Fungicide Control of Brooks Fruit Spot of Apple

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ABSTRACT

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Unusually wet growing seasons in northern Virginia in 1978 and 1979 resulted in increased incidence of Brooks fruit spot (Phoma fruit spot) caused by *Mycosphaerella pomi*, affording opportunity to test fungicides for control of this relatively minor apple disease. Benomyl and Dikar, among materials widely used for general summer disease control but not specifically registered for Brooks fruit spot, provided good control. Folpet, thiram, and zineb, which are registered for control of this disease, provided adequate control but were significantly less effective than benomyl under severe test conditions. Metiram gave adequate control, whereas dodine, pyrazophos, and sulfur gave relatively poor disease control. Benomyl and Dikar, because of their effective control of Brooks fruit spot and powdery mildew, are particularly adaptable to disease management on Jonathan apple, which is highly susceptible to these diseases.

Brooks fruit spot, also known as Brooks spot and Phoma fruit spot, is caused by the ascomycete *Mycosphaerella pomi* (Pass.) Lindau. Although this disease has been recognized in most of the apple growing regions of the northeastern United States, its economic significance is usually relatively minor (1). Wet growing seasons in northern Virginia in 1978 and 1979 promoted a dramatic increase in Brooks fruit spot incidence on unsprayed trees or in poorly sprayed commercial orchards. Incidence was generally most common on the cv. Jonathan but also occurred on Delicious and Golden Delicious. Sooty blotch caused by *Gloeodes pomigena* (Schw.) Colby, fly speck caused by *Zygophiala jamaicensis* Mason, and several fruit rots were generally common in commercial orchards infected with Brooks spot, probably because of relaxed control practices during the unusually wet cover spray period.

Commercial recommendations for Brooks fruit spot control in Virginia include applications of effective fungicides at 12- to 14-day intervals from petal-fall through the summer cover sprays (2). Fungicides registered for control of this disease include captan, ferbam, folpet, thiram, and zineb. Dikar, benomyl, and metiram, commonly used for the control of one or more "summer diseases" of apple, are not specifically registered for control of Brooks fruit spot. Because the registration status of standard fungicides is uncertain, continued surveillance of the effectiveness of standard and experimental materials on control of minor apple diseases such as Brooks fruit spot is warranted. Summarized here are the results of several field tests of standard and experimental compounds for Brooks spot control conducted during the wet years of 1978 and 1979 and the relatively dry year of 1980. A portion of this work has been cited previously (3).

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MATERIALS AND METHODS

The materials evaluated alone or in combination for control of Brooks fruit spot were benomyl (Benlate 50W), captan 50W, CGA 64251 (1-[[2-(2,4-dichlorophenyl)-4-ethyl-1,3-dioxolan-2-yl]methyl]-1*H*-1,2,4-triazole; Vangard, Ciba-Geigy Corp., Greensboro, NC 27409), dodine (Cyprex 65W), Dikar (a mixture of 72% mancozeb and 4.7% dinocap), dinocap (Karathane 19.5W), ferbam (Carbamate 76W), folpet 50W, glyodin 30EC, liquid lime sulfur 29%, metiram (Polyram 80W), pyrazophos (Afugan 30EC), sulfur (Kolodust Xtra Dust or Spray 53W, Kolospray 81.25W, Magnetic 95W, Super Six 6F), emulsifiable oil (Sun Oil 7E), thiram (Thylate 65W), and zineb (Zineb 75W).

The materials were tested at the Virginia Polytechnic Institute and State University Fruit Research Laboratory orchard or in a commercial apple orchard, both located near Winchester. Treatments were applied to 14- or 25-yr-old, semidwarf, Jonathan or Golden Delicious apple trees in a randomized block design with four to six single-tree replicates. Fungicides were usually applied as dilute treatments to the point of runoff with a single-nozzle handgun and a high-pressure sprayer at 3,446 kPa (500 psi). In one test, treatments were applied as concentrate (×4, 935 L/ha) treatments with a conventional air-blast sprayer (Hardie model 525, no longer commercially available).

As part of season-long disease control evaluation programs, the fungicides were applied at 7- to 10-day intervals from early season to petal-fall and at 14-day intervals throughout the cover spray period. Rainfall totals (centimeters) during the months of May through August, respectively, for the test years were 13.1, 12.9, 15.8, and 17.9 in 1978; 16.8, 10.2, 13.0, and 11.1 in 1979; and 12.5, 8.6, 11.4, and 6.4 in 1980. Fruits were evaluated for infection at harvest. Commercial insecticides, bactericides, and growth regulators were applied to entire test orchards as needed.

Table 1. Control of Brooks fruit spot in apple by commercial apple fungicides, Winchester, VA

Treatment[w]	Formulated material (per liter)	Fruit infected (%)[x]		
		Golden Delicious	Jonathan	
		1979	1979	1980
No fungicide	None	87 d	77 c	12 b
Dikar 76.7W	2.40 g	6 abc	7 ab	0 a
Benomyl 50W + spray oil 7E	225 mg + 2.50 ml	1 a	0 a	0 a
Dodine 65W	600 mg	16 c	15 b	2 a
Metiram 80W	2.40 g	7 abc	12 b	...[y]
Zineb 75W[z]	2.40 g	4 abc	13 b	0 a
Captan 50W[z]	2.40 g	8 abc	6 ab	...
Folpet 50W[z]	2.40 g	9 abc	15 b	0 a
Captan 50W + zineb 75W	1.20 g + 1.20 g	3 ab	...	...
Thiram 65W[z]	2.40 g	16 bc	...	...
Ferbam 76W[z]	1.80 g	5 abc	...	...

[w] Dilute treatments applied by handgun at 3,446 kPa (500 psi) to point of runoff.
[x] Averages of four replicates. Column means followed by the same letter do not differ significantly according to Duncan's multiple range test ($P = 0.05$).
[y] Treatment not tested on indicated cultivar.
[z] Registered for control of Brooks fruit spot.

RESULTS

In the wet seasons of 1978 and 1979, the incidence of Brooks fruit spot infection on untreated trees was 77–91% (Tables 1–4); however, in the relatively dry weather from the middle to late in the season in 1980, only 12–32% of the fruit was infected on untreated trees.

A test of registered apple fungicides was conducted in the Fruit Research Laboratory orchard (Table 1). In this orchard, treatments were applied to interplanted Jonathan and Golden Delicious trees at the same time in 1979 to allow some assessment of treatment-cultivar interaction and disease susceptibility. Benomyl provided excellent fruit spot control on both cultivars. Dikar and captan also performed adequately on both cultivars. Dodine gave only fair results. On Jonathan, fruit spot control by metiram, zineb, and folpet was less effective than that by benomyl. There was no significant difference in fruit spot control by metiram, zineb, or folpet on Golden Delicious. Good control of Brooks spot resulted from all treatments repeated on Jonathan during the drier season of 1980. Fruit spot was not present on Golden Delicious in 1980.

Results of tests conducted in a commercial orchard are in Tables 2–4. Benomyl, Dikar, and captan + dinocap again performed well (Table 2). Lime sulfur, pyrazophos, dodine + pyrazophos, and metiram combined with sulfur performed poorly.

Sulfur formulations, tested primarily for control of powdery mildew (*Podosphaera leucotricha* (Ell. & Everh.) Salm.) on highly susceptible Jonathan, provided poor control of Brooks fruit spot (Table 3). The flowable formulation provided slightly better control compared with the wettable powder formulation in 1979. The addition of glyodin did not improve control by Dikar, although an improvement was evident when glyodin was combined with sulfur 53W compared with the same rate of sulfur alone.

The sterol-inhibiting fungicide CGA 64251 was compared with Dikar under commercial application conditions directed toward control of powdery mildew (Table 4). Under these conditions, control of Brooks spot by CGA 64251 was not significantly different from that by Dikar, although control by both materials was much better during the drier summer of 1980 than in the much wetter summer of 1979.

DISCUSSION

Benomyl and Dikar provided good control of Brooks fruit spot, although neither is specifically registered for control of this disease. The performances of benomyl and Dikar in control of Brooks spot have useful implications for disease management programs on Jonathan. This cultivar is highly susceptible to both powdery mildew and Brooks spot, and both fungicides are useful for management of both diseases. They are being tested further in combination for control of both diseases (4). Combinations are used to delay the development of fungus strains resistant to benomyl and to allow the systemic quality of benomyl to complement the protectant qualities of mancozeb and dinocap in Dikar.

Metiram, also not registered for Brooks spot, was moderately effective and would probably be suitable for management of this disease under light disease potential, but it was less effective than benomyl under heavier disease

Table 2. Effectiveness of selected fungicides for control of Brooks fruit spot on Jonathan apple

Treatment[x]	Formulated material (per liter)	Fruit infected (%)[y] 1978	1979
No fungicide	None	77 c	90 d
Benomyl 50W + spray oil 7E	225 mg + 2.50 ml	2 a	2 a
Pyrazophos 30 EC + spray oil 7E	0.30 ml + 2.50 ml	21 b	...[z]
Pyrazophos 30 EC + dodine 65W + spray oil 7E	0.30 ml + 600 mg + 2.50 ml	...	17 c
Captan 50W + dinocap 19W	1.20 g + 600 mg	7 a	...
Lime sulfur 29%	15.0 ml	29 b	...
Dikar 76.7W	2.40 g	4 a	6 ab
Metiram 80W + sulfur 81.25W	1.20 g + 2.40 g	...	10 bc

[x] Dilute treatments applied by handgun at 3,446 kPa (500 psi) to point of runoff.
[y] Averages of 50 fruits from each of six replicates in 1978 or 100 fruits from each of six replicates in 1979. Column means followed by the same letter do not differ significantly according to Duncan's multiple range test ($P = 0.05$).
[z] Treatment not tested in indicated year.

Table 3. Effectiveness of Dikar, benomyl, glyodin, and sulfur for control of Brooks fruit spot on Jonathan apple

Treatment[x]	Formulated material (per liter)	Fruit infected (%)[y] 1978	1979
No fungicide	None	78 f	91 d
Benomyl 50W	150 mg	3 a	...[z]
Dikar 76.7W	2.40 g	8 ab	11 a
Dikar 76.7W	1.20 g	...	15 ab
Dikar 76.7W + glyodin 30EC	1.20 g + 1.25 ml	...	29 abc
Lime sulfur 29%	15.0 ml	41 de	...
Sulfur 95W	2.85 g	44 de	...
Sulfur 95W	9.5 g	52 de	...
Sulfur 53W	5.07 g	37 cde	...
Sulfur 53W	3.40 g	...	85 d
Sulfur 53W + benomyl 50W	3.40 g + 150 mg	...	28 abc
Sulfur 53W + glyodin 30EC	3.40 g + 1.25 ml	...	40 bc
Sulfur 6F	3.75 ml	30 bcde	50 c
Sulfur 6F + benomyl 50W	2.50 ml + 150 mg	2 a	11 a

[x] Dilute treatments applied by handgun at 3,446 kPa (500 psi) to point of runoff.
[y] Averages of 25 fruits from each of five replicate trees in 1978 or 50 fruits from each of five replicate trees in 1979. Column means followed by the same letter do not differ significantly according to Duncan's multiple range test ($P = 0.05$).
[z] Treatment not tested in indicated year.

Table 4. Effectiveness of reduced volume applications of Dikar and CGA 64251 for control of Brooks fruit spot on Jonathan apple

Treatment[y]	Formulated material (per hectare)	Fruit infected (%)[z] 1979	1980
No fungicide	None	90 b	32 b
CGA 64251 10W	70 g	47 a	3 a
Dikar 76.7W	6.7 kg	26 a	3 a

Applied with a conventional air-blast sprayer at 935 L/ha.
[z] Averages of 50 fruits from each of four single-tree replicates. Column means followed by the same letter do not differ significantly according to Duncan's multiple range test ($P = 0.05$).

pressure. Dodine, sulfur, and pyrazophos, although reducing disease incidence somewhat, would not be considered where Brooks fruit spot control is the primary objective.

CGA 64251 or other sterol-inhibiting fungicides may also be adaptable to control of both Brooks spot and powdery mildew, but these fungicides need further testing for general summer disease control on apples.

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