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Anthracnose Fruit Rot of Strawberry[1]

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Anthracnose fruit rot, caused by the fungus *Colletotrichum acutatum*, is an important disease for strawberry worldwide. Other species of *Colletotrichum*, such as *C. fragariae* and *C. gloeosporioides*, are less frequently involved in fruit rot. Although fruit are most frequently affected by *C. acutatum*, other organs of the plant, including the crown, leaves, petioles, and roots, are also susceptible.

Pathogens and Symptoms

Anthracnose fruit rot lesions appear as dark, sunken spots on infected fruit (Figure 1). On green fruit, anthracnose lesions are small (1/16–1/8 inch across), hard, sunken, and dark brown or black. Lesions on ripening fruit are larger (1/8–1/2 inch), hard, sunken, and tan to dark brown. During wet weather, the lesions become covered with sticky, light orange ooze composed of millions of spores (conidia) in a mucilaginous matrix (Figure 2). When conditions are favorable for infection, multiple lesions nearly cover the fruit, and lesions may appear on petioles (Figure 3). Infected strawberry flowers are highly susceptible and turn brown and remain attached to the plant (Figure 4). Flowers infected by the gray mold fungus *Botrytis cinerea* may show similar symptoms. Small black spots on green button-sized fruit may also develop from flower infections (Figure 5).

Figure 1. Anthracnose lesions on a ripe fruit
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Disease Development and Spread

The most common way a new strawberry crop is infected is through transplants from the nursery. *C. acutatum* is a strong colonizer of runner plants in the nursery and may be present on the foliage of apparently healthy plants. In some cases, infected runner plants may show visible lesions on the petioles (Figure 3) and roots. A new crop may also be infected by inoculum carried over from the previous crop. In the past, traditional postseason crop destruction and cultivation were believed to eliminate inoculum carryover

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Figure 2. Spore mass of *C. acutatum* on anthracnose lesion
Credits: UF, GCREC

from Florida production fields. However, *C. acutatum* has been recovered from dead plants left on old plastic during the summer. Thus, if strawberry is planted on old plastic, the disease could affect the new crop. Various weeds in and around production fields may also be colonized by *C. acutatum* from strawberries. In theory, inoculum from these non-strawberry hosts could infect the strawberry crop, although this has not been demonstrated.

C. acutatum appears to spread first on the foliage, often without causing visible symptoms. A few conidia (asexual spores) are formed on green leaves and petioles, and more are produced as the tissue ages and dies. Conidia are moved from the foliage to the flowers and fruit primarily by splashing water. They then germinate and infect. Developing infections on flowers and fruit produce abundant conidia that are spread to other plants and fields by equipment and harvesters.

Anthracnose fruit rot development is favored by warm, wet weather. For this reason, epidemics typically occur in the spring when conditions are more favorable. Such epidemics cause serious losses for Florida growers. Crop losses occur mostly in the field since visibly spotted fruit are culled and the development of latent infections postharvest is suppressed by precooling and refrigeration.

Figure 3. Anthracnose lesions on petioles
Credits: UF, GCREC

Figure 4. Anthracnose flower blight
Credits: UF, GCREC

Control

Anthracnose fruit rot is best controlled by exclusion (i.e., by not introducing the pathogen into the field). Wherever possible, transplants should be obtained from pathogen-free nurseries. In addition, moving personnel and equipment from diseased to healthy fields without proper cleaning should be avoided. The newly released cultivars 'Florida Radiance' and 'Winterstar' have higher levels of resistance to anthracnose than 'Strawberry Festival' or the highly susceptible cultivars 'Treasure' and 'Camarosa'. When highly susceptible cultivars are grown, regular preventive fungicide applications are needed to suppress the disease.

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Figure 5. Anthracnose lesion on green fruit
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In Central Florida, anthracnose management has been based on weekly applications of the broad-spectrum, protectant fungicide captan. Applications can be made at lower label rates early in the season because weather conditions are less favorable for disease development at that time. Often a few anthracnose-infected flowers and fruit that appear in late January or early February lead to epidemics during the main harvest in late February and March. During the critical January to March period, protectant fungicides should be applied at higher label rates, and additional fungicides with some curative activity, such as Abound®, Cabrio®, and Switch®, may be needed for adequate disease control.

Since anthracnose incidence is highly dependent on weather conditions, fungicide applications can be timed based on key factors, such as leaf wetness duration and temperature. The Strawberry Advisory System (SAS) (http://edis.ifas.ufl.edu/ae450) (http://www.agroclimate.org/tools/strawberry/) has been developed to advise growers of the need to spray to prevent Anthracnose fruit rot as well as Botrytis fruit rot. SAS provides growers with recommendations for timing as well as suggestions for selecting the appropriate product. Disease risk alerts can also be provided to growers via e-mail or text messages.

Research has demonstrated that fungicide sprays can be reduced without affecting disease control or yield when following the SAS recommendations, especially when the more tolerant cultivars, such as 'Strawberry Festival', 'Florida Radiance', and 'Winterstar' are grown.

A list of fungicide products recommended for Anthracnose fruit rot control based on research trials is provided in Table 1.

Table 1. Fungicides recommended for control of Anthracnose fruit rot of strawberries in Florida

Product name (active ingredient)	Fungicide group[a]	Maximum rate/A		Minimum days to harvest	Re-entry interval (hours)	Remarks
		Per application	Per season			
Captan 80 WDG (captan)	M4	3.75 lb.	30 lb.	1	24	Do not apply in combination with or immediately before or closely following oil sprays. Do not mix with strongly alkaline materials.
Captec 4L® (captan)	M4	3 qt.	54 qt.	1	24	Do not apply in combination with or immediately before or closely following oil sprays. Do not mix with strongly alkaline materials.
Quadris Top™ (difenoconazole + azoxystrobin)	3 + 11	14 fl. oz.	56 fl. oz.	0	12	Do not make more than two consecutive applications before alternating to another fungicide group and no more than four applications per crop per year.
Abound® (azoxystrobin)	11	15.4 fl. oz.	1.92 qt.	0	4	Do not make more than two consecutive applications and no more than four applications per crop per year.
Cabrio® EG (pyraclostrobin)	11	14 fl. oz.	70 fl. oz.	0	12	Do not make more than two consecutive applications and no more than five applications per crop per year.
Evito® 480 SC, Aftershock™ (fluoxastrobin)	11	5.7 fl. oz.	22.8 fl. oz.	1	12	Do not make more than two consecutive applications and no more than four applications per crop per year.
Flint® (trifloxystrobin)	11	3.2 oz.	19.2 oz.	1	12	Do not make more than two consecutive applications and no more than six applications of group 11 fungicides per crop per year.
Switch® 62.5 WG (cyprodinil + fludioxonil)	9 + 12	14 oz.	56 oz.	0	12	Do not make more than two consecutive applications. Do not plant crops not on the label for 30 days after last application.

[a] Fungicide group (FRAC Code): Numbers (1–37) and letters (M) are used to distinguish the fungicidal mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered when making decisions about how to manage fungicide resistance. M = multisite inhibitors, fungicide resistance is low; NC = not classified. Source: http://www.frac.info/ (Fungicide Resistance Action Committee, FRAC).

Always read a current product label before applying any chemicals.

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