

# Using Fungicides to Control Strawberry Fruit Rots in Ohio 2012

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In Ohio, perennial matted row production has a long tradition and still is the most common strawberry production system. In recent years, annual plastic culture production has increased considerably in Ohio. Both systems have the same fruit rot diseases and will use the fungicides discussed below for control. In matted row production, we have a limited bloom period that help us to time sprays for control of Botrytis and a fairly defined harvest period that allows us to better time or target fungicide applications for anthracnose and leather rot. In annual plastic cultures systems, Bloom occurs over a much longer period of time and will require more applications for Botrytis control. In addition, anthracnose is inherently a far greater problem in the annual plastic culture system. Thus, a more intensive fungicide program will probably be required for plastic culture berries. For example, sprays for anthracnose control should be applied throughout the production season. The sprays used for anthracnose control can also be effective for controlling Botrytis and leather rot as well. Therefore, it is very important to know what fungicides are effective for each specific disease.

The most common fruit rots on strawberry in Ohio are: Botrytis fruit rot (gray mold), caused by *Botrytis cinerea*; anthracnose fruit rot, caused by *Colletotrichum acutatum*; and leather rot caused by *Phytophthora cactorum*. Especially in wet growing seasons, successful strawberry production may depend on the simultaneous control of all of these diseases. Generally, all three diseases do not occur simultaneously in the same planting, but this can occur. Botrytis fruit rot or gray mold is the most common disease and generally requires some level of fungicide for control each year. Anthracnose is a problem in years with warm to hot temperatures combined with prolonged rainfall prior to and during harvest. Anthracnose is generally not a problem in most plantings; however, when it does develop, it can be devastating. New fungicide chemistry with good to excellent activity against anthracnose has recently been registered for use on strawberry and should be helpful in providing effective control. Leather rot is a problem in years with excessive rainfall or in fields with poor drainage that have standing water (all of these diseases are a problem in situations such as this). Many growers do a good job of controlling leather rot by planting on sites with good soil drainage and maintaining a layer of straw mulch to prevent contact of berries with soil. In years with excessively wet weather or on sites with problem soil drainage, fungicides may be beneficial for leather rot control.

As previously mentioned Botrytis or gray mold is the most common disease and is probably the easiest to control with effective fungicide use. Most fruit infections by Botrytis occur only during bloom. Therefore, most growers in perennial matted row systems apply fungicides only during bloom and generally do a very good job of controlling Botrytis and do not need to apply fungicides pre-bloom or during harvest. If anthracnose and leather rot **are not a problem**, fungicide sprays during bloom only are generally all that is required. Obviously this is

an ideal situation in relation to reducing costs and overall fungicide use.

In Annual plastic culture systems and in perennial matted row plantings during growing seasons (warm and wet) where anthracnose or leather rot are problems, the need for a more intensive fungicide program is greatly increased. In most years, an intensive fungicide spray program will be required in plastic culture systems. The following information provides guidelines for developing an effective fungicide program for control of the major fruit rots in matted row production systems in Ohio.

### **Prebloom**

In most years, there is generally little or no need for fungicides prior to bloom for control of Botrytis. If weather is exceptionally wet from rain or overhead irrigation from frost protection, some early season fungicide may be required prior to bloom. If anthracnose is a concern, especially in plastic culture berries, prebloom applications of fungicide are beneficial in reducing the buildup of inoculum in the planting. This is especially true if prebloom temperatures are abnormally warm and conditions are wet. Applications of Captan or Thiram alone at the highest rate (Captan 50WP, 6 lb/A; Captan 80WDG, 3.75 lb/A; Captec 4L, 3 qts/A, Thiram 75WDG, 4.4 lb/A) should be effective in reducing inoculum buildup of all three diseases. A seven day application interval should be sufficient.

### **During Bloom**

This is the critical period for control of Botrytis. In addition, in fields infested with Colletotrichum (anthracnose), the fungus may be able to build up inoculum on symptomless (apparently healthy) foliage during warm, wet weather. Increased inoculum could result in increased fruit infections if weather remains favorable for disease development. The main fungicides for control of Botrytis are Elevate 50WG, Captivate 68WDG, Switch 62.5WG, Scala SC and Pristine 38WG. Captivate is a package mix of Captan and Elevate. All of these materials have excellent efficacy for control of Botrytis, but only Switch and Pristine have efficacy against anthracnose. This is an important point to remember if anthracnose is a problem in the planting. I also recommend that all of these materials be tank-mixed with Captan or Thiram during bloom. Captan and Thiram are protectant fungicides that provide some additional control against Botrytis (gray mold), anthracnose fruit rot, and leather rot. In addition, mixing the materials should also aid in reducing the risk of fungicide resistance development.

Elevate, Scala, Switch, and Pristine are all at high risk for development of fungicide resistance in Botrytis. None of these fungicides should be used alone in a season long program for Botrytis control. They all have different chemistry so they can be alternated with each other as a fungicide resistance management strategy. It is wise not to apply any of these fungicides in more than two sequential sprays without alternating to a different fungicide.

For successful Botrytis control, it is important to provide fungicide protection throughout

bloom. Remember that early blooms (king bloom) may be your largest and best quality fruit, so protection needs to be started early (at least 10% bloom). The number of bloom sprays required depends upon the weather. If it is hot and dry, no fungicides are required. All of the fruit rot diseases discussed here require water on the flowers and fruit in order to infect. 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. Fortunately, 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. Although Botrytis is the primary pathogen we are trying to control during bloom, the selection of the proper fungicides should also aid in reducing the buildup of anthracnose as well. This is important to remember in plantings where anthracnose is a problem or threat. This is especially true in plastic culture plantings.

### **Post Bloom Through Harvest**

As bloom ends and green fruit are present, the threat from Botrytis infection is generally over. Green fruit are resistant to Botrytis. If you got fruit infection by Botrytis during bloom, the symptoms (fruit rot) will not show up until harvest as fruit start to mature. At this point, it is too late to control it.

As new fruit form through harvest, the threat of anthracnose fruit infection increases. In many perennial matted row plantings, anthracnose is not present or is not a problem. In these plantings no additional fungicide should be required after bloom through harvest. Unfortunately, you cannot determine if anthracnose is a problem until you see it. Often, this is too late to control it. In plantings with a history of anthracnose fruit rot, or if the disease is identified in the planting, fungicides with efficacy for anthracnose control may be required from the end of bloom through harvest. Remember, anthracnose is favored by warm to hot wet weather. In addition, anthracnose is a much greater problem in plastic culture plantings and in my opinion requires season long control.

Abound 2.08F, Cabrio 20EG, and Pristine 38WG are strobilurin fungicides and are the most effective fungicides currently registered on strawberry for control of anthracnose fruit rot and all are very effective for control of leather rot. These fungicides are also registered for control of powdery mildew and leaf spots and they also provide good suppression of Botrytis fruit rot (gray mold). Pristine provides excellent control of Botrytis. In fact, Pristine is the only fungicide that provides excellent control of all three fruit rots. All of these fungicides are at high risk for fungicide resistance development in the anthracnose fungus. In addition, they are all in the same class of chemistry; therefore, they cannot be alternated with each other as a fungicide resistance management strategy. In order to delay the development of fungicide resistance, the label states that no more than four applications of Abound or five applications of Cabrio or Pristine can be made per season. In addition, the label states that no more than two sequential sprays of each fungicide can be made without switching to a fungicide with a different type of chemistry. For anthracnose control, the only fungicides that currently can be used in such a rotation with these fungicides are Captan, Thiram, or Switch. Switch 62.5 WG has been reported

to provide good to excellent control of anthracnose fruit rot as well as excellent control of Botrytis, and would be my fungicide of choice in an alternating program with Abound, Cabrio or Pristine.

The following are suggestions for developing a fungicide program for simultaneous control of strawberry fruit rots.

<b>Fungicide and (rate/A)</b>	<b>Comments</b>
<b><u>Prebloom</u></b> Captan 50 WP (6 lb) or Captan 80WDG (3.75 lb) or Captec 4L, 3 qt or Thiram 75WDG (4.4 lb)	Prebloom applications should be required only if excessive water from rain or irrigation is a problem early in the season. Fungicides here could help reduce build-up of Botrytis and Colletotrichum inoculum. In dry or more “normal” seasons, fungicide is probably not required until bloom starts.

**During bloom**

Switch 62.5WG (11-14 oz)

or

Scala SC (18 fl. oz)

or

Elevate 50WG (1-1.5 lb)

**PLUS**

Captan 50WP (4-6 lb)

or

Captan 80WDG (3.75 lb)

or

Captec 4L (2-3 qt)

or

Thiram 75WDG (4.4 lb)

**OR**

Captevate 68WDG (3.5-5.25 lb)

**OR**

Pristine (18.5 - 23 oz)

This is the main time to control Botrytis and if temperatures are high, Anthracnose could build up in the planting. Pristine is highly effective for Botrytis, Anthracnose and leather rot. Switch is excellent for control of Botrytis and has been reported to have good activity for control of anthracnose. Obviously, this is ideal. The addition of Captan or Thiram provides additional protection against all the fruit rot diseases and may aid in reducing fungicide resistance development. Scala and Elevate are excellent for control of Botrytis, but have no activity against anthracnose. Where anthracnose is not a threat, these fungicides will provide excellent Botrytis control. When Elevate, or Scala are combined with the high rate of Captan or Thiram, the combination should provide some level of anthracnose control. Captevate is a package-mix combination of Elevate plus Captan. If anthracnose is a concern, Pristine or Switch would be the fungicide of choice. None of the fungicides (Pristine, Switch, Scala, or Elevate should be applied more than twice before alternating with a fungicide of different chemistry. This is to aid in reducing fungicide resistance development. Abound, Cabrio, and Pristine are the fungicides of choice for anthracnose control. They also provide excellent control of leather rot. Abound and Cabrio provide some control of Botrytis. Pristine provides excellent control of all three fruit rots. Although they could be used during bloom, I prefer to use them after bloom in perennial matted row systems and from bloom thorough harvest in plastic culture systems when the threat of anthracnose fruit infection is greatest.

<p><b><u>Post bloom Through Harvest</u></b>  Abound 2.08F (6.2-15.4 fl oz)  or  Cabrio 20EG (12-14 oz)  or  Pristine 38WG (18.5 - 23 oz)  or  Switch 62.5WG (11-14 oz)  tank-mixed or alternated with  Captan 50WP (3-6 lb)  or  Captan 80WDG (3.75 lb)  or  Captec 4L (1.5-3 qt)</p> <p>If more than two applications of Abound, Cabrio, or Pristine are required, Switch should be considered as an alternating fungicide.</p>	<p>As green fruit develop the threat of anthracnose infection increases, especially under warm, wet conditions. Abound, Cabrio, or Pristine are the most effective materials for anthracnose control. If anthracnose is a problem, the highest label rate should be used. This may be the best time to use Abound, Cabrio, or Pristine. Switch also has good activity for control of anthracnose. If the risk of anthracnose is high or the disease has been observed in the planting, Quadris, Cabrio, or Pristine plus Captan should be applied 7 days after the last bloom spray for Botrytis in matted row plantings. If anthracnose remains a threat, sprays should probably be repeated on a 7 day interval through harvest. In plastic culture plantings sprays should be made from early bloom through harvest. As harvest approaches, Captan should be removed from the program. Captan applied close to harvest could result in visible residues on fruit and this can be a big problem. Abound, Cabrio, Pristine or Switch applied alone should result in minimal visible residues on fruit and can be applied on the day of harvest (0-day PHI). Remember, <b><u>these preharvest sprays are required only if anthracnose or leather rot is a threat or problem in matted row plantings. I would apply them as a good form of insurance in plastic culture berries.</u></b></p>
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The extensive use of Captan in this program could result in problems with visible residues on fruit. This needs to be considered, but under heavy disease pressure for anthracnose a high level of Captan usage may be required. The Captec 4L (flowable) should result in less visible residue than the Captan 50W (wetttable powder) or Captan 80WDG formulation. The use of Abound, Cabrio, Pristine or Switch alone in the last spray or two before harvest should aid greatly in reducing visible residues.

### **Leather Rot**

As mentioned previously, leather rot should be controlled by good soil drainage (no standing water) and a good layer of straw mulch to prevent berries from soil contact. If leather rot is a threat or a problem, fungicides may be required. Abound, Cabrio, and Pristine have

excellent activity against Phytophthora diseases on other crops. Although leather rot is not on the label, studies in Ohio have shown that Abound, Cabrio, and Pristine all have very good to excellent activity for control of leather rot in addition to anthracnose and Botrytis gray mold. Pristine would be the fungicide of choice because it provides excellent control of all the major fruit rot diseases ( Botrytis gray mold, anthracnose, and leather rot ). If applied at the time suggested above (green fruit through harvest) for anthracnose, Abound, Cabrio, and Pristine should be beneficial for control of leather rot as well. Recent research at Ohio State indicated that these materials have good to excellent activity against leather rot.

### **Fungicides for Leather Rot Control**

As previously mentioned, emphasis for leather rot control should be placed on the use of cultural practices such as planting on well drained sites or improving water drainage in the planting and a good layer of straw mulch to prevent berry contact with the soil. When needed, the following fungicides are labeled specifically for control of leather rot.

**Ridomil Gold SC** is labeled for control of Red Stele (caused by *Phytophthora fragariae*) and Leather Rot (caused by *Phytophthora cactorum*). The label for perennial strawberries reads as follows: “Established Plantings: Apply Ridomil Gold SL at 1 pt. per treated acre in sufficient water to move the fungicide into the root zone of the plants. Make one application in the spring after the ground thaws and before first bloom. A second application may be applied after harvest in the fall. **Note:** Although not labeled for leather rot control, the early spring application for red stele control should provide some control of leather rot. **For supplemental control of leather rot**, an application may be made during the growing season at fruit set. This application at fruit set (as green fruit are present) has been very effective for leather rot control.

### **Phosphorous acid Fungicides**

Several phosphorous acid (phosphite) fungicides are registered for control of red stele and leather rot on strawberry. They all have essentially the same active ingredient. These fungicides include Aliette, Agri-Fos, PROPHYT, Phostrol and Topaz. There are several other phosphite fungicides on the market and new ones continue to be introduced. These materials are highly systemic and are applied as foliar sprays for leather rot control.

Research at Ohio State University has shown that phosphorous acid fungicides are highly effective for control of leather rot when applied in a protectant program on a 7-day interval. In addition, Agri-Fos provided up to 36 hours of curative activity against leather rot in laboratory and field trials. Use recommendations and price varies among products. Compare price and see labels for rates and use recommendations.

**Table 1. Efficacy of Fungicides for Strawberry Disease Management.**

Fungicide <sup>a</sup>	Gray Mold	Leather Rot	Leaf Spot	Powdery Mildew	Anthraco-nose	Preharvest Interval Days
<b>Alone</b>						
Abound <sup>b</sup>	++	+++	++	+++	+++	0
Aliette	0	+++	0	0	0	0
Cabrio <sup>b</sup>	++	+++	++	+++	+++	0
Captan <sup>c</sup>	++	+	++	0	++	0
Elevate	+++	0	0	0	0	0
Nova	0	0	+++	+++	0	1
Ridomil	0	+++	0	0	0	0 <sup>a</sup>
Sulfur	0	0	0	+++	0	0
Switch	+++	0	0	0	++	0
Thiram <sup>d</sup>	++	+	++	0	+	0 <sup>c</sup>
Topsin <sup>e</sup>	+++	0	+++	+++	++	1
Phosphorous Acid	0	+++	0	0	0	0
Pristine <sup>b</sup>	++	+++	++	+++	+++	0
Scala 0	+++	0	0	0	0	
<b>In Combination</b>						
Abound + Captan	++	+++	++	+++	+++	0 <sup>c</sup>
Cabrio <sup>b</sup> + Captan <sup>b</sup>	++	+++	++	+++	+++	0 <sup>c</sup>
Elevate + Captan	+++	+	++	0	++	--
*Elevate + Thiram	+++	+	++	0	+	--
Switch + Captan	+++	+	++	0	++	--
Switch + Thiram	+++	+	++	0	+	--
Topsin + Captan	+++	+	+++	+++	++	--

Topsin + Thiram	+++	+	+++	+++	++	--
* Scala will perform similar to Elevate in combination with Captan or Thiram.						
Efficacy rating system: +++ = highly effective; ++ = moderately effective; + = slightly effective; 0 = not effective, ? = activity unknown.						
<p>a See label for harvest restrictions.</p> <p>b Abound, Cabrio, and Pristine have good activity against leather rot.</p> <p>c Although the preharvest interval for Captan is 0 days, protective clothing must be worn for 24 hours after application when entering the planting or harvesting fruit.</p> <p>d Thiram can not be applied within 3 days of harvest.</p> <p>e Always apply Topsin, Elevate, Scala or Switch in combination with an unrelated fungicide such as Captan or Thiram, or in an alternating program with a fungicide of different chemistry.</p>						

**Remember** these are only suggested guidelines for a fruit rot control program. It is always the grower's responsibility to read and understand the label. For the most current pesticide recommendations in Ohio, growers are referred to Bulletin 506-B "Midwest Commercial Small Fruit and Grape Spray Guide".

If growers have questions regarding the information covered here, they should contact: Mike Ellis; PH: 330-263-3849 and e-mail: [ellis.7@osu.edu](mailto:ellis.7@osu.edu).