The New York Berry News

CORNELL UNIVERSITY

Volume 02, Number 04 April 16, 2003

What's Inside

Spring has sprung and growers should be gearing up for the season ahead. The warmest weather of the year on April 14 and 15 pushed many crops ahead. But as Mother Nature would have it, this beautiful weather was followed by freezing temperatures and a little bit of snow (I sure hope my daffodils make it!). This weather should serve to remind us that we need to be thinking about frost protection. In this months issue of the NYBN we revisit Marvin Pritts' article where he tells us everything we need to know about frost protection and strawberries.

In addition to frost protection, springtime is when we should be most concerned about managing disease. In this issue, we cover strawberry gray mold, mummy-berry, and raspberry cane diseases in detail. The articles address the biology, cultural and chemical management practices, and discuss how to incorporate some of the most recently labeled fungicides for managing these diseases.

Aside from these diseases, we should also be concerned about *red stele*. The best solution to this disease is simply to plant resistant varieties. In the northeast 'Allstar', 'Annapolis', 'Cavendish', 'Delmarvel', 'Earliglow', 'Guardian', 'Idea', 'Lateglow', 'Midway', 'Mohawk', 'Northeastern', 'Primetime', 'Redchief', 'Scott', 'Sunrise', 'Tribute', 'Tristar', and 'Winona' are considered resistant. Yet, if a susceptible variety is planted (such as Jewel and Honeoye) and the disease has been a problem in the past, a spring application of Ridomil Gold can be applied in a banded application after the ground thaws but before bloom. This treatment will only prove to be effective if the berries are NOT planted in a particularly wet site.

We wrap up this issue with an article focusing on strawberry sap beetle. We've been seeing more and more of this pest over the past few years and Rebecca Loughner and Greg English-Loeb discuss what we know and what we think we know about this insect.

Pesticide News:

Section 18 Label Update: New York submitted a petition to EPA for an Emergency Exemption in 2003 for the use of Indar 75 WSP fungicide in blueberries to control mummyberry disease. We also submitted a petition for Topsin-M 70 WSB in blueberries to help in the management of cane diseases, gray mold, and mummyberry. This is the same material we petitioned successfully for in 2002. We have yet to be informed about EPA's decision, but should be hearing very soon. It is very likely that we will have our petition approved and I will inform you as soon as I hear.

Grants Awarded to Northeast Farmers

Helen Husher, University of Vermont, Burlington, VT

Fifty-two farmers in the Northeast were recently awarded $268,744 in grants under the Northeast Sustainable Agriculture Research and Education (SARE) Farmer/Grower program. Awards ranged from $1,555 for a new marketing effort for local, additive-free pork in Maryland to $10,000 to see if certain delicate varieties of lettuce can be grown successfully in New York. The average grant was about $5,200. Projects are chosen for their relevance, innovative design, and potential impact on the sustainability of farms across the region.

Northeast SARE supports projects in sustainable agriculture for farmers, researchers, and educators, and is a program of the USDA. The region includes CT, DE, ME, MD, MA, NH, NJ, NY, PA, RI, VT, WV, and Wash D.C. Details on each of the funded projects can be found at www.uvm.edu/~nesare/news_FNE02.html.

Frost Protection in Strawberries

Marvin Pritts, Dept. of Horticulture, Cornell University, Ithaca, NY

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. 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.

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.

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 (see 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.

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

1. Store sufficient water for 2 or 3 consecutive nights of frost protection
2. Use small diameter nozzles (1/16 - 3/16 in. diameter)
3. A 30 X 30 ft. staggered spacing of nozzles is preferable
4. Use metal sprinklers to minimize icing
5. 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.

Table 2. Starting temperature for frost protection based on dewpoint

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

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 (Table 2). 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.

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.

Awakened from the Tomb

Bill Turechek, Dept. of Plant Pathology, Cornell University, Geneva, NY

Mummyberry is caused by the fungus *Monilinia vacinii-corymbosi* and is one of the most serious diseases of blueberry in New York. The disease appears to much more problematic in the Southern Tier, the Finger Lakes Region, and Western New York than in Eastern New York and the Champlain Valley. Nonetheless, if mummyberry occurs in your planting and you are growing a susceptible variety, control procedures are likely necessary since losses can exceed 30 to 40% when no control is practiced.

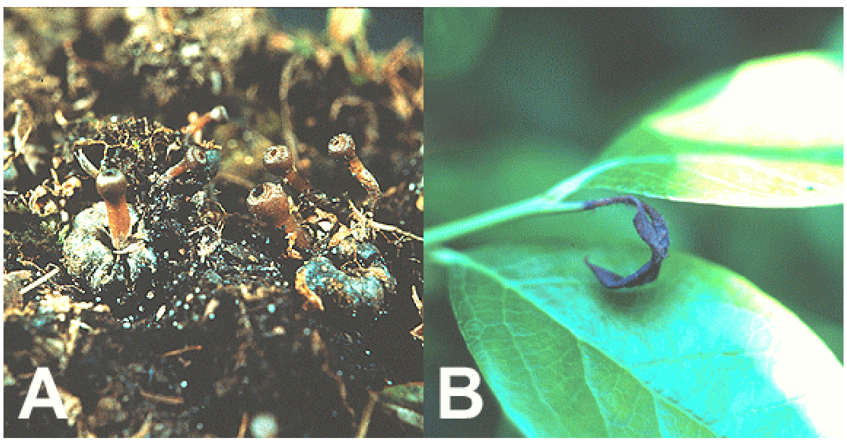

Figure 1. (A) Mushroom-like structures (apothecia) growing from mummified berries that produce the first spores of the season; **(B)** Shoot tip infection which will eventually lead to the production of secondary spores.

The fungus causing mummyberry overwinters in infected berries or "mummies" lying under the bushes. In early spring, infected berries produce the primary inoculum (i.e., ascospores) in a mushroom-like structure called an apothecia (Fig. 1A). These spores are disseminated by wind and rain and infect emerging leaf buds and shoots. Shoots are most vulnerable to infection by ascospores when they are between approximately 1/8 to 1.5 inches in length. Infection requires free water on the plant surface and can occur within 4 hrs under the optimum temperature of 57 F, but takes nearly 10 hrs at 35 F. Infected shoots and leaves wilt, turn brown and die; this is the shoot blight phase of the disease (Fig 1B). Its appearance is similar to, and sometimes confused with, frost damage. Symptoms typically develop 2 weeks after infection. Infected shoots produce a second spore type, called conidia, that infect the blossoms. The formation of conidia requires high relative humidity. Conidia are disseminated to blossoms by both wind and pollinating bees. The bees are attracted to the masses of conidia at the ends of blighted shoots via the reflection of ultraviolet light off the surrounding necrotic tissue and by the "scent" of sugars secreted by the conidia. Once a conidium has been introduced in to the flower, it will germinate with the pollen and slowly infect the developing fruit. Blossom infections are therefore not evident until the fruit begins to ripen later in the season when the berries begin to shrivel and turn a pinkish color. These are the "mummyberries" and they have been colonized by the fungus. Infected berries eventually fall to the ground, shrivel, and turn dark brown in which they will serve as the primary inoculum source the following spring.

Mummberry can be a difficult disease to control even under the best management practices. Like the disease apple scab, however, the disease is more easily manageable if primary infections are well controlled. This can be done using cultural practices such as raking or discing the soil beneath the blueberry bushes or covering the fallen mummyberries with a 3-4 inch layer of mulch. Growers may also choose to apply 200 lbs/A of 50% urea prills directly under the bushes to hasten the degradation of the mummyberries. Remember, the formation of apotehecia is greatly enhanced when the mummies make physical contact with the soil. Burying these mummies disrupts their formation.

If you are planting blueberries this year and are concerned about mummyberry, you should avoid planting in areas of the field that are prone to frost (i.e., frost pockets), that are wet, and/or are slow to dry as these areas tend to have more problems with mummyberry. A number of resistant varieties are available. A table of susceptible varieties is presented below. The table was compiled from resources at Michigan State University and the Northwest Berry & Grape Information Network (Oregon State University).

		Oregon				Oregon	
	Michigan	*Primary Infection*	*Secondary Infection*		**Michigan**	*Primary Infection*	*Secondar y Infection*
Berkeley	S	MR	MR	Elliott	R	R	R
Bonus	MR	n/a	n/a	Jersey	MR	MR	S
Bluecrop	S	S	MR	Lateblue	R	MR	MR
Bluegold	S	n/a	n/a	Little Giant	n/a	n/a	n/a
Bluehaven	S	n/a	n/a	Nelson	n/a	n/a	n/a
Bluejay	R	R	R	Northblue	R	n/a	n/a
Blueray	S	S	MR	Northcountry	n/a	n/a	n/a
Bluetta	***S***	R	MR	Northland	S	S	S
Burlington	R	n/a	n/a	Patriot	n/a	n/a	n/a
Chippewa	n/a	n/a	n/a	Rancocas	MS	S	S
Collins	S	S	R	Rubel	S	R	S
Coville	MR	S	MR	Sierra	S	n/a	n/a
Darrow	R	R	MR	St. Cloud	n/a	n/a	n/a
Dixi	n/a	R	R	Spartan	MR	R	R
Duke	R	n/a	n/a	Sunrise	n/a	n/a	n/a
Earliblue	S	S	S	Toro	n/a	n/a	n/a
				Weymouth	S	S	S

Fungicides are often necessary to manage disease on susceptible varieties or under high disease pressure. A key to efficient control with fungicides is to realize that the two spore types are managed differently. Unfortunately, there are no fungicides currently available that have excellent activity against the primary spores. A green tip application of triforine (Funginex) is the most effective chemical treatment for the disease, unfortunately, this fungicide is no longer being produced. Echo 720 and Echo 90DF (manufactured by Sipcam Agro) are chlorothalonil products (like Bravo WeatherStik) which have just received labeling on blueberry for control of mummyberry (as well as anthracnose). These products have not been tested in New York but, in trials conducted in other states, chlorothalonil has been largely ineffective in controlling mummyberry. Many states in the northeast have obtained a Section 18 Emergency Exemption for the use of Indar (or the closely related fungicide Orbit) against the shoot blight phase of the disease. *We submitted a petition to EPA for an Emergency Exemption in 2003 for the use of Indar 75 WSP fungicide in blueberries to control mummyberry disease. We are waiting for their reply but we are very optimistic that it will be granted (Please check with your local Extension office to receive the current status of the request).*

To control the blossom blight/fruit rot phase of the disease, an application of Captan 50WP plus Topsin M (at 5 lb/1 lb per acre, respectively) repeated at a 7 - 10 day interval is recommended. Currently, Topsin-M is not labeled in New York. Last year we received a section 18 for Topsin-M and we applied for, and anticipate, receiving another one this year. This is also an important spray for controlling Botrytis fruit rot when conditions favor disease develeopment. As bloom progresses the effectiveness of fungicide applications will decline as these fungicides cannot "cure" infections that have already occurred. For maximum control, fungicide applications should made prior to mid-bloom and should not be applied post bloom.

Managing Gray Mold of Strawberry

Bill Turechek, Dept. of Plant Pathology, Cornell University, Geneva, NY

Gray mold is the most common fruit rotting pathogen of strawberry in New York. It is a major problem during bloom and on ripening and harvested fruit. Aside from the direct losses the disease can cause in the field, diseased fruit are unsightly in pick-your-own operations or in pre-picked baskets and may have an adverse affect return customers.

Disease Cycle

Gray mold is caused by the fungus *Botrytis cinerea*. This fungus is probably the most ubiquitous pathogen worldwide in that it attacks numerous fruits, vegetables, and ornamental plants. *B. cinerea* survives the winter in dead or dying leaf tissue and plant debris. In spring, the fungus produces spores that are disseminated to susceptible plant parts by wind and splashing rain (or irrigation water).

Under cool and wet conditions, fungal spores germinate and infect the blossoms and leaves. Symptoms on leaves are not obvious until leaves begin to die, and for several weeks afterwards, the fungus produces spores on the dead and dying leaves. These spores serve as the major source of inoculum for blossom and fruit infection. Blossom and mature fruit infection is possible when rain, heavy dew, or overhead irrigation occurs in combination with temperatures within the range of 40-85 F. The most conducive temperatures for infection lie within the range of 59-77 F. Infection can occur with as little as 6 hours of wetness, but the rate of infection approaches 90% with 24 hours or greater of wetness.

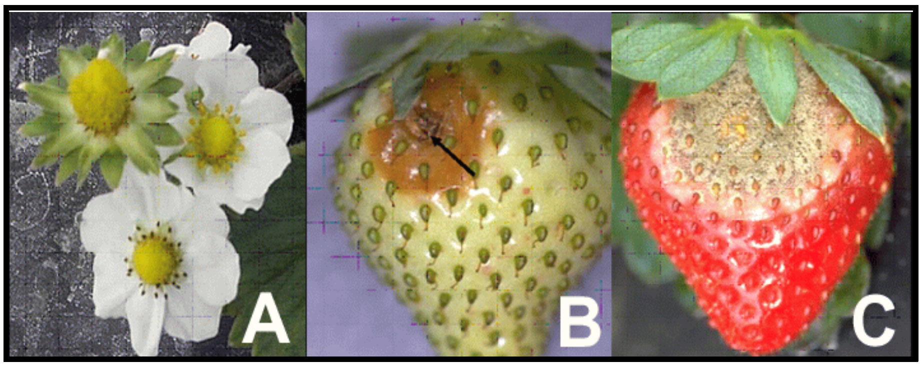

Figure 2. Gray mold infection showing **(A)** blackened flower parts; **(B)** developing latent infection; and **(C)** characteristic symptoms of mature fruit. (Pictures courtesy Dan Legard)

Blossom infection is the primary means in which fruit become infected. Flowers are susceptible once they have opened, but the susceptibility to infection increases dramatically two to three days after opening. The fungus attacks the petals, stamens, and pistils but not the sepals (Fig 2A). One to several blossoms per cluster (inflorescence) may become infected and infected blossoms often turn brown, wilt, and die. This is called blossom blight. The fungus enters immature fruit through these individual flower infections where it remains quiescent (latent) until the fruit begin to ripen. Green fruit are virtually resistant infection.

Upon ripening, the fungus becomes active and begins to colonize the fruit. Symptoms start as a discoloration and typically begin at the calyx end (Fig 2B). If the infected berries do not fall to the ground, they shrivel, dry and eventually form a "mummy". In the process, the fruit become covered with the grey powdery fungal spores that are easily dispersed by wind and splashing rain (Fig 2C). Additional fruit infection from these spores is considered to be of minor importance compared to those initiated through blossom infection. However, healthy fruit can become infected through direct contact with rotten fruit, particularly when wet weather occurs through the harvest period.

Disease Management

Several cultural practices can help minimize disease development. Because prolonged wetting events significantly increase the risk of infection, any practice that facilitates good air circulation through the canopy and rapid drying of fruit can diminish the amount of infection. This includes proper plant spacing within and between rows and weed control. Gray mold is often most severe within the canopy where the air circulation is poorest. Another practice that helps reduce the risk of infection is to remove the dead and rotting tissue from the planting. It is these rotting tissues where the fungus produces the majority of the infective spores. Although, the fungus can attack many plants, it appears that outside sources of inoculum play a small role in the overall development of the epidemic relative to local sources of inoculum. Mature fruit are very susceptible to infection, especially if they have been bruised during picking. Therefore, fruits should be handled gently during picking and packing. If wet weather is prevalent during harvest, fruits should be picked promptly to avoid additional infection in the field.

In New York, gray mold can be controlled usually with two well-timed fungicide applications during bloom. The first application should be made at early bloom (5-10%) followed by another 7 to 10 days later or at full bloom. For successful Botrytis control, it is important to provide fungicide protection throughout bloom. Remember that early blooms (king bloom) typically produce your largest and best quality fruit, so protection needs to be started early. The number of bloom sprays required depends upon the weather. If it is hot and dry, no fungicides are required. If it is very dry and overhead irrigation is used for supplemental water, irrigation can be applied in early morning so that plants dry as fast as possible. Keeping plants dry reduces the need for fungicide application. Most years are not this dry and fungicides are generally applied on at least a 7-day schedule through bloom. If it is extremely wet, a shorter interval (4-5 days) may be required in order to protect new flowers as they open.

Many products are labeled for use on strawberry. Elevate 50WG and Switch 62.5WG are the most effective fungicides for disease management during bloom. For resistance management, no more than 2 consecutive sprays of Elevate or Switch should be applied. Therefore, in years when wet weather prevails during bloom (i.e., when more than two sprays are needed), a broad-spectrum fungicide such as Captan (50WP, 80WP or Captec 4L), Thiram 65WSB, or Topsin-M 70WSB should follow the use of Elevate and Switch. These fungicides also have some activity against leaf blight and leaf spot.

Anthracnose and Leather Rot:

Although gray mold is the primary disease we are managing during bloom, we should also be thinking about managing anthracnose as well. In the pre-bloom period, Captan should be applied if the weather is particularly wet and warm to reduce the build-up of anthracnose spores. During bloom Elevate plus Captan will provide excellent control of gray mold and will have some efficacy against anthracnose. Switch is labeled for control of both gray mold and anthracnose. This fungicide is excellent against gray mold but the jury is still out on how well it works against anthracnose. Once the berries begin to develop, a different class of fungicides will be used to manage anthracnose fruit rot. This will be covered in next months edition of the NYBN.

Aliette 80WDG is labeled for control of Red Stele and Leather Rot. For Leather Rot, apply 2.5 to 5 lb/A. Apply as a foliar spray between 10% bloom and early fruit set, and continue on a 7-14 day interval as long as conditions are favorable for disease development. Applications can be made the same day as harvest (PHI=0 days). Aliette has no activity against gray mold, so this fungicide should be included in mixture with your gray mold fungicide

Fungicides for Caneberry and Bushberry

Rovral 4F (1-2 pt/A) and Elevate 50WDG (1.5 lb/a) are labeled for use on caneberries (i.e., raspberries and blackberries) and bushberries (i.e., blueberries, currants, gooseberries, and elderberries) for control of gray mold. The label permits 4 applications of each per season and the last application can made up to and including the day of harvest. Captan is labeled for use only on blueberry for control of gray mold. Several states, but not including NY, have received a special local needs registration (FIFRA 24(c)) for Captan for control of gray mold, but more importantly for control of anthracnose and spur blight on raspberry. This special registration may be pursued in the future if the demand for it is great enough.

Managing Cane Diseases of Raspberry

Bill Turechek, Dept. of Plant Pathology, Cornell University, Geneva, NY

Anthracnose, spur blight, and cane blight are three diseases where early season management is critical to their control. All three diseases cause lesions on the cane and can seriously impact the health of the planting. Anthracnose is caused by the fungus *Elsinoe veneta*. Symptoms of anthracnose appear as small purple spots scattered on young canes and tends to be much worse on black and purple raspberries than reds (Fig 3). Spur blight is caused by the fungus *Didymella applanata* and is problem mainly on red raspberries. Symptoms of spur blight are centered around individual buds and appears as purple to brown blotches in mid-summer (Fig 4). Even though symptoms are not evident until later in the season, infection occurs early and infected buds fail to grow. Cane blight is caused by the fungus *Leptosphaeria coniothyrium* much more of a problem on black and purple raspberries due to tipping practices, but can be equally problematic on red raspberries. Cane blight can be confused with spur blight. However, cane blight is much more likely to involve the entire cane (not just the buds) and infection sites are typically associated with pruning wounds or other injuries (Fig 5).

Managing these disease begins with pruning or removing the diseased canes before new canes emerge in the spring. A dormant application of lime sulfur or copper is also critical where any of these diseases are problematic. Liquid lime sulfur at 20 gallons per acre should be applied when new leaves are exposed 1/4 to 3/4 inches; if you are late in your application and don't spray until a few leaves have unfolded, cut the rate to 10 gallons per acre. Thorough coverage of the canes is critical to achieving control so be sure that this application is done on a calm day. A note of caution: This spray may be phytotoxic if applied after ½ inch green, particularly on a warm day. A dormant lime spray is not needed on fall bearing raspberries because the previous year's canes should be mowed down and removed.

Several states, but not including NY, have applied for and received a special local needs registration (FIFRA 24(c)) for captan for control of anthracnose and spur blight. This spray is used in addition to the delayed-dormant application of lime sulfur. This special registration may be pursued in the future if the demand for it is great enough.

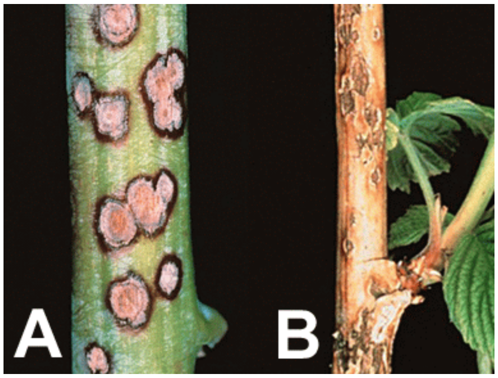

Figure 3. Anthracnose on **(A)** primocanes and **(B)** floricanes.

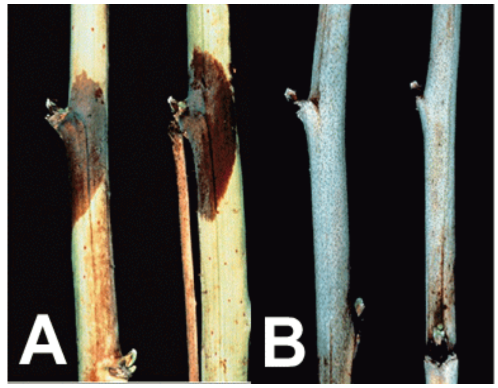

Figure 4. Spur blight **(A)** primocanes and **(B)** floricanes.

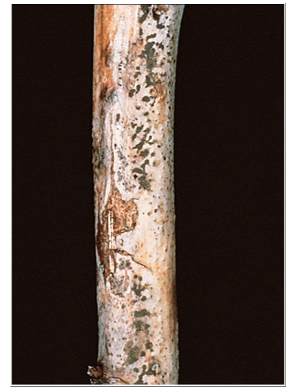

Figure 5. Cane blight

Strawberry Sap Beetle Biology and Possibilities for Control

Rebecca Loughner and Greg English-Loeb, Dept of Entomology, Cornell University, Geneva, NY

Strawberry sap beetle (Coleoptera:Nitidulidae) is a relatively new pest of strawberry in New York, although it was reported to infest strawberries in Wisconsin, Virginia, Maryland, and Michigan as early as the 1950's. Strawberry sap beetle, *Stelidota geminata* (Say), adults are a dark brown color, oval-shaped, and about 1/10 of an inch long [Fig 6A]. The related sap beetle *Glischrochilus quadrisignatus* (Say) is also found in strawberries and is commonly referred to as the picnic beetle. Although the picnic beetle is more noticeable due to its larger size (1/4 inch long), black color, and four yellowish orange spots on the back [Fig 6C], the strawberry sap beetle is considered a more significant pest.

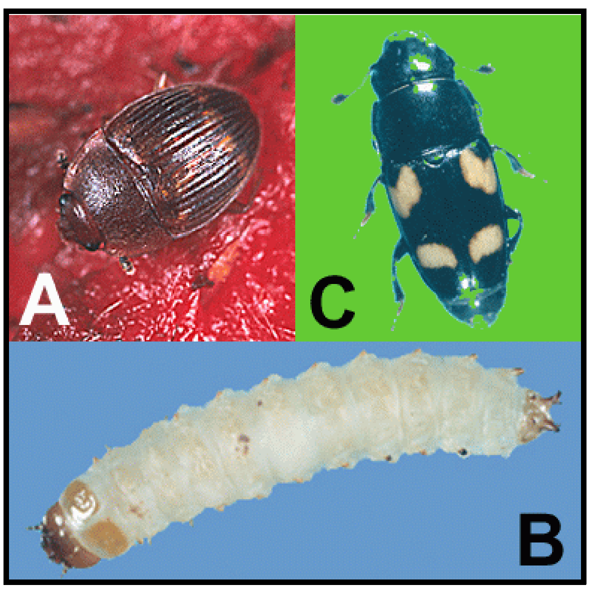

Figure 6. (A) Adult strawberry sap beetle; **(B)** adult picnic beetle; and **(C)** immature or larvae of the sap beetle (often found feeding in fruit). (Pictures A and C courtesy of: Pritts, M., and D. Handley (eds.). 1998. Strawberry production guide for the Northeast, Midwest, and Eastern Canada. Northeast Regional Agriculture Engineering Service.)

Strawberry sap beetle (SSB) is widely distributed throughout strawberry acreage in New York. At least a few SSB were found on every farm included in a survey conducted in 2002 (see NYBN Vol 2 No. 2). The insect is considered a serious pest in some locations and causes little concern at other farms. The reason for the difference in pest status is not clear, but may be related to the type of crops or vegetation surrounding strawberry fields. The beetles feed on numerous fruit and vegetable crops, but are particularly problematic in strawberry where fruit ripens on the ground and is easily accessible to SSB. The adults typically feed on the underside of berries, creating small tunnels into the berries. Damage is often unnoticeable at low beetle population densities since the adults scatter when berries are disturbed. Larvae [Fig 6B] feed on berries and become apparent to customers when berries are washed in the home for processing. Customer complaints of finding the larvae in the berries are causing increased concern among growers.

The current understanding of beetle biology is that SSB overwinters as an adult in wooded areas outside of strawberry fields. Beetles may also be overwintering in other crops or within strawberry fields, however no conclusive evidence has been reported. Adults move into strawberry plantings and feed on the fruit. Overripe fruit is preferred although beetles will damage ripening berries. Eggs are oviposited in the soil, hatch, and the larvae search for berries to feed on. The time from egg to adult is approximately 3 weeks in the field, suggesting that there is ample time for more than one generation to develop per year if food resources are sufficient.

Crops such as apples, cherries, vegetable crops, corn, and raspberries are frequently grown adjacent to strawberry fields and have large amounts of crop residues on the ground, especially in U-pick operations. Refuse from other crops in addition to fungi and leaf litter may make it possible for SSB to have more than one generation per year. The adults can be captured in various crops from April or May until fall, however the extent to which the beetles continue reproducing on various crop residues is unclear.

Current recommendations for SSB control are removing overripe strawberries from the field (sanitation) and application of Brigade or Danitol, both pyrethroids with highly variable effectiveness in the field. Brigade has zero days to harvest on its label while Danitol requires a 2 day interval between application and harvest. The best or most effective time to apply control measures has not been well worked out. However, sufficient water to cover fruit near the ground is likely to increase efficacy. Research is being conducted this summer to determine: 1) if the adults overwinter in strawberry fields, 2) when the overwintering generation of adults is moving into the field relative to the timing of berry ripening, and 3) if any other crops such as apples, raspberries, or vegetable crops are suitable hosts for SSB to reproduce on after strawberries are not available. A better understanding of the timing of SSB movement from overwintering locations into strawberry fields and potentially into other crops after strawberry renovation will help time insecticide applications such that they are more likely to contact the beetles and may suggest other management practices that may have a role in minimizing SSB populations for the following year, such as removing fruit residues from surrounding crops.

Questions or Comments about the New York Berry News?

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