of any given temperature.

Electronic devices and plug-in probes offer some useful advantages over standard thermometers. For example, if a probe is positioned under a row cover with connecting wires outside of the row cover, the temperature under the row cover can be measured easily. Also, even once irrigation is turned on, the temperature in the field can be monitored. Note that with some electronic devices, the number display is not meant to withstand temperatures below freezing, so the display could "black out" when you need it the most! So, use the display portion in the field only when obtaining the reading.

Frost alarms and alerts are especially valuable if your field is further than walking distance away from where you live. Once the temperature drops to a certain point, the alarm either sounds a buzzer, calls you on the phone, or flashes a light, depending on the model. If you get a model that calls you, it will likely need to be located where there is access to a phone line. A recent addition to frost protection gadgetry is a device that flashes a light that is color-coded to the temperature. This means that it is possible to track the temperature in your field from indoors, or monitor fields in several locations at one time. *(Reprinted from: The Penn State Vegetable and Small Fruit Gazette, Vol. 11 N0. 4, April 2007.)*

RASPBERRY

Bramble Disease Control

Janna Beckerman, Purdue University

Raspberries are beginning to show new growth. Delayed dormant applications of lime sulfur should only be made before buds are 1/2” long for control of many bramble diseases, including cane blight, spur blight and anthracnose. Unless cane blight, anthracnose or spur blight have been problems, fungicide applications prior to bloom are usually not required. This is especially true if the delayed dormant application of limesulfur has been made. Unfortunately, if you didn’t make an application of lime sulfur, pruning out disease tissue is one of the only options available until 6-12” of growth, or bloom. At bloom, the captan/fenhexamid mixture (Captevate 68WDG) is labeled for control of anthracnose and spur blight on raspberries. Only 2 sequential applications of this product may be used before switching to a different group of fungicide chemistry. The strobilurins, which include azoxystrobin (Abound), pyraclostrobin (Cabrio EG and a pyraclostrobin/boscalid mixture (Pristine WG) should be used at disease onset. Pay careful attention to label restrictions for these products. Like Captevate, no more than 2 sequential applications of these products may be made before switching to an alternate chemistry.

A word to the wise on fungicide resistance development; Elevate, Rovral, Switch, and Pristine should not be used alone for seasonlong control of Botrytis fruit rot due to the high risk of fungicide resistance developing to each fungicide. The addition (tank mix) of Captan to Elevate (or the pre-mix CaptEvate), Rovral, Switch, or Pristine should provide a higher level of disease control and aid in preventing fungicide resistance development. Rotating the use of these fungicides in one-two-spray blocks is a good resistance management strategy. Keep in mind that because brambles are a relatively small market share for fungicide companies, fewer fungicides are available for use. For this reason, it is imperative to maximize the efficacy and to carefully rotate and/or tank mix fungicides to minimize the risk fungicide resistance development. (***Source**: Facts for Fancy Fruit, Vol. 8, No. 3, April 2008*)

BLUEBERRY

New Herbicides Registered for Blueberries

Bernard Zandstra and Eric Hanson, Michigan State University

Supplemental labels have been issued for Callisto (mesotrione, Syngenta Crop Protection) and Chateau (flumioxazin, Valent Biosciences) for use on blueberry. The supplemental labels are part of the Section 3 federal labels and do not have expiration dates.

Callisto provides preemergent and postemergent control of several broadleaf weeds that are troublesome in blueberries, including several pigweed species, chickweeds, horsenettle, lambsquarters, marestail, eastern black nightshade, ragweed, and smartweed. Callisto has limited effect on grasses. Callisto is absorbed by weeds through the roots and leaves. Apply Callisto before bloom at up to 6 fl. oz. per acre. This amount may be split into two 3 oz. applications at least 14 days apart. Apply as a directed spray to soil beneath the bushes. The addition of crop oil concentrate (COC) will improve postemergent activity, but combinations with postemergent herbicides such as Gramoxone or Rely are suggested for very weedy areas. Callisto with COC may injure blueberry leaves and young stems. Callisto can be used on young, non-bearing and bearing bushes. Avoid plant contact as much as possible.

Chateau is primarily a preemergent, soil-active herbicide. Chateau has some postemergent activity when it is applied with a non-ionic surfactant or COC, but it is more effective as a burndown in combination with postemergent herbicides such as Aim, Rely, Gramoxone, or Roundup. Troublesome blueberry weeds controlled by Chateau include chickweeds, dandelion, common groundsel, lambsquarters, eastern black nightshade, several pigweeds, ragweed and most annual grasses. Application rates are 6 to 12 oz product per treated acre. Do not apply Chateau after bud break through final harvest. Do not mow treated areas between bud break and final harvest, because dust created by mowing may settle on blueberry leaves and cause injury. Do apply to bushes established less than two years. Rain or irrigation is needed to activate Chateau.

One last change is a new formulation of an old herbicide. Casoron CS is a micro-encapsulated liquid formulation. The older granular product, Casoron 4G, is hard to uniformly apply beneath blueberries. Casoron CS can be applied to bushes that have been in the ground at least six months, and should not be used on light sandy soils. Casoron CS works best when applied in the late fall or early spring. Susceptible weeds include many annual grasses and broadleaves and some troublesome perennials, such as wild aster, horsetail, red sorrel, yellow woodsorrel and bindweeds.

Callisto, Chateau and Casoron have weed control spectrums somewhat different from the commonly used preemergent herbicides such as Princep, Karmex and Sinbar. They also have different modes of action, so it may be helpful to rotate these products over time to broaden the weed control spectrum and discourage development of herbicide resistant weed populations in blueberries. (***Source**: Michigan Fruit Crop Advisory Team Alert, Vol. 23, No. 3, April 15, 2008*)

GRAPE

Early Season Insects in Grapes

Alice Wise, Cornell Cooperative Extension of Suffolk County

Early Season Insects: Generally early season insects are a curiosity more than a concern, the exception being European red mites. Scouting, which we all should be able to do at this time of year, is important in catching any developing problems.

• **Flea beetle** – Flea beetles or steely beetles are small (5 mm), shiny black beetles. They overwinter as adults. They attack both wild and cultivated grapes by boring into swollen buds, hollowing out the inside. Damage is more common near shrubby or wooded areas. Sometimes it is difficult to discern between flea beetle and cutworm injury.

• **Cutworm** – This general term applies to the larvae of a large number of lepidopterous species. These nocturnal feeders chomp on buds and will also feed on young leaves. In some eastern grape growing regions, cutworm is a pest problem that sometimes requires treatment, infestations are apparently worse with cool spring weather. Bud swell for an extended period gives the larvae more opportunity to feed. Damage is also more likely if there is mulch and/or weeds under the trellis as these provide daytime cover for larvae. This damage is not uncommon on Long Island but it does not appear to be so serious as to warrant treatment. As buds swell, take a couple of walks around the vineyard, particularly where previous cutworm damage has been seen. In the

06 Recommends, Sevin, Danitol and Imidan are listed as control options.

• **Grape plume moth** - Signs of grape plume moth (GPM) feeding have been increasingly common in local vineyards. First seen a few years ago on Long Island, this prebloom pest is actually the hairy larva of the plume moth. More advanced cases involve webbing together of leaves and even clusters. If the mass is examined, usually frass and sometimes the larvae may be present. You might also see a vine or part of a vine with basal leaves full of large holes. Expect to see more problems on edge rows. According to Cornell entomologist Greg EnglishLoeb, Sevin and Bt's should work. He recommends a 20% threshold, that is, 20% of shoots/clusters affected before treatment is warranted. If the infestation involves primarily clusters, the risk of crop loss is higher and a slightly more conservative threshold would be warranted. Often the window for treatment is gone by the time damage is seen. Experience with infestations at the research vineyard: the damage looks worse than it actually is and crop loss was minimal. Also, by the time the canopy filled the trellis, it was difficult to tell where the plume moth damage had been. Still, we are seeing more and more of GPM on Long Island and the situation merits watching.

• **European red mite** - Very stunted, pale shoots may mean a mite outbreak. Upon close examination, leaves are loaded with tiny red mobile mites. It is common for a small area – one side of a vine, one vine or a couple of vines – to be infested while neighboring vines have few or no mites. Thus, these early spring outbreaks are usually spotty, not well distributed through a block. It is difficult to predict exactly where these infestations will take place. If you can't walk your blocks, tractor scouting is a good way to spot mite infestations because the pale, stunted shoots will stand out. Logically, it seems the best chances for early infestations lie in blocks with heavy mite populations the fall prior. But that's just a guess.

European red mite early season infestations happen periodically in local vineyards. The need for treatment depends on the number of hot spots in a block. Use of JMS Stylet Oil or Purespray Green Oil prebloom likely keeps these early infestations in check and is the recommended treatment given the narrow options in miticides. The big advantage to early season oil – miticides can be saved for later in the season (if needed) when oil application becomes tricky due to heat, incompatibility with materials such as sulfur and issues with Brix accumulation. However, if sulfur and/or captan are part of your early season schedule, horticultural oils cannot be used due to incompatibility issues.

Miticide options other than oil are as follows. Prebloom miticide treatments are not common but neglect of a significant mite infestation at this time can really set vines back. Due to limited products and expense, materials must be chosen carefully. Lower rates are appropriate at this time of year.

Acramite 50 WS – Has reduced risk status, only one application per season permitted. Use a minimum of 50 GPA water, 12 hr. restricted entry interval (rei). Minimal impact on natural enemies. Acramite has continued to work well in research plots at LIHREC.

Agri-Mek 0.15EC and **ABBA** (generic label) – Restricted use materials with a 12 hr. rei. Do not apply within 150 ft. of water and include an NIS (non ionic surfactant). Labeled for two spot but not for ERM. Use a minimum of 50 GPA water. Two apps/season permitted but Agri-Mek is most effective on tender young foliage. A lower rate + generic label may make this cost competitive.

Danitol 2.4 EC– Restricted use, 24 hr. rei. Harsh on mite predators. Use no more than 2 apps/season for resistance management. Do not use within 100 ft. of water.

JMS Stylet Oil and **Purespray Green** – Horticultural oils can do a good job of ERM control if coverage is excellent. Both have a 4 hr. rei. Not compatible with sulfur, captan and other materials – check label for details. JMS has both a standard and an organic formulation. Purespray Green is similar to JMS in formulation and thus should work in a similar manner.

Kelthane 50 WSP – Restricted use. Kelthane has a status of registered – discontinued. According to the PIMS website, 'the registrant is no longer producing and shipping this product into NYS and intends to remove them [it] from registration on the expiration date listed'. Existing supplies can be used – double check the PIMS or DEC website to make sure the product is still registered before using it. Has a 48 hr rei, 2 apps/season. Some growers have noted reduced efficacy in recent years.

M-Pede – This insecticidal soap is OMRI listed. It is labeled for control of ERM on grapes with a 1-2% v/v solution for motile stages. The label suggests enhanced residual control when tank mixed with Kelthane or Vendex. Experience with materials such as M-Pede suggest that its best use would likely be for low to moderate infestations. Keep an eye on infested blocks to judge to need for follow up. Do not expect to successfully use this type of product on a raging infestation of mites. Also check label carefully for potential incompatibilities with other spray materials.

Sulfur, adjuvants and penetrants and foliar fertilizers are all listed as incompatible.

Vendex 50 WP – Restricted use, 48 hr. rei, 2 apps/ season. Label gives a range of 1-2.5 lbs/a. If you have seen reduced efficacy in recent years, use a higher rate. Compatible with predatory mites.

Zeal Miticide 1 - Experience with Zeal indicates that it is best used earlier in the season, not on a raging infestation. It can take a week or so for Zeal to control mites. In research plots, after about 10 days, Zeal was one of the better miticide treatments. Zeal is reduced risk. Zeal is labeled for two-spot but there is a 2ee for European red mite. Make sure both labels are on hand. (***Source****: Long Island Fruit & Vegetable Update, No. 6&7, APRIL 20 & 27, 2007*)

General

Biological Fungicides and Batericides; Using Fungi and Bacteria for Disease Management

Steve Bogash, Penn State University

Direct application of beneficial fungi and/or bacteria to soil, potting media, and plant foliage is a relatively recent practice which is rapidly catching on with producers. The methods and philosophy of using biofungicides such as Actinovate AG and Plant Shield are distinct from our past practices of starting with "sterile" media and fighting to keep it clean. We've typically fought the plant disease wars through the application of various chemical fungicides in rotation as we attempt to slow the development of resistance.

Standard chemical fungicides fall into two main categories: protectant and systemic. Protectant materials such as chlorthalonil (Bravo, Daconil, and many other trade names) provide fungal disease protection by creating a chemical barrier to disease penetration. Systemic materials such as Azoxystrobin (Quadris, Heritage, and other trade names) move into plant tissue to provide disease management from within. Protectants cannot manage a disease once it has infected a plant; however, systemic materials will provide a measure of "clean-up" disease control activity. The mindset of relying completely on non-biological materials assumes that growers take a long series of "fall back" positions as there are always new strains of disease causing organisms as well as diseases that get missed until our crops have received serious damage.

The application of beneficial organisms (biofungicides) is another tool to add to our arsenal in managing diseases in the greenhouse and field. These materials have unique modes of action (MOA) that can provide levels of disease management not possible with our traditional fungicides. Since these are living organisms, their application requires strict adherence to the labeled application instructions. Often pH, tank mixing, and surfactant instructions are very precise in order to reach reasonable levels of efficacy. Even with these challenges, field experience over the past few years has proven that these biological materials can provide disease management in situations where traditional chemistries have failed to do so. Also, since they are living materials, many of these biological materials have short storage lives and specific storage instructions.

How biological fungicides work

Direct Competition: Before infection can occur, the pathogen must gain access to the root zone then penetrate plant tissue. An effective biofungicide will grow faster than the pathogen and out compete it for nutrients and space.

Antibiosis: Some biological materials produce chemical compounds such as antibiotics and toxins that kill or inhibit pathogen growth. These compounds can prevent germination of fungal spores or restrict growth.

Predation and or Parasitism: Some materials such as Actinovate AG, Plant Shield, and SoilGard 12G claim that their materials actively seek out pathogens and destroy them.

Induced Resistance: While plants do not have immune systems like animals, they do have defense mechanisms. Certain biological controls will induce plants to produce defensive compounds such as salicylic acid (similar to aspirin). Salicylic acid can travel throughout the plant and stimulate the plants own defense mechanisms prior to infection.

All of these biological fungicides require application before the plant becomes infected with a pathogen. Most commonly, a producer will drench transplants or cuttings either just before or during the planting process. Products like SoilGard 12G are incorporated directly into potting media. Those with foliar activity are applied (as a foliar spray) in much the same manner as protectant fungicides such as Chlorthalonil. These living materials colonize the root zone (rhizosphere) and surface of leaves (phylosphere), fruit and flowers. For those growers using fumigants, it is very important to inoculate soil with a beneficial organism immediately after fumigation in order to have the desired organism (biological fungicide) dominates. Most fumigants require a waiting period before planting so that the fumigant can do its' job and move out of the soil or breakdown. Talk to your fumigant supplier's technical support for advice on when to apply a biofungicide after treatment.

This is a different way of thinking about disease management. As we rapidly move from the age of miracle chemicals to solve all of our production challenges further into the era of IPM, these biological materials are a great fit. Many of these materials are OMRI approved. Used properly, they can provide cost effective, proactive disease management when used with other IPM practices. Crop rotation, variety selection, cover cropping, organic matter management, and nutrient management are other parts of our current toolbox.

Current Biological Fungicides and Bactericides

Material	Active Ingredient / Organism	Greenhouse or Field	Labeled diseases controlled	Foliar or Soil Application	Mode of action
Actinovate AG	*Streptomyces lydicus*	Greenhouse & Field	Fusarium, Rhizoctonia, Pythium, Phytophthora, Verticillium….	Foliar and Soil drench	Defensive barrier & parasitism
Companion	*Bacillus subtillus* GB03	Greenhouse only	Rhizoctonia, Pythium, Fusarium, Phytophthora	Soil drench	Defensive barrier and antibiosis
Mycostop	*Streptomyces griseoviridis* K61	Greenhouse and Field	Fusarium, Alternaria, Botrytis, Pythium, Phytophthora & Rhizoctonia	Foliar, soil drench and seed treatment	Defensive barrier and growth enhancer
PlantShield & RootShield	*Trichoderma harzanium* T-22	Greenhouse and Field	Botrytis, Powdery mildew, Pythium, Rhizoctonia, Fusarium, & *Thielaviopsis*	Foliar and soil drench	Defensive barrier, parasitism, & nutrient enhancer
Rhapsody	*Bacillus subtillus* QST 713	Greenhouse, Field, Turf, Interiorscapes, Landscapes, and Forests	Rhizoctonia, Pythium, Fusarium, & Phytophthora…	Foliar, soil drench & post harvest cut flower dip	Defensive barrier (multiple MOA's)
Serenade	*Bacillus subtillus* QST 713	Field: fruits and vegetables	Botrytis, Mildews, Alternaria, Bacterial spot & speck, Rusts…	Foliar	Defensive barrier (multiple MOA's)
SoilGard 12G	*Gladicladium virens* GL-21	Greenhouse, Field, Interiorscapes, & nurseries	Pythium, Rhizoctonia	Soil drench	Defensive barrier, parasitism & Antibiosis

Read and follow label instructions carefully since these materials have specific mixing instructions, varying compatibility with other materials, pH requirements, shelf life and storage conditions. (***Source****: The Vegetable & Small Fruit Gazette, April 2008, Volume 12, No. 4*)

Upcoming Meetings:

May 3, 2008. **Introduction to Berry Growing**, Putnam County CCE, class at Cascade Farms, Patterson, NY. For more information see **www.cce.cornell.edu/putnam** or contact Diane Olsen, 845-278-6738.

May 20, 2008, **UMass Fruit Team Twilight Meeting**, Cider Hill Farm, Amesbury, MA (http://www.ciderhill.com/)
5:30 PM Farm tour including update on phenology and current pest status.
6:30 PM Speaking program will include updates of current cultural and integrated pest management practices. *Pesticide-license recertification credit (2 hours) will be offered at all meetings. You must be there on time to receive pesticide credits.* ***$20/person registration fee. (Except NH meeting.) Light refreshments will be served.***

May 21,2008, **UMass/UNH Fruit Team Twilight Meeting,** Alyson's Orchard, Walpole, NH (www.alysonsorchard.com/)

5:30 PM Farm tour including update on phenology and current pest status.

6:30 PM Speaking program will include updates of current cultural and integrated pest management practices. *Pesticide-license recertification credit (2 hours) will be offered at all meetings. You must be there on time to receive pesticide credits.*

May 22, 2008, **UMass Fruit Team Twilight Meeting,** Steere Orchard 150 Austin Ave. Greenville, RI (401-949-1456)

5:30 PM Farm tour including update on phenology and current pest status.

6:30 PM Speaking program will include updates of current cultural and integrated pest management practices. *Pesticide-license recertification credit (2 hours) will be offered at all meetings. You must be there on time to receive pesticide credits.* ***$20/person registration fee. (Except NH meeting.) Light refreshments will be served.***

For more info on the Fruit Team Meetings, go to http://www.umass.edu/fruitadvisor/meetinginfo/april08twilight.pdf .
