# *Incidence and Control of* SOOTY BLOTCH *and* FLY SPECK *on Apples in Alabama*

Circular 208 September 1973
AGRICULTURAL EXPERIMENT STATION / AUBURN UNIVERSITY
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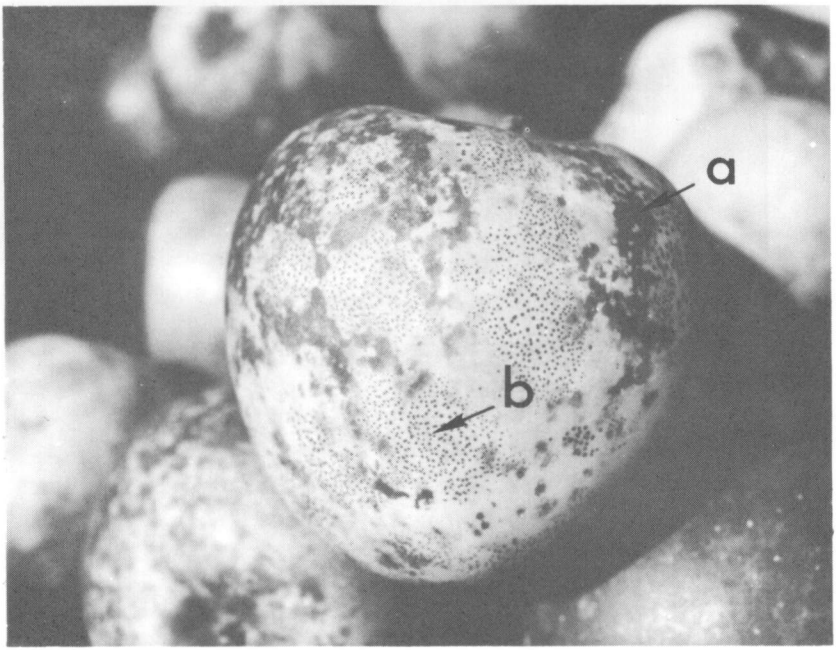


**Solid blotches (a) are typical of sooty blotch disease and pin point spots (b) are typical of fly speck disease. See cover for full color illustration of the two serious apple diseases.**

# Incidence and Control of Sooty Blotch and Fly Speck on Apples in Alabama

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PROBABLY NO AREA in the United States has as much potential for profit in apple production as northern Alabama. Between 150,000 and 200,000 apple trees have been planted in that area during the past few years, according to data from Auburn University Cooperative Extension Service.

Diseases like sooty blotch and fly speck, which cause apples to appear commercially unappealing, represent one possible limiting factor. These diseases may become serious problems whenever apples are produced in humid climates, and they have been observed wherever apples are grown in Alabama. A severe outbreak of both occurred at the North Alabama Horticulture Substation, Cullman, during 1968 despite use of a standard disease prevention program.

## DISEASE DEVELOPMENT AND CONTROL

Sooty blotch and fly speck typically occur together on the same fruit, but they are distinct diseases caused by two different fungi. Sooty blotch, caused by *Gloeodes pomigena* (Schw.) Colby, gives a smudged or sooty appearance to affected fruit. The sooty area is composed of hundreds of dark, minute pycnidia (fungal structure that contains spores) connected by loose, profusely branched, thread-like fungal growths. (See cover photo and page 2 illustration.)

Fly speck is caused by *Microthyriella rubi* Petr. This fungus appears like true fly specks, but actually consists of definite, cir-

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cular, black, often glistening spots on affected fruit. These spots occur 10 to 50 in a group, scattered widely and larger in size than sooty blotch pycnidia, as can be seen in the cover photo. Both fungi occur superficially on the apple and can be removed by vigorous rubbing.

The two fungi overwinter on twigs of apple, dogwood, maple, oak, sassafras, and tupliptree, and on blackberry canes, among some 23 hosts *(1,4)*. Baines *(2)* reported control of sooty blotch in Indiana with fungicides applied between the end of May and middle of June. Hickey *(4)* reported that first infections by *G. pomigena* and *M. rubi* occurred before June 21 and were numerous on fruit exposed for any 2-week period from July 2 through September 15 in Pennsylvania. Apparently, conidia of these fungi were aerially disseminated in orchards from spring until fall.

Baines and Gardner *(1)* inoculated apples in the orchard at varying intervals from June 6 through August 3 and found that a short incubation period was associated with moderate rainfall and cool temperatures; conversely, the incubation period was extended by hot, dry summer weather. Optimum growth of *G. pomigena* occurred at 68°F with good growth ranging from 64° to 80°. Little development of *G. pomigena* occurred at 90 per cent relative humidity or less *(1)*. Similarly, practically no growth of the fungus occurred at 86°F. Consequently, this disease may be entirely absent during seasons when hot, dry weather prevails until harvest *(1)*.

According to Hickey *(4)*, the incubation period for *G. pomigena* was 4 to 12 days on inoculated fruit in a moist chamber; inoculations on 45-day-old apples in the orchard required 20 to 25 days incubation. With natural infections in the orchard, the incubation period was 28 days on 42-day-old apples *(4)*. *M. rubi* has an incubation period of about 15 days with cool temperature *(4,6)*. It required the same moisture and temperature conditions for infection as *G. pomigena*, which explains the association of these fungi *(6)*.

Hickey *(4)* reported captan, ferbam, folpet, thiram, and zineb controlled sooty blotch when applied at 2-week intervals. Dodine inhibited growth of *G. pomigena* but was unsatisfactory against *M. rubi*. Diener *(3)* reported dodine and folpet gave outstanding control of sooty blotch and fly speck under severe conditions in Alabama. Difolatan was reported as another outstanding fungicide for control of these diseases *(7)*.

In a 1970 Alabama study *(5)*, fungicides other than Benlate that normally control sooty blotch and fly speck failed to do so. Examination of diseased fruit still on trees showed excellent control on fruit surfaces facing outward and when fruit was located on outer branches, but not on fruit within the canopy of foliage and branches.

## DESCRIPTION OF EXPERIMENT

Investigations reported here were conducted during 1969-72 at the North Alabama Horticulture Substation, Cullman. Objectives were to develop a fungicidal program for disease control and to evaluate the effect of cultural practices on disease incidence.

During 1970, the development of sooty blotch and fly speck was studied with 'Richared Delicious' apples bagged on the trees and later exposed to natural inoculation. A 1-quart plastic bag was slipped over an apple cluster with attached leaves and tied above the apple stem. Apples were 12 to 20 mm. diameter when bagged shortly after pollination on May 6-8. The bottom edges of the plastic bags were cut 2.5 cm. at right angles to the bottom, to permit release of condensation. Nine hundred apple clusters were bagged; subsequently 100 apples were uncovered for a 3-week exposure period and then rebagged. At harvest (August 19), disease incidence was evaluated according to the following indices: 1, trace (up to 1 per cent); 2, light coverage (2-10 per cent); 3, medium coverage (11-25 per cent); 4, heavy coverage (26-50 per cent); 5, solid coverage by disease (51-100 per cent).

Richared Delicious and 'Golden Delicious' apples were used in the sooty blotch and fly speck investigation, with fungicide evaluations conducted on mature, single-tree plots (trees planted in 1950). Treatments were randomized and replicated 3 to 7 times depending on cultivar used. A dormant application of 2 quarts of 4, 6-dinitro-*o*-cresol (Elgetol 30) per 100 gallons of water with 6 gallons Volck 70 Supreme oil was made before March 15 each year. Fungicides evaluated are listed by trade, common, and chemical names in Table 1.

Initial fungicide applications were made at the green-tip stage, followed by successive applications on a 7- to 10-day schedule until July and thereafter at 14-day intervals. During 1969, applications were made to one part of the orchard on a 7-day schedule and to another part on a 14-day schedule. Streptomycin sulfate

TABLE 1. FUNGICIDES USED IN SOOTY BLOTCH AND FLY SPECK APPLE DISEASE CONTROL INVESTIGATIONS

| Trade or proprietary name | Common name | Chemical name |
|---|---|---|
| Benlate 50W | benomyl | 1-(butylcarbamyl)-benzimidazolecarbamate |
| Captan 50W | captan | N-(trichloromethylthio)-4-cyclohexene-1,2-dicarboximide |
| Cyprex 65W | dodine | n-dodecylguanidine acetate |
| Difolatan 4F | ---------- | N-[1,1,2,2-tetrachloroethyl)-sulfenyl] *cis*-4-cyclohexene-1,2-dicarboximide |
| Dikar 80W | ---------- | (1-methyl heptyl) phenyl-crotonate and related dinitro phenol 6%, and zinc ion and manganese ethylene bisdithiocarbamate coordination products 74% |
| Fermate 76W | ferbam | ferric dimethyldithiocarbamate |
| Phaltan 50W | folpet | n-(trichloromethylthio) phthalimide |
| Polyram 80W | ---------- | mixture of 5.2 parts ammoniates by weights of [ethylenebis (dithiocarbamate)]-zinc with 1 part ethylene bis [dithiocarbamic acid] bimolecular & trimolecular cyclic anhydrosulfides and disulfides |
| Thylate 65W | thiram | tetramethylthiuram disulfide |
| Thynon 75W | dithianon | 1,4-dithioanthroquinone-2,3-dicarbonitrile |
| Topsin-M 70W | thiophanatemethyl | 1,2-bis (3-methoxycarbonyl-2-thioureido) benzene |

(60 p.p.m.) was applied at 4- to 5-day intervals during blossoming for fire blight control. Guthion was included in cover sprays for insect control. Applications of fungicides, insecticides, and streptomycin were made with a John Bean air-blast sprayer.

In the 1972 test, 32 Richared Delicious trees were pruned severely during dormancy to improve spray coverage of fruit. Another 14 trees of the variety were partially pruned according to standard procedures. Selected fungicides were used in connection with both pruning procedures to determine effects on disease control. Apples were harvested August 28 to September 6, 1969-72. Approximately 1 bushel of apples was picked per tree and evaluations of sooty blotch and fly speck incidence tabulated. Data were recorded in per cent of fruit diseased by sooty blotch and fly speck.

## RESULTS AND DISCUSSION

Sooty blotch incidence fluctuated from a rating of 1.35 to 1.92 on apples bagged May 6-8 and exposed for 3 weeks or left covered during other portions of the season, Table 2. Apples exposed

TABLE 2. SOOTY BLOTCH AND FLY SPECK ON APPLES EXPOSED FOR DIFFERENT PERIODS OF TIME

| Exposure periods | Number fruit harvested | Index average | |
|---|---|---|---|
| | | Sooty blotch | Fly speck |
| 1—pollination to May 6-8 | 100 | 1.59 | 0.27 |
| 2—pollination to May 27 | 85 | 2.21 | 1.04 |
| 3—May 27-June17[1] | 85 | 1.92 | 1.04 |
| 4—June 17-July 8 | 92 | 1.84 | 1.04 |
| 5—July 8-July 29 | 66 | 1.35 | 1.20 |
| 6—July 29-August 19 | 0[2] | ----- | ----- |
| 7—pollination-August 19 | 100 | 4.00 | 4.85 |

[1] Apples in exposure periods 3-7 were also subjected to natural infection prior to May 6-8, i.e., they were not covered by plastic bags until that date.

[2] Not enough apples remaining to test; bagged apples had rotted, died, or fallen from trees for unknown reason.

until May 27 showed a higher incidence of sooty blotch, 2.21; apples exposed all season were rated 4.00. Largest concentrations of sooty blotch were at stem and calyx ends of the fruit, apparently where water of transpiration collected when the fruit or leaves became moist in the bags that were like humidity chambers. However, neither *G. pomigena* nor *M. rubi* grew as much on bagged fruit as on uncovered fruit.

Only trace amounts of fly speck occurred on apples not exposed after bagging May 6-8 (see exposure period 1, Table 2). Throughout exposure periods 2, 3, and 4, indices remained constant at 1.04 with an increase found in period 5. Fly speck incidence was rated 4.85 on fruit exposed all season (period 7). Unfortunately, disease intensity could not be followed during the July 29 to August 19 period, since most of the unexposed bagged apples had fallen, rotted, or died. Deterioration of bagged apples was caused by worm damage and subsequent bacterial or fungal invasion. High incidence of sooty blotch (4.0 index) and fly speck (4.85 index) apparently caused fruit to fall 3 weeks earlier than fungicide-sprayed fruit on adjacent trees of the same cultivar.

*G. pomigena* and *M. rubi* apparently infected Richared Delicious apples during the last weeks of April and before May 6-8, Table 2. At the June 17 apple rebagging, the unbagged, unsprayed apples were rated 3.0 for fly speck incidence. 'July Delicious' apples on neighboring trees exhibited similar disease indices of 3.0 for sooty blotch and 1.0 to 2.0 for fly speck. 'Transparent' apples showed *G. pomigena* and *M. rubi* infections also. Sooty blotch and fly speck developed on apples from natural inoculum as early as mid-June in Alabama.

Fungicidal control of sooty blotch and fly speck in 1969 showed

significant differences between the 7- and 14-day spray schedules, according to the analysis of variance. Lowest total disease percentages occurred in the 7-day schedule, Table 3. Benlate, Cyprex + Fermate + Phaltan, and Difolatan gave significantly better control than Cyprex + Fermate + Captan or Thylate + Captan combinations; Captan was not as effective in the 7-day schedule as other treatments. No significant differences in sooty blotch and fly speck control among fungicides were found on Golden Delicious apples, but all treatments were significantly better than the unsprayed check. Difolatan caused russeting of Richared and Golden Delicious fruit surfaces and hence was eliminated from further evaluations.

TABLE 3. CONTROL OF SOOTY BLOTCH AND FLY SPECK WITH DIFFERENT FUNGICIDES, 1969

| Treatment and rate, lb./100 gal. | Percentage affected fruit | | |
|---|---|---|---|
| | Richared Delicious | | Golden Delicious |
| | 7-day schedule | 14-day schedule | 14-day schedule |
| | *Pct.* | *Pct.* | *Pct.* |
| Benlate 50W, 0.5 | 6.0ab[1] | 0.3a | 0.5a |
| Cyprex 65W,[2] 0.5 + Fermate 76W,[2] 0.5 + Captan 50W, 2.0 | 27.3b | 70.7c | 36.5a |
| Cyprex 65W,[2] 0.5 + Fermate 76W,[2] 0.5 + Phaltan 50W, 2.0 | 6.3ab | 21.0ab | 9.0a |
| Difolatan 4F, 1.0 | 2.7ab | 6.3ab | 0.5a |
| Thylate 65W,[2] 2.0 + Captan 50W, 2.0 | 20.0ab | 74.0cd | 20.5a |
| Check | 98.0d | 96.7d | 100.0b |
| Means | 26.7 | 44.8*[3] | 27.8 |

[1] Means followed by same letters are not significantly different at the 1 per cent level according to Duncan's Multiple Range Test.

[2] Applications (3 to 5) made during blossoming.

[3] * = significant difference between 7- and 14-day schedules.

On Richared Delicious apples, control of sooty blotch and fly speck was significantly better with Benlate than with other fungicides in 1970, 1971, and 1972, Table 4. Captan, Thynon, Dikar, Phaltan, Polyram, and Topsin-M gave little or no control. Disease control data on Golden Delicious apples for 1970 were not analyzed statistically since several trees died and an unsprayed check failed to bear fruit. No significant differences were found in sooty blotch and fly speck control on Golden Delicious during 1971.

The overall per cent disease incidence for treatments during

TABLE 4. CONTROL OF SOOTY BLOTCH AND FLY SPECK WITH FUNGICIDES IN 1970-1972

| Treatment and rate, lb./100 gal. | Percentage affected fruit | | | | |
|---|---|---|---|---|---|
| | Richared Delicious | | | Golden Delicious | |
| | 1970 | 1971 | 1972 | 1971 | 1972 |
| | *Pct.* | *Pct.* | *Pct.* | *Pct.* | *Pct.* |
| Benlate 50W, 0.5 | 21.8[1] | 16.0a | 0.3a | 39 | 6.2a |
| Cyprex 65W,[2] 0.5 + Fermate 76W[2], 0.5 + Phaltan 50W, 2.0 | 77.8bc | 84.8bc | ---- | ---- | ---- |
| Dikar 80W, 2.0 | 76.4b | 75.5bc | 52.4b | 76 | 21.1a |
| Polyram 80W, 2.0 | 92.4c | 92.5c | 80.1bc | 98 | 92.4b |
| Thylate 65W,[2] 0.625 + Phaltan 50W, 2.0 | | 93.1c | 58.6b | 98 | 42.1a |
| Thynon 75W, 0.5, 1.0[3] | 98.8d | ---- | 58.6b | ---- | ---- |
| Topsin-M 70W, 0.75 | | 63.1b | 78.2[4]bc | ---- | ---- |
| Check (untreated) | 100.0d | ----[5] | 100.0c | | 100.0b |

[1] Small letters indicate Duncan's Multiple Range groupings of treatments which do not differ at 1 per cent level.

[2] Applications (3-5) made during blossoming.

[3] 0.5 used 1970; 1.0 used 1972.

[4] 0.75 during blossoming and 0.50 during cover sprays.

[5] All apples fallen before harvest.

1970 and 1971 generally was quite similar, Table 4; however, after the trees were pruned severely, disease incidence dropped 12 to 35 percentage points in some treatments and increased only with Topsin-M. Analysis of disease control data between 1971 and 1972 with Benlate and Thylate + Phaltan showed significantly better disease control when trees were "opened-up" by the severe pruning, Table 5. Thus, pruning trees sufficiently to favor drying of foliage improved disease control in the particularly difficult environmental conditions encountered in 1972.

TABLE 5. CONTROL OF SOOTY BLOTCH AND FLY SPECK WITH FUNGICIDES IN STANDARD PRUNED (1971) AND SEVERELY PRUNED (1972) APPLE TREES

| Treatment and rate, lb./100 gal. | Percentage affected fruit | |
|---|---|---|
| | Standard pruning | Severe pruning |
| | *Pct.* | *Pct.* |
| Benlate 50W, 0.50 | 20.5a[1] | 1.5a |
| Thylate 65W,[2] 0.625 + Phaltan 50W, 2.00 | 95.5c | 58.8b |
| Means | 58.0 | 30.0*[3] |

[1] Disease means followed by same letters are not significantly different at the 1 per cent level according to Duncan's Multiple Range Test.

[2] Applications (3-5) made during blossoming only.

[3] * = significantly better disease control.

## SUMMARY

Significantly better control of sooty blotch and fly speck was obtained with a 7- than a 14-day fungicide spray schedule.

Benlate provided significantly better control than other fungicides tested during 3 of the 4 years. During 1969, Cyprex + Fermate + Phaltan, Difolatan, and Thylate + Captan were equal to Benlate for control of sooty blotch and fly speck. However, Difolatan caused pronounced russeting on the fruit.

*Gloeodes pomigena* infected Richared Delicious apples before May 6-8, but only a trace of fly speck developed on apples exposed before that date. Optimum conditions for infection by the fly speck fungus apparently developed after May 6-8. No appreciable change in fly speck incidence was observed when apples were re-exposed to naturally occurring inoculum after May 27. A high incidence of disease occurred only on non-covered apples in 1970.

Data on sooty blotch and fly speck incidence for 1971 and 1972 showed significantly better control when trees were pruned adequately to provide proper aeration and permit spray penetration of foliage in the highly humid orchard.

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## AGRICULTURAL EXPERIMENT STATION SYSTEM OF ALABAMA'S LAND-GRANT UNIVERSITY

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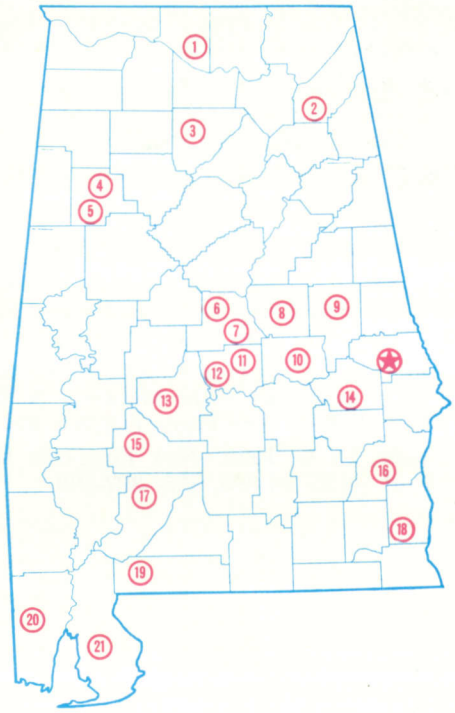


### Research Unit Identification

★ Main Agricultural Experiment Station, Auburn.

1. Tennessee Valley Substation, Belle Mina.
2. Sand Mountain Substation, Crossville.
3. North Alabama Horticulture Substation, Cullman.
4. Upper Coastal Plain Substation, Winfield.
5. Forestry Unit, Fayette County.
6. Thorsby Foundation Seed Stocks Farm, Thorsby.
7. Chilton Area Horticulture Substation, Clanton.
8. Forestry Unit, Coosa County.
9. Piedmont Substation, Camp Hill.
10. Plant Breeding Unit, Tallassee.
11. Forestry Unit, Autauga County.
12. Prattville Experiment Field, Prattville.
13. Black Belt Substation, Marion Junction.
14. Tuskegee Experiment Field, Tuskegee.
15. Lower Coastal Plain Substation, Camden.
16. Forestry Unit, Barbour County.
17. Monroeville Experiment Field, Monroeville.
18. Wiregrass Substation, Headland.
19. Brewton Experiment Field, Brewton.
20. Ornamental Horticulture Field Station, Spring Hill.
21. Gulf Coast Substation, Fairhope.