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SOOTY BLOTCH AND FLYSPECK OF APPLE

Sooty blotch and flyspeck are two of the most common diseases of apple that often occur on fruit at the same time. Sooty blotch is a disease complex caused by the fungi *Peltaster fructicola, Geastrumia polystigmatis, and Leptodontium elatius.* Flyspeck is caused by the fungus *Zygophiala jamaicensis.* These diseases are wide spread in the Midwest. Since both diseases are controlled in the same way, they are usually considered together (Figure 1).

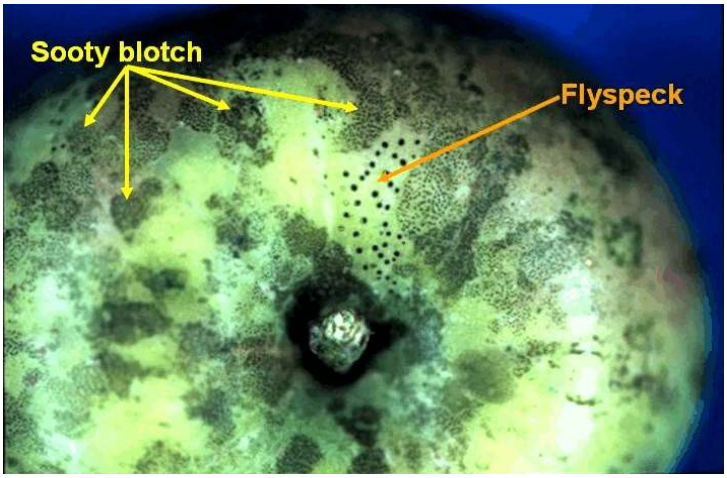

Figure 1. Sooty blotch and flyspeck on an apple fruit.

Because the fungi causing sooty blotch and flyspeck grow superficially on the surface of the fruit, losses are primarily through lowered fruit quality. Infections are much more obvious on yellow-skinned apple cultivars.

There are more than 50 reservoir hosts of sooty blotch and flyspeck. The sooty blotch fungi infect the leaves, twigs, and fruit of more than 25 different plants including ash, blackberry, bladdernut, citrus, crabapple, elm, hawthorn, maple, pear, persimmon, prickly-ash, raspberry, sassafras, sumac, sycamore, and willow (Table 1). The flyspeck fungus also infects a variety of plants including banana, blackberry, carnation, citrus, grape, Japanese persimmon, pear, plum, quince, raspberry, and sumac (Table 2). These diseases are very common during wet seasons.

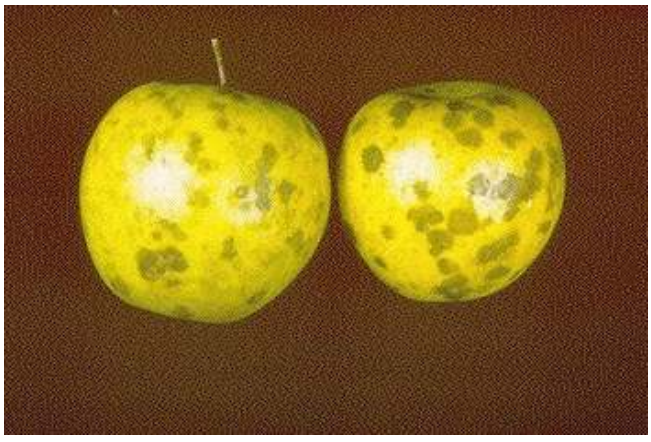
Figure 2. Sooty Blotch on apple fruit.

Symptoms

SOOTY BLOTCH: Sooty blotch appears as sooty or cloudy blotches on the surface of the fruit. The blotches are olive green with an indefinite outline (Figure 2). The blotches are usually one fourth of an inch in diameter or larger, and may coalesce to cover much of the fruit. The "smudge" appearance

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results from the presence of hundreds of minute, dark pycnidia that are interconnected by a mass of loose, interwoven dark hyphae. The sooty blotch fungus is generally restricted to the outer surface of the cuticle and can be removed by vigorous rubbing or bleaching. In rare cases, the hyphae penetrate between the epidermal cell walls and the cuticle.

FLYSPECK: Groups of a few to 50 or more slightly raised, black and shiny round dots that resemble fly excreta, appear on the apple fruit (Figure 3). The individual "fly specks" are more widely scattered and much larger than the pycnidia of the sooty blotch fungus. The flyspecks are sexual fruiting bodies (pseudothecia) of the fungus, and are interconnected by very fine hyphae. The blemishes can be removed by vigorous rubbing or bleaching.

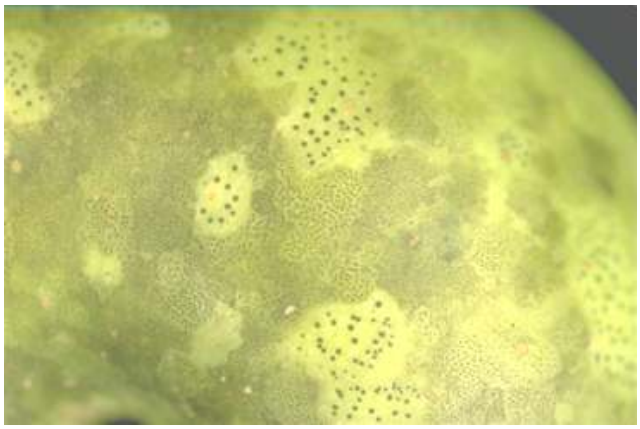

Figure 3. Close-up of flyspeck on an apple fruit.

Disease Cycle

Both fungi overwinter on the twigs of many woody plants (Tables 1 & 2). The disease cycles, as well as the temperature and moisture conditions necessary for infection, are much the same for both diseases.

SOOTY BLOTCH: The pycnidia on host plants produce large numbers of spores (conidia) that ooze out of infections and collect in a gelatinous mass. The conidia are carried by air currents and windblown rain through orchards from late May or early June until autumn. The thick-walled, dark hyphae formed on apple and other twigs often break up into cell-like fragments. These fragments may be washed from twigs onto the developing fruit, where they initiate infections. After spread and enlargement, secondary infections occur on fruit. Current-season twig growth is also infected during the summer and early autumn.

The fungi grow in a wide range of temperatures, 64°to 80°F (18° to27°C). Moist condition is essential for infection and disease development. When May and June are cool and are followed by a hot July and August, sooty blotch often does not appear on the fruit until close to harvest. Disease outbreaks are most severe when cool, rainy weather in the spring is coupled with summer rains and cool fall temperatures prior to harvest. Under ideal conditions, the incubation period from infection to the appearance of symptoms may be as short as 5 days. In the orchard, however, this period usually lasts 20 to more than 60 days. Fruit infection can occur any time after petal fall, but it is most prevalent during mid- to late-summer.

FLYSPECK: In late spring, this fungus produces both ascospores and conidia that are wind-borne into orchards from other plants. The incubation period in cool weather (65°F or 18°C) is about 15 days.

Control

Sooty blotch and flyspeck are most prevalent in the damp, shaded areas of an orchard. Any practice that improves air movement and promotes rapid drying greatly improves control. To control these diseases, fungicides must be applied, starting shortly after petal fall (calyx) and continuing when cooler weather occurs in the autumn prior to harvest. Most growers apply preventive fungicide spray on a 10- to 14-day schedule for control of sooty blotch/flyspeck (http://www.extension.iastate.edu/Publications/PM1282.pdf). However, there are a wide range of integrated pest management (IPM) options available to growers who wish to reduce pesticide use.

Cultural Methods

1. **Pruning**. A properly pruned tree will slow the development of sooty blotch/flyspeck. Annual pruning will allow better and faster drying of fruit after rain or dew. Sooty blotch/flyspeck fungi require periods of wetness in order to grow, so keeping the surface of the fruit as dry as possible can reduce diseases. In addition, a well-pruned tree allows better penetration of fungicides. Fruit in the inner canopy of an inadequately pruned tree often show sooty blotch/flyspeck damage, even in orchards that receive frequent fungi sprays.

2. **Bramble Management.** Various species of *Rubus*, including blackberries and raspberries are major reservoir hosts for sooty blotch/flyspeck. If you produce these berries on your farm, it is advisable to plant them far away from the orchard or on the other side of a windbreak or hedgerow. Wild brambles located near the edges of orchard blocks should be removed during the spring and summer to reduce the amount of sooty blotch and flyspeck spores.

3. **Thinning.** When sooty blotch/flyspeck fungi coat the surface of apples early in the season, the apples are too small to touch each other. When the apples grow larger and form clusters, tight clusters can provide sooty blotch/flyspeck fungi with a humid environment and a refuge from fungicide. Harvested apples may then have sooty blotch/flyspeck blotches on the surface that were protected by the cluster. Proper thinning will reduce clustering, thus reducing the ability of these fungi to "hide" from fungicides.

4. **Mowing.** Mowing is another strategy that can promote better air flow and faster drying in an orchard. Apples on low-hanging branches, especially in tall grasses, can remain wet with dew until late morning. Regular mowing allows low-hanging apples to dry quickly and discourages multiplication of sooty blotch/flyspeck fungi.

5. **Cultivar Selection**. Although there are no apple varieties resistant to sooty blotch/flyspeck, some cultivars have physiological characteristics that may reduce risk of sooty blotch/flyspeck damage. For example, only early-maturing cultivars may show less damage because sooty blotch/flyspeck fungi have less time to multiply on the apple surface. Symptoms are less visible on dark-skinned fruit than on light-skinned fruit. Although dark red apples have as many sooty blotch/flyspeck blemishes as yellow apples, the red apples can be more appealing to consumers as the spots are not as obvious. Planting early-maturing, dark red apple cultivars can therefore reduce the damage caused by sooty blotch/flyspeck.

Chemical Methods

Fungicides can be used effectively and safely to manage sooty blotch/flyspeck. Various IPM methods for timing sprays and choosing chemicals have been successful in Illinois orchards.

1. **Weather-based Spray Timing.** In recent years, a disease warning system for sooty blotch/flyspeck has been developed. In this system, a total of 175 hours of wetness due to rain and/or dew (Figure 4) must be measured after the first-cover spray before the second-cover spray is applied. Once the second-cover spray is applied, fungicides are applied preventively (approximately every 10 to 14 days) until close to harvest. A tank mix of a benzimidazole fungicide (i.e., thiophanate-methyl) and a contact fungicide (such as captan) should be used in the first- and second-cover fungicide sprays when applying the warning system.

Growers can record wetness of trees by using a personal weather sensor. The sensor is mounted in the lower canopy of a representative tree in the orchard for data collection (Figure 5), and the data is downloaded to a personal computer as often as necessary (usually once a week in the beginning and more often as approaching the threshold level).

With the wetness measurement system, data collection begins after the first-cover spray. Wetness hours are added each day until the total hours are 175. At this time, the second-cover spray is applied. A standard 14-day schedule is followed for the rest of the season.

Figure 4. An apple with free moisture on the surface, a condition favorable for development of sooty blotch and flyspeck.

2. **Reduced-risk fungicides**. Sooty blotch/ flyspeck control by two "reduced-risk" strobilurin fungicide, kresoxim methyl (Sovran) and trifloxystrobin (Flint), have been evaluated for control of sooty blotch/flyspeck. When sprays of Sovran® or Flint® were alternated with sprays of thiophanate-methyl (Topsin-M) plus captan, control of sooty blotch/flyspeck equaled that of full-season sprays of thiophanate-methyl plus captan. These strobilurin fungicides are less dangerous to human health and to the environment but provide the same level of control as conventional sprays.

Figure 5. A Wetness/Temperature Logger under canopy of an apple tree.

3. **Organic fungicide**. Potassium bicarbonate ($KHCO_3$) is a new, moderately effective fungicide for control of sooty blotch/flyspeck. Potassium bicarbonate is more effective treatment for control of apple diseases, particularly powdery mildew in organic orchards.

Effectiveness of fungicides against sooty blotch and flyspeck

Fungicide	Activity against SB	Activity against FS
Flint, Sovran	Excellent	Excellent
Topsin M	Excellent	Good
Captan, Ziram	Fair to Good	Fair to Good
Ferbam, Thiram	Fair	Fair
Mancozeb (Dithane, Manzate, Penncozeb)*	Excellent	Excellent
Sulfur, Syllit	Poor	Poor
Bayleton, Nova, Procure, Rubigan	None	None

*Cannot be sprayed within 77 days of harvest.

Table 1. Plants that have been reported as hosts to the sooty blotch fungi

ash	magnolia	prickly-ash
blackberry	maple	raspberry
bladdernut	mountain-ash	redbud
Citrus	oak	sassafras
crabapple	orchids	spicebush
dogwood	Oriental bittersweet	sumac
grape	paw paw	sycamore
hawthorn	peach	trifoliage orange
Kentucky coffee-tree	pear	tuliptree
leatherwood	persimmon	willow
		wintergreen

Table 2. Plants that have been reported as hosts to the flyspeck fungus

American elderberry	manzanita	quince
banana	maple	raspberry
blackberry	orchids	sassafras
camphor-tree	pear	sumac
carnation	persimmon,	trifoliate orange
Citrus	Japanese and Texas	wild-goose plum
crabapple	plum	willow
grape	prickly-ash	wintergreen