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Control of Sooty Blotch and Flyspeck with a Pre-bloom Application of Captafol

SUMMARY

Sooty blotch and flyspeck diseases occurred on apples that developed from hand pollinated blossoms covered with plastic bags in 1974. Trace amounts of the diseases developed on apples sprayed with captafol at delayed dormant, pre-pink, and petal fall stages of development in 1975, whereas unsprayed apples covered at the same time developed twice as much sooty blotch and three times as much flyspeck. With applications of captafol at pre-pink and near full-bloom in 1976, sooty blotch and flyspeck ratings were less than 2. During 1978, when captafol was applied at green tip and metiram was used throughout the cover sprays, sooty blotch and flyspeck incidence was 1.01 and 0.16, respectively.

COVER PHOTO. Red Delicious apple infected with sooty blotch and flyspeck (right) and clean apple (left). Solid greenish-black blotches are typical of sooty blotch disease and pin point spots are typical of flyspeck disease.

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Control of Sooty Blotch and Flyspeck of Apples *with a* Pre-bloom Application of Captafol

A. J. LATHAM AND M. H. HOLLINGSWORTH[1]

SOOTY BLOTCH AND FLYSPECK are problem diseases on apples grown in humid areas such as Alabama. Symptoms of these diseases have been found on July Red Delicious and Transparent apples as early as mid-June *(1)*. Besides causing an unappealing fruit appearance, a high incidence of these diseases has caused apples to fall 3 weeks earlier than disease-free fruit on adjacent trees of Richared Red Delicious apples *(9)*. Sooty blotch is caused by *Gloeodes pomigena* (Schw.) Colby and flyspeck is caused by *Zygophiala jamaicensis* Mason.

Ascospores of *Z. jamaicensis* were discharged in April in coastal California during and following the apple blossom season *(4)*. In Indiana, mature ascospores of *Z. jamaicensis* were found during the first part of June *(1)*, and those of *G. pomigena* in late May and early June *(2)*. First infections by these fungi occurred before June 21 *(6)* or within a month of petal fall *(8)* in Pennsylvania. The spores are airborne for considerable distance, and initiate primary infections on newly developed plant parts *(3)*. Five to 15 days are required for symptoms to develop on apples under cool, moist conditions *(6,14)*. Growth of *Z. jamaicensis* occurred over a temperature range of 40-80°F *(1)*. Similar moisture and temperature conditions are required for infection by *G. pomigena*, which explains the association of these fungi *(13)*.

Generally, recommended spray schedules in apple-growing areas call for fungicide control of sooty blotch and flyspeck to start with

[1]Associate Professor, Department of Botany, Plant Pathology, and Microbiology, and Superintendent, North Alabama Horticulture Substation, respectively.

Appearance of this apple with its many pin point spots is typical of fruit infected with sooty blotch disease.

the second *(11,12)* to fourth *(7,13)* cover spray, and continue until harvest. Timing fungicide applications according to such schedules does not appear to coincide with development of the diseases in Alabama. Both fungi are active during humid, cool spring weather, but may be entirely absent during hot, dry, summer weather *(2)*. In Alabama, control of sooty blotch and flyspeck was poor with a dodine + ferbam blossom spray followed by folpet cover sprays, or a season long application of metiram, mancozeb + dinocap, thiram + folpet, dithianon, or with thiophanate methyl *(9)*.

The purpose of this investigation was to obtain effective control of sooty blotch and flyspeck on apples by improving the timing of fungicidal applications in Alabama.

MATERIALS AND METHODS

In 1974, the seasonal development of sooty blotch and flyspeck was investigated on mature Richared Red Delicious apples at the North Alabama Horticulture Substation, Cullman. A 1-quart plastic bag was placed over apple blossoms or fruit clusters, with only a few attached leaves included, and tied to the twig. The bag was cut 1 inch deep at right angles to the bottom, to release water condensate. On April 9, 15, and 23, a total of 260 blossoms was bagged on each of six trees. The blossoms had browned stamens and pistils, indicating pollination probably had occurred. Bagging continued on April 30 and May 7, with 60 apple clusters

bagged on each of six trees; average diameter of the apples on the two dates was 3/8 and 5/8 inch, respectively. Fruit set occurred between April 9 and 15. On August 15, all bagged apples and nonbagged check fruit were harvested for disease determinations. Incidence of sooty blotch and flyspeck on each apple was rated on a 0 to 5 scale, where 0 = no disease, 1 = trace, 2 = 2-10 percent, 3 = 11-25 percent, 4 = 25-50 percent, 5 = 51 to 100 percent of fruit surface diseased.

In 1975 benomyl[2] (0.5 pound per 100 gallons of water plus 1 quart non-phytotoxic oil) and captafol[3] (5 quarts per 100 gallons plus 1 quart non-phytotoxic oil) were applied at silver tip (March 26), tight cluster (April 11), and petal fall (May 1) stages of growth on Red Delicious apples. The fungicides were applied separately by hand gun as dilute sprays to run-off, using a John Bean sprayer at 400 p.s.i. to six single-tree replicates. Six unsprayed trees served as checks. No oil was used with captafol on April 11 or May 1. On May 9, all trees were sprayed with Guthion 50W and Cygon 267 EC for insect control. No other sprays were applied during the season. Subsequently, Golden Delicious apple pollen (Antles' Pollen Supplies, Wenatchee, Wash.) was applied to stigmas of blossoms on sprayed and unsprayed trees with a camel hair brush and the blossoms were covered with plastic bags. On April 15, 17, and 21, twenty-five hand pollinated blossoms or clusters of blossoms were bagged per tree. Similarly, on April 24, May 1, and May 8, twenty-five developing apples or apple clusters that were naturally pollinated were bagged per tree. The average diameter of 60 apples from six trees was 7/8 inch on May 8. On August 5, all bagged and 25 nonbagged fruit per tree were harvested and disease evaluations made.

In 1976, captafol (5 quarts per 100 gallons water plus 1 quart non-phytotoxic oil) was applied to 12 trees in the pink stage (April 1) and near full bloom (April 7). Six trees received no additional fungicide applications; the other six were sprayed with metiram[4] (2 pounds per 100 gallons water). Fungicide and insecticide applications were made on April 19 and 26, May 3, 10, 17, and 24, June 1, 8, 16, 21, and 29, and July 6, 17, and 30. Six trees were left unsprayed to serve as controls. Apples were harvested on August 8 and disease evaluations were made from 1 bushel of apples randomly selected from each tree.

[2]Benlate 50WP.
[3]Difolatan 4F.
[4]Polyram 80WP.

During 1978, captafol (1976 rate) was applied in the green tip stage (April 3) and, subsequently, metiram (to five trees) was applied at 1976 rates on April 17 and 24, May 2, 9, 19, and 28, June 9 and 23, July 7 and 21, and August 4 and 18. Dodine[5] (0.5 pound per 100 gallons water) was applied during bloom (April 10), followed by metiram cover sprays. Five trees were left unsprayed to serve as controls; however, fruit had rotted or dropped from two of these trees by harvest on August 29. One bushel of apples randomly selected from each tree was evaluated for diseases.

RESULTS

Observations in 1974 indicated that the source of infection by the sooty blotch fungus might have been inoculum on twigs or leaves within the bags. Sooty blotch was most prominent in the stem depression of the fruit. Other sites of extensive infection were the blossom ends and areas adjacent to where leaves were in contact with the fruit. Sooty blotch developed where plastic bags were in contact with an apple, if the area was wet. Parts of apples submerged in condensate showed extensive sooty blotch.

From the data, it appeared that inoculum of *Z. jamaicensis* was not abundant on twigs at the time blossoms or apples were bagged, table 1. In addition to these data, 44 apples showing bitter rot, black rot, white rot, or other rots too extensive to permit evaluations for sooty blotch and flyspeck were also collected from the bags.

Evaluations of sooty blotch and flyspeck development in 1975 showed index ratings less than 2 on apples bagged during the

TABLE 1. INCIDENCE OF SOOTY BLOTCH AND FLYSPECK AT HARVEST ON APPLES ENCLOSED IN PLASTIC BAGS AT VARIOUS STAGES OF GROWTH DURING 1974[1]

Dates bagged	Apple growth	Disease indices[2]		Apples harvested
		Sooty blotch	Flyspeck	
April 9, 15, 23	Bloom	1.9	0.2	91[3]
April 30	3/8 inch diameter	1.5	.7	40
May 7	5/8 inch diameter	1.9	.7	29
August 15 (control)	not bagged	4.7	2.9	38

[1]Data are averages from apples harvested from six trees on August 15.
[2]Disease severity scale: 0 = no disease, 1 = trace, 2 = 2-10 percent, 3 = 11-25 percent, 4 = 26-50 percent, 5 = 51-100 percent of fruit surface diseased.
[3]Number of apples harvested per treatment; rotted apples were not included in totals.

[5]Cyprex 65WP.

blossoming period. Apparently, benomyl gave no disease control, since there was no difference in disease indices between benomyl and controls; however, captafol reduced sooty blotch to an index one-half that of the controls, and flyspeck was much lower than the controls, table 2. Similar results occurred with matured apples that were bagged in the juvenile apple stage.

TABLE 2. INCIDENCE OF SOOTY BLOTCH AND FLYSPECK ON BAGGED AND NONBAGGED APPLES FROM FUNGICIDE SPRAYED AND UNSPRAYED TREES IN 1975

Treatment	Disease indices[1]		
	Apples bagged at		Apples not bagged
	Blossom stage[2]	Juvenile apple stage[3]	
	SOOTY BLOTCH		
Benomyl	1.51 b[4]	1.70 b[4]	4.95 b[5]
Captafol	.60 a	.56 a	.80 a
Check	1.52 b	1.94 b	5.00 b
	FLYSPECK		
Benomyl	.32 a	.25 a	3.89 b[5]
Captafol	.09 a	.07 a	.24 a
Check	.16 a	.22 a	3.61 b

[1]Disease severity scale: 0 = no disease, 1 = trace, 2 = 2-10 percent, 3 = 11-25 percent, 4 = 26-50 percent, 5 = 51-100 percent of fruit surface diseased.
[2]Blossoms were hand pollinated and bagged April 15, 17, and 21.
[3]Apples naturally pollinated and bagged April 24 and May 1 and 8.
[4]Means followed by the same letters are not significantly different at the 0.05 level of Duncan's Multiple Range Test.
[5]Means followed by the same letter are not significantly different at the 0.01 level of Duncan's Multiple Range Test.

Applications of benomyl (1975) made at silver-tip, tight cluster, and petal fall did not reduce sooty blotch or flyspeck when the apples were not covered with plastic bags, table 2. Many of the apples on trees sprayed with captafol were free of sooty blotch and flyspeck infection at harvest; however, some phytotoxicity was evident in the form of fruit russet. Without the protective cover sprays, bitter rot, black rot, white rot, and scab developed.

In 1976, applications of captafol at the tight cluster and near full bloom stages prevented sooty blotch and flyspeck infection. Disease indices of only 0.5 to 1.63, or 0.1 to 5 percent diseased fruit surfaces, resulted from captafol applications, table 3. Scab increased in captafol treatments which did not receive cover sprays of metiram. All fruit on three check trees had fallen by harvest time and that which had not rotted showed extensive sooty blotch and flyspeck infection.

TABLE 3. EFFECTIVENESS OF FUNGICIDE APPLICATIONS FOR PREVENTION OF APPLE DISEASES AT THE NORTH ALABAMA HORTICULTURE SUBSTATION, 1976

Treatments	Rate per 100 gal.	Disease ratings			
		Sooty blotch index[1]	Fly-speck index[1]	Pct. scab	Pct. russet
Captafol 4F	5 qt.[2]	1.09	0.52	38.6	20.6
Captafol 4F metiram 80W	5 qt.[2] 2 lb.[3]	1.63	.97	15.1	19.9
Check (unsprayed)	—	5.0	4.0	100.0	14.6

[1]Disease severity scale: 0 = no disease, 1 = trace, 2 = 2-10 percent, 3 = 11-25 percent, 4 = 26-50 percent, 5 = 51-100 percent of fruit surface diseased.
[2]Applications made pre-pink April 1 and near full bloom April 7.
[3]Sprays applied 14 times from April 19 to July 30.

TABLE 4. EFFECTIVENESS OF FUNGICIDE APPLICATIONS FOR PREVENTION OF APPLE DISEASES AT THE NORTH ALABAMA HORTICULTURE SUBSTATION, CULLMAN, 1978

Treatments	Rate per 100 gal.	Disease ratings[1]			
		Sooty blotch index[1]	Fly-speck index[1]	Pct. scab	Pct. russet
Captafol metiram	5 qt.[2] 2 lb.[3]	1.01 a	0.16 a	0.2 a	0
Dodine metiram	0.5 lb.[4] 2 lb.[3]	1.43 a	.28 a	1.8 a	0
Check (unsprayed)	—	4.73 b	3.62 b	90.1 b	0

[1]Disease severity scale: 0 = no disease, 1 = trace, 2 = 2-10 percent, 3 = 11-25 percent, 4 = 26-50 percent, 5 = 51-100 percent of fruit surface diseased.
[2]Applications: green tip April 3, 1978.
[3]Metiram applied 12 times from April 17 to August 18.
[4]Applications: April 10, 1978.

The single green tip (April 3) application of captafol followed by metiram cover sprays during 1978 resulted in an average disease index of 1.01 for sooty blotch and 0.16 for flyspeck, or about 1 percent sooty blotch and 0.2 percent flyspeck infected fruit surface, table 4. Apples from trees not treated with fungicides were severely diseased. The single green tip application of captafol did not cause fruit russeting of the Red Delicious apples.

DISCUSSION

Sooty blotch and flyspeck developed on apples grown in plastic bags from hand pollinated blossoms in 1974 and 1975. These results agreed with studies made in other states and indicate that ascospores or conidia of *G. pomigena* and *Z. jamaicensis* are dis-

seminated as soon as temperatures are warm enough for blossom development *(2,3,4,5,6,8)*.

Early application of captafol to reduce or eliminate russet on fruit at green tip showed promise as an eradicant for a spring clean-up of inoculum that causes sooty blotch and flyspeck *(10)*. These results indicated that infections by the sooty blotch and flyspeck pathogens occur early in the season. The single application of captafol recommended by the manufacturers for control of apple scab permitted only trace amounts of sooty blotch and flyspeck when followed by cover sprays.

Fungicide cover sprays are essential since *Z. jamaicensis* has been reported from 78 species in 36 families of plants *(3)*, and *G. pomigena* from 23 or more species *(2)*. Many of these grow near apple orchards in Alabama, and may provide season-long inoculum. One application of captafol seemed to provide near season-long protection from sooty blotch and flyspeck. Scab and the summer rots caused by *Botryosphaeria dothidea, Glomerella cingulata,* and *Physalospora obtusa* were not controlled and required some applications of fungicides effective against these diseases.

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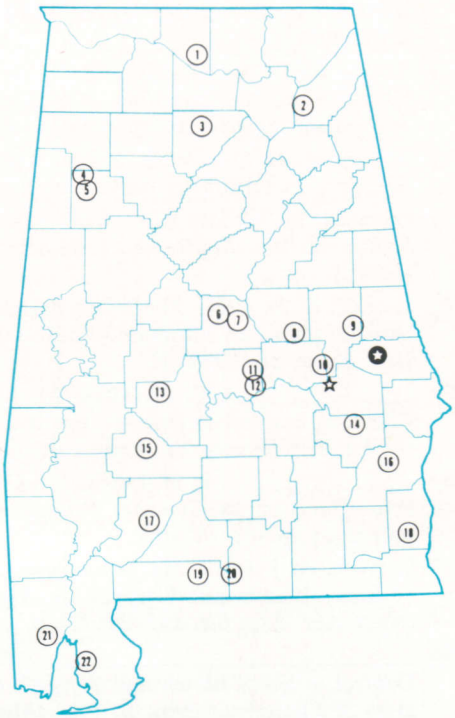

Research Unit Identification

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2. Sand Mountain Substation, Crossville.
3. North Alabama Horticulture Substation, Cullman.
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