Increased Severity of Sclerotinia Blight in Peanuts Treated with Captafol and Chlorothalonil

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ABSTRACT

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Captafol, applied at rates recommended for control of Cercospora leaf spot of peanut, significantly increased the severity of blight caused by *Sclerotinia minor*. Increases were similar with chlorothalonil, another leaf spot fungicide. Disease severity was similar in all plots at the time of the first fungicide treatment, but at the end of the growing season, disease was significantly more severe in plots treated with captafol and chlorothalonil than in untreated control plots or plots treated with benomyl. At the end of the growing season, two and four times more plants were dead in plots treated with chlorothalonil and captafol, respectively, than in untreated controls. Pod yields and values were significantly lower in plots receiving four applications of captafol and chlorothalonil than in untreated control and benomyl-treated plots.

Peanut (*Arachis hypogaea*), a major field crop in Virginia, is susceptible to many plant pathogens. One of the most destructive diseases is Sclerotinia blight, caused by *Sclerotinia minor* Jagger (3). This disease was first observed in Virginia in 1971 and in North Carolina in 1972 (7). According to aerial infrared photographs, disease severity and yield losses from Sclerotinia blight in peanuts are highly correlated (8).

The severity of nontarget diseases sometimes increases after fungicide application for a specific pathogen. This is especially true for benzimidazole derivatives: application of benomyl to peanuts for Cercospora leaf spot increased the incidence of southern stem rot (1); application of benomyl to cowpeas increased the incidence of Pythium wilt (12); application of fungicides containing benzimidazole increased the severity of Pythium blight associated with bentgrass (11); and application of similar compounds to control *Penicillium* spp. on pears increased Alternaria decay (9). Although most instances of increased severity of nontarget diseases follow the application of narrow-spectrum systemic fungicides such as benomyl, disease activity may increase following the use of broad-spectrum fungicides. In screening trials, peanut plants treated with chlorothalonil were more prone to infection by *S. minor* than were untreated controls (2). In later tests, chlorothalonil not only increased the severity of Sclerotinia blight but also greatly reduced pod yields in treated plots (5,6).

Because of the economic importance of Sclerotinia blight in Virginia (P. M. Phipps, *personal communication*) and unpublished laboratory data suggesting that captafol (a fungicide also currently recommended for Cercospora leaf spot of peanuts) might act as chlorothalonil does in increasing the severity of Sclerotinia blight, the following investigation was conducted.

MATERIALS AND METHODS

Three field experiments were conducted at farms with a history of Sclerotinia blight. During both years of the study, a randomized block design was used with four replicates of plots with four 12.2-m rows spaced 0.9 m apart. Peanuts (VA 72R) were planted each year in May.

Fungicides evaluated were captafol 4F (*cis*-*N*-[(1,1,2,2-tetrachloroethyl)thio]-4-cyclohexene-1,2-dicarboximide), 1.68 kg a.i./ha; chlorothalonil 6F (tetrachloroisophthalonitrile), 1.26 kg a.i./ha; and benomyl 50W [methyl 1-(butylcarbamoyl)-2-benzimidazolecarbamate], 2.24 kg a.i./ha.

Fungicides were applied (three spray nozzles with D2-13 tips per row) with a CO_2 pressure-regulated sprayer (calibrated to deliver 186 L of H_2O/ha at 206844

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Table 1. Effect of fungicides on severity of Sclerotinia blight of peanuts in three Virginia fields

	Disease index[x]								
	1977[y]			1978-A			1978-B		
	Aug. 4	Sept. 16	Oct. 6	Aug. 7	Sept. 6	Oct. 4	Aug. 9	Sept. 19	Oct. 4
Untreated control	1.7 b[z]	2.4 c	2.9 b	1.6 a	1.9 b	3.4 c	1.5 a	2.0 b	3.2 c
Benomyl	1.4 a	1.5 d	2.1 c	1.6 a	1.8 b	3.5 c	...	...	...
Chlorothalonil	1.8 b	2.8 b	3.4 a	1.9 a	2.3 a	3.9 b	1.5 a	3.3 a	4.0 b
Captafol	1.9 b	3.2 a	3.5 a	1.9 a	2.3 a	4.4 a	1.4 a	3.4 a	4.4 a

[x] Disease index on a scale of increasing severity from 1 = no disease to 5 = death of plant.
[y] The applications of fungicides were made in 1977 on 19 July and 4, 19, and 31 August; in 1978-A on 19 July and 2, 16, and 30 August; and in 1978-B on 24 July, 7 and 21 August, and 4 September.
[z] In a column, means followed by a common letter do not differ significantly ($P = 0.05$), according to Duncan's multiple range test.

Table 2. Percentages of plants infected with *Sclerotinia minor* on 4 October 1978 in two Virginia fields

	Disease index[x]									
	1978-A[y]					1978-B				
	1	2	3	4	5	1	2	3	4	5
Untreated control	0	3 a[z]	53 c	21 a	23 a	0	3 a	48 c	35 b	6 a
Benomyl	0	0 a	44 bc	27 b	18 a	...	...	...	...	...
Chlorothalonil	0	0 a	31 b	31 b	29 b	0	1 a	29 b	35 b	34 b
Captafol	0	7 a	13 a	33 b	60 c	0	0 a	14 a	31 a	55 c

[x] Disease index on a scale of increasing severity from 1 = no disease to 5 = death of plant.
[y] Percentage of plants based on average number of plants per 24-m row times four replicates.
[z] In a column, means followed by a common letter do not differ significantly ($P = 0.05$), according to Duncan's multiple range test.

kPa). The dates of the three series of applications of each fungicide are given in Table 1.

Data were taken from the two center rows of each plot. Plants were monitored weekly for evidence of infection by *S. minor.* Disease indexes were calculated on a 1–5 scale. On each scoring date, 20 sites were chosen at random in each of the two center rows of each plot and rated for disease severity. At the end of the growing season (10 October 1977, 9 October 1979) peanut pods were harvested, dried, and graded by standard procedures (10) to determine yield and value. Data were subjected to analysis of variance (P=0.05) with Duncan's multiple range test.

RESULTS

Disease severity indexes during the first week of August were similar in untreated control plots and in plots treated with captafol and chlorothalonil (Table 1). The September disease indexes were significantly greater in captafol-treated and chlorothalonil-treated plots than in the untreated control plots. In 1977, captafol-treated plants exhibited significantly more disease than did plants treated with chlorothalonil. At all three test sites Sclerotinia blight was severe in October. The average disease indexes for the untreated control plots and plots treated with chlorothalonil and captafol were 3.2, 3.8, and 4.1, respectively. Disease was generally a little less severe in benomyl-treated plots than in the untreated controls.

The number of plants killed by *S. minor* was significantly greater in captafol-treated plots than in chlorothalonil-treated plots (Table 2). Likewise, the number of dead plants was significantly greater in chlorothalonil-treated plots than in the untreated control plants.

Pod yields in plots treated with captafol and chlorothalonil were similar and averaged a little more than 2,100 kg/ha, or about 500 kg/ha less than the untreated control plots (Table 3). Yields from benomyl-treated plots averaged somewhat higher than yields from untreated control plots.

Value per hectare in the untreated control plots averaged $1,156 (Table 3). Value of pods in captafol-treated and chlorothalonil-treated plots averaged 18% less than that of pods from the untreated control plots.

Table 3. Effect of fungicides on yield and value of peanuts in three fields

	Yield (kg/ha)			Value ($/ha)		
	1977	1978-A	1978-B	1977	1978-A	1978-B
Untreated control	3157 b[z]	2173 a	2478 a	1363 b	982 a	1124 a
Benomyl	4019 a	2028 ab	···	1766 a	917 ab	···
Chlorothalonil	2707 b	1828 b	1804 b	1166 b	834 b	815 b
Captafol	2724 b	1808 b	1909 b	1188 b	824 b	887 b

[z]In a column, means followed by a common letter do not differ significantly (P = 0.05), according to Duncan's multiple range test.

DISCUSSION

Applied at rates normally recommended for Cercospora leaf spot control, captafol increased the severity of Sclerotinia blight of peanuts (Tables 1 and 2). The increase with captafol was similar to that observed recently with chlorothalonil (2,6).

Captafol and chlorothalonil applied to control Cercospora leaf spot may create an imbalance in the microbiological ecosystem under the dense peanut foliage canopy that would favor the growth of *S. minor*. Recently, *S. minor* mycelia insensitive to chlorothalonil developed on culture media amended with this fungicide (4,5). If fungicide-insensitive mycelia develop after chlorothalonil application, the microbial balance at the soil surface in peanut fields could shift drastically in favor of *S. minor.* A similar phenomenon might occur when captafol is applied to peanuts and could account in part for the increased severity of Sclerotinia blight.

These results suggest that broad-spectrum fungicides, such as captafol and chlorothalonil, applied to control a specific plant pathogen, can disrupt the existing ecosystem in favor of a nontarget pathogen. Narrow-spectrum fungicides containing benzimidazole derivatives used to control a specific pathogen can increase the severity of disease caused by other nontarget organisms (2,9,11,12). Since broad-spectrum fungicides such as captafol and chlorothalonil are widely used, more detailed studies are needed to determine the mechanism of disease enhancement of nontarget plant pathogens following their use for specific pathogens.

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