Peanut Foliar Fungicides: Relationships Between Leafspot Control and Kernel Quality

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ABSTRACT

The effectiveness of foliar fungicides for control of peanut leafspot caused by **Cercospora arachidicola** Hori and **Cercosporidium personatum** (Berk. & Curt.) Deight, was evaluated from 1971-1974. Benomyl, chlorothalonil, triphenyl-tin-hydroxide and copper hydroxide were applied at recommended rates by conventional ground sprayer at 14-day intervals. Leafspot severity was rated by determining percent defoliation and infection. All fungicide-treated plots had less defoliation and infection than the untreated control plots. Kernel quality was determined using Federal-State Inspection Service procedures. Plots sprayed with chlorothalonil had better quality kernels than those from any other fungicide treatment. However, kernels harvested from the untreated control plots had significantly better quality than those from the chlorothalonil-treatment. Kernels harvested from the benomyl and copper hydroxide treatments were slightly inferior in quality than the chlorothalonil treatment. Kernels from the triphenyl-tin-hydroxide treated plots were significantly inferior in quality than those from plots treated with other fungicides. These data indicate that while kernel quality is not related to leafspot control, certain foliar fungicides adversely affect peanut kernel quality probably by altering the ecology of the geocarposphere.

Key words: Kernel quality, fungicides, **Arachis hypogaea, Cercospora** sp.

For many years the most important disease affecting peanuts was leafspot, caused by *Cercospora arachidicola* Hori and *Cercosporidium personatum* (Berk. & Curt.) Deight. Beginning with the introduction of benomyl in the late 1960's, several fungicides which control peanut leafspot have been developed and have become widely used in the Southeast. Use of benomyl, chlorothalonil, triphenyl-tin-hydroxide (TPTH), and copper hydroxide ($Cu[OH]_2$) has reduced leafspot infection and the resulting defoliation to the point that a relatively complete foliar canopy is maintained throughout the growing season. Maintenance of a virtually intact peanut canopy made at least three major changes in the ecology of soil-borne fungi: (i) fewer leaves were lost to the soil surface to serve as organic food sources; (ii) pesticides were filtered from the soil surface by the "umbrella effect" of the intact canopy; (iii) an altered subcanopy environment was created which may be stimulatory to certain soil-borne fungi. Recently, Backman et al (1) reported important differences in *Sclerotium rolfsii* severity, depending on the fungicide selected for use in the leafspot program. Their paper indicated that kernel quality differences may exist, but were inconclusive. This paper examines the effects of foliar fungicides on the quality of harvested peanut kernels. A preliminary report has been published (3).

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Materials and Methods

Peanuts, cultivar "Florunner," were planted in a Dothan sandy loam soil on a one-year rotation with corn, (**Zea mays** L.) from 1971-1974. These peanuts were evaluated for leafspot disease control (defoliation and infection levels), yield and quality. From the 1971 test benomyl 50% WP, triphenyl-tin-hydroxide 47% WP (TPTH), chlorothalonil 54% flowable, copper hydroxide 86% WP ($Cu[OH]_2$) and an untreated check were chosen for evaluation. Plot size for 1971 and 1972 was 7.3 x 45.8 meters (m), containing 8 single rows. The 1973 and the 1974 plots were 15.2 m x 7.3 m. The 1972, 1973, and 1974 tests were evaluated for the same fungicides, with the exception that the copper hydroxide 86% WP was replaced by the more effective flowable copper hydroxide + sulfur (27% + 15.5%). In all tests benomyl 50% WP was applied at a rate of 0.39 Kg/ha; TPTH 47% WP at 0.43 Kg/ha; chlorothalonil 54% flowable at 1.7 l/ha; $Cu[OH]_2$ 86 WP 1.7 Kg/ha (or $Cu[OH]_2$ + S (27% + 15.5%) flowable 4.7 l/ha). All fungicides were applied by conventional ground sprayer calibrated to deliver 132.5 l/ha at a pressure of 4.2 Kg/cm^2.

Leafspot incidence (**Cercospora** + **Cercosporidium**) was determined 14 days before harvest by removing 10 vertical runners at random from each plot and determining infection using the following criteria: (i) total leaflets = number of leaf nodes × 4; (ii) percent defoliated = number of leaflets lost ÷ total leaflets × 100; (iii) total leaflets infected = number of leaflets lost + number of leaflets infected and (iv) percent infection = leaflets infected ÷ total leaflets × 100. This method assumes that defoliation occurred because of previous leafspot infection. Quality determinations were made based solely on dollar value per ton obtained by using standard Federal-State Inspection Service methods (5). Deductions which could be attributed to farmer malpractice were standardized. Value of harvested peanuts per hectare was calculated based on yield and price per Kg.

Results were analyzed on a multi-year basis using Duncan's Multiple Range Test. Yearly means were weighted for the number of replications in the test (4). In addition, defoliation and infection levels (Tables 1 and 2) were evaluated on a yearly basis.

Results

Test results revealed significant ($p \leq 0.05$) differences in infection, defoliation, yields and kernel quality not only between the control and fun-

Table 1. Infection level (%) of Arachis hypogaea L. caused by Cercospora sp. in leafspot control test, 1971-1974.

Treatment	1971	1972	1973	1974	*$\bar{X}$
Control	97.2 a	85.7 a	64.8 a	92.9 a	87.0 a
Chlorothalonil 54 F	56.1 c	8.8 c	16.1 c	24.7 c	36.0 c
Benomyl 50WP	40.5 d	7.4 c	20.9 c	88.6 a	25.8 d
TPTH 47WP	60.7 c	29.4 b	26.5 b	51.7 b	45.4 b
$Cu[OH]_2$ + S (27 + 15) F	**75.9 b	25.4 b	12.2 c	55.9 b	40.2 bc

Values within columns followed by the same letter are not significantly different at the 5% level using Duncan's Multiple Range Test

* Weighted mean

**$Cu[OH]_2$

Table 2. Defoliation level (%), of Arachis hypogaea L. caused by Cercospora sp. in leafspot control tests, 1971-1974.

Treatment	1971	1972	1973	1974	* $\bar{X}$
Control	79.9 a	53.0 a	44.0 a	64.4 a	59.3 a
Chlorothalonil 54 F	43.4 c	6.4 d	5.8 bc	15.0 d	22.7 c
Benomyl 50WP	24.8 d	5.3 d	6.1 bc	55.1 b	17.5 d
TPTH 47WP	50.2 bc	18.5 b	12.4 b	33.1 d	30.3 b
$Cu[OH]_2$ + S (27 + 15) F	**56.3 b	12.1 c	2.6 c	18.7 d	20.7 cd

Values within columns followed by the same letter are not significantly different at the 5% level using Duncan's Multiple Range Test

* Weighted mean

**$Cu[OH]_2$

Table 3. Yield values (Kg/ha) obtained from peanut (Arachis hypogaea L.) leafspot control tests, 1971-1974.

Treatment	1971	1972	1973	1974	* $\bar{X}$
Control	2075	3560	2678	3158	2868 d
Chlorothalonil 54 F	4023	4241	3958	5216	4360 a
Benomyl 50WP	4251	4029	3280	3177	3684 c
TPTH 47WP	3515	3961	3075	4842	3848 bc
$Cu[OH]_2$ + S (27 + 15) F	**3560	3801	3674	5070	4026 b

Values within columns followed by the same letter are not significant ($p \leq 0.05$) using Duncan's Multiple Range Test

* Weighted mean

**$Cu[OH]_2$

gicides tested, but also among the fungicides themselves. Defoliation and infection levels in all fungicide-treated plots were significantly less than in the untreated control (Tables 1 & 2). When yield data were analyzed (Table 3) a generally inverse relationship was found when compared to infection level data (Table 1).

Multiyear analysis of kernel quality (dollar value per metric ton, Table 4) indicated a significant ($p \leq 0.05$) difference between the control and all fungicides tested. Grade data indicated that damage to the mature kernels was causing the inferior quality and that this damage was fungi-related. Kernels from the control plots were significantly better in quality than the fungicide plots. Kernel quality of peanuts from plots treated with chlorothalonil was slightly better than that of other fungicide treatments, but was inferior to the quality of the control plot. The plots treated with TPTH were significantly ($p \leq 0.05$) inferior in quality than any of the other fungicide-treatments or the control. Considering yield, quality, and value per hectare chlorothalonil returns more money to labor and management than any other fungicide tested or the control (Table 5).

Discussion

The level of disease control achieved with all test fungicides was significantly better than the untreated control (Table 1 and 2), yet kernel quality of peanuts from all fungicide-treated plots was inferior to that of the non-treated control plots (Table 4). Data from this study and from a previous study (1) indicate that maintenance of a complete foliar canopy alters the subcanopy environment with a resulting deterioration of kernel quality. These data support this study and also indicate another possible mechanism for kernel quality effects: a direct toxic action effect of the foliar fungicides on soil-borne pathogenic or antagonistic fungi. Kernels of superior quality would be expected from plots where the fungicide exhibited toxicity to the pathogen(s), but little or no effect on the natural antagonist(s). The inferior quality kernels would be found in plots where fungicides exhibited toxicity to the antagonist(s), but with little or no effect on the quality-deteriorating pathogens. Several observations support this hypothesis. First, similar levels of defoliation were obtained when benomyl, TPTH, and $Cu[OH]_2$ were used to control leafspot. However, use of TPTH resulted in significantly inferior kernels when compared to the other two fungicides giving similar leafspot control. Secondly, when values for kernel quality are examined, the control had a significantly higher dollar value

Table 4 Kernel quality values (dollar value/metric ton) obtained from peanut (Aarchis hypogaea L.) leaf spot control tests, 1971-1974.

Treatment	Rate	1971	1972	1973	1974	$\bar{X}$ *
Control	0	335.39	326.41	328.47	450.38	360.16 a
Chlorothalonil 54 F	1.7 l/ha	331.55	320.02	304.94	438.30	348.63 b
Benomyl 50WP	.39 kg/ha	327.06	309.83	295.41	435.25	342.11 b
TPTH 47WP	.43 kg/ha	328.78	313.27	263.65	404.64	328.56 c
$Cu[OH]_2$ + S (27 + 15) F	4.7 l/ha	**331.27	329.20	320.80	425.02	344.65 b

Values within columns followed by the same letter are not significant at the 5% level of probability using Duncan's Multiple Range Test

* Weighted mean

**$Cu[OH]_2$

Table 5. Yield (Kg/ha), quality ($/metric ton) and value per ha (dollar) obtained from peanut (Arachis hypogaea L.) leafspot control tests, 1971-1974.

Treatment	Rate	Yield Kg/ha	Value ($/ metric ton)	Value ($/ha)
Control	0	2868 d	360.16 a	1039.79 d
Chlorothalonil 54 F	1.70 l/ha	4360 a	348.63 b	1547.14 a
Benomyl 50WP	.39 kg/ha	3684 c	342.11 b	1252.37 c
TPTH 47 WP	.43 kg/ha	3848 bc	328.56 c	1298.04 i
$Cu[OH]_2$ + S (27 + 15) F	4.70 l/ha	4026 b	344.65 b	1416.18 b

Values within columns followed by the same letter are not significant at the 5% level of probability using Duncan's New Multiple Range Test.

per ton than any of the fungicide treatments. If peanuts from the control plots are of better quality and a true inverse relationship exists between leaf maintenance and kernel quality, then benomyl or $Cu[OH]_2$-treated plots (which had the least defoliation) should have the most inferior kernel quality of the fungicide-treated plots. Peanuts from the benomyl and $Cu[OH]_2$-treated plots were not significantly inferior in quality than peanuts from the chlorothalonil-treated plots. A third indication that a toxic action of the fungicides altered the geocarposphere was observed with the fungicide benomyl. Benomyl was extremely effective as a leafspot control fungicide in 1971 and 1972. However, during 1973 the pathogen developed resistance to this fungicide (2) and during the 1974 season disease severity in benomyl-treated plots was nearly equal to that of the control. Comparisons of quality data for benomyl-treated plots over the 4 year period showed no improvement in kernel quality as defoliation levels increased. While not conclusive, these observations indicate that a direct toxic effect of a fungicide on a natural antagonist (or pathogen) is more important to kernel quality than the degree of leaf maintenance and the resulting canopy. Additional research is necessary to determine to what degree each mechanism affects kernel quality and if any interaction exists.

Literature Cited

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