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Control of Early and Late Leafspot on Two Peanut Cultivars[1]

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ABSTRACT

The effectiveness of four fungicides for control of *Cercospora arachidicola* Hori (CA) and *Cercosporidium personatum* (Berk and Curt.) Deighton (CP) on *Arachis hypogaea* L. 'Florunner' and 'Early Bunch' was evaluated in 1978 and 1979. Chlorothalonil (3.5 liters/ha) + flowable sulfur on a 10-day schedule (T1) gave the best control of both leafspots. Chlorothalonil alone (2.3 liters/ha) on a 14-day schedule (T2) provided better disease control and higher pod yields than three other fungicide treatments on both cultivars in 1979. With reduced disease pressure in 1980, triphenytin hydroxide + flowable sulfur and mancozeb + flowable sulfur were almost as effective as T1 and T2 in maintaining high pod yield on Florunner. Yields were significantly less both years on Early Bunch for all treatments other than T1 and T2. The incidence of CA leafspot was low both years and CP was the predominant leafspot pathogen. Significantly higher numbers of CP lesions were observed on Early Bunch than on Florunner at 70 and 90 days after planting (DAP) in 1979 and at 110 DAP in 1980. Numbers of CA lesions on the two cultivars were not significantly different. Average pod yields across fungicide treatments of the two cultivars were not significantly different in 1979 or 1980. Differences in

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disease levels and pod yields were greater among fungicide treatments than between cultivars.

Key Words: *Arachis hypogaea* L., Early Bunch, Florunner, *Cercospora arachidicola*, *Cercosporidium personatum*, Fungicides.

Cercospora arachidicola Hori and *Cercosporidium personatum* (Berk. and Curt.) Deighton are the most destructive foliar pathogens of peanut (*Arachis hypogaea* L.) (1,9). The early leafspot pathogen *C. arachidicola* (CA) causes necrotic tan to brown lesions with sporulation on the adaxial leaf surface. In contrast, *C. personatum* (CP) produces dark olive to black concentric tufts of conidiphores mainly on the abaxial leaf surface. High levels of infection of either pathogen result in severe defoliation with reduced pod yields.

Woodroof (10) reported that CP occurred at irregular intervals in two of five seasons (1928 to 1933) at Experiment, Georgia. She stated that CP was more destructive than CA. Jenkins (4) found that CA appeared at Experiment in early July and CP occurred a few weeks later. He concluded that CA was generally more widespread than CP.

In a 1947 survey of peanut leaf samples from 10 southeastern states (USA), Miller (6) found that the majority of the lesions were caused by CA. One exception to this was an August 1 sample from Gainesville, Florida, in which 51% of the spots were caused by CP. A sample from the same location two weeks later had 88% CP. Jackson (3) reported that 88% of the lesions on leafspot samples from 35 Florida farms in a 1979 survey were CP. His samples were collected in mid-August, at 92-136 days after planting. Smith and Littrell (9) reported a resurgence of late leafspot in the southeastern US beginning in 1976.

With the introduction of fungicide sprays in the early 1970's, effective chemical control of these two foliar pathogens became feasible (9). Since that time many fungicides have been tested for control of peanut foliar diseases. Shokes et al. (8) reported that fungicides varied in their effectiveness against CA and CP. Several foliar fungicides are recommended for control of the peanut leafspot diseases in Florida (5) but little is known of their relative efficacy on CP, particularly on different cultivars.

A study was conducted at the Agricultural Research Center, Marianna, Florida in 1979 and 1980 to determine the relative effectiveness of four fungicides recommended in Florida (5) for control of CA and CP leafspot. A second objective of this study was to determine differences in susceptibility of the cultivars 'Florunner' and 'Early Bunch' to CA and CP and their response, utilizing the four fungicides.

Materials and Methods

Florunner and Early Bunch peanuts were planted in a split-plot randomized complete block design with four replications. Main plots were cultivars, and subplots were fungicide treatments. Plots were four 9.1m rows planted on 91cm centers. Peanuts were planted on May 29 in 1979 and 1980. Early Bunch peanut were harvested 127 days after planting (DAP) and Florunner was harvested at 135 DAP both years. The experiment was irrigated with a center pivot irrigation system. If less than 1.3 cm 0f rainfall was received within a 6-7 day period, 1.0-2.5 cm of water was applied. Recommended fertility, weed control, and insect control practices were followed. Stem rot was not a problem either year and no soil fungicides were applied for its control. A preplant granular nematicide was used both years.

Fungicide treatments included chlorothalonil 4.17F (tetrachloroisophthalonitrile) at 3.5 liters/ha (1.5x rate) + flowable sulfur at 2.3 liters/ha (T1), chlorothalonil 4.17F at 2.3 liters/ha (T2), triphenyltin hydroxide 50W at 560 g/ha + flowable sulfur at 2.3 liters/ha (T3), cupric hydroxide + sulfur at 4.6 liters/ha (T4) (Kocide 404S, Kocide Chemical Corp., Houston, Tx), and (T5) mancozeb 80W at 2.2 kg/ha + flowable sulfur at 2.3 liters/ha. Flowable sulfur was added to T3 and T4 because it is recommended in Florida for best disease control with these compounds (5). T6 was not treated with fungicide and was designated the untreated check. T1, a higher rate of chlorothalonil than is recommended on the label for peanut leafspot control, was applied on a 10-day schedule beginning 39 DAP and was designated as a treated check. This treatment was used in an attempt to attain optimal disease control for comparison with other treatments. T1 plots received a total of nine sprays. Treatments 2-5 received seven sprays applied at 14-day intervals beginning 39 DAP. All fungicides were applied in 374 liters/ha of water at 276 kPa with a CO_2 backpack sprayer. Three nozzles per row were used with D4-45 hollow cone tips. The center two rows of plots were treated, leaving the two border rows unsprayed.

Disease assessments were made at 50, 70, 90, 113, and 125 DAP in 1979 and at 50, 70, 89, 110, and 125 DAP in 1980. All disease samples and yields were taken from the center two rows of plots. Ten leaflets were collected from each plot from the third fully expanded leaf from the terminal of randomly selected upright stems. Leafspots were counted and lesions/leaflet determined. CA and CP were identified on the basis of color, shape, and pattern of sporulation (4). Lesion numbers were transformed by $n = [(\text{no. lesions/leaflet}) + 1]^{1/2}$ before analysis. Defoliation assessments were made at 125 DAP on 10 stems per plot using the method of Backman et al. (1), in which the leaflets remaining and leaflets lost, were determined. This method assumes that missing leaflets were abscised because of leafspot(s). Arcsin transformations of percent defoliation data were used for statistical analysis by $n = \arcsin[(\%\ \text{defoliation}/100)^{1/2}]$. Analysis of variance was performed to detect main and subplot effects and interactions.

Results and Discussion

Overall disease incidence and severity were lower in 1980 than in 1979. Rainfall was 19.0 cm and 16.0 cm in July and August, 1979 but only 14.9 cm and 6.4 cm, respectively, in 1980. The incidence of CA was low both years. CA was present but not observed on sampled leaflets until 70 DAP in 1979 and 90 DAP in 1980 (Fig. 1). Untreated Early Bunch peanuts were extensively defoliated by leafspot at 113 DAP in 1979 and 125 DAP in 1980, precluding subsequent collection of representative leaflet

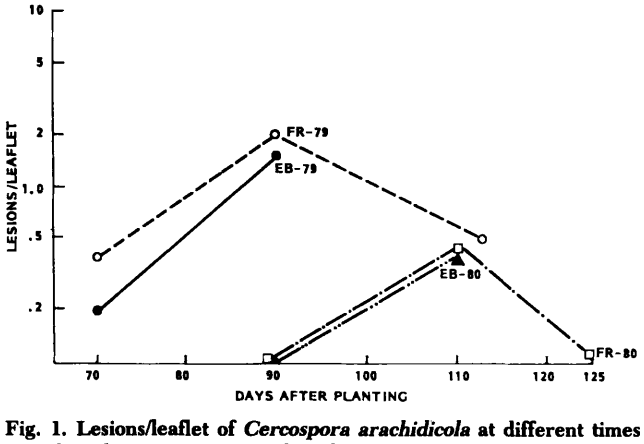

Fig. 1. Lesions/leaflet of *Cercospora arachidicola* at different times after planting on untreated Early Bunch (EB) and Florunner (FR) peanuts in 1979 and 1980.

samples. Late leafspot was significantly higher on untreated Early Bunch than on Florunner (Fig. 2) at 90 DAP in 1979 and at 90 and 110 DAP in 1980. Chlorothalonil

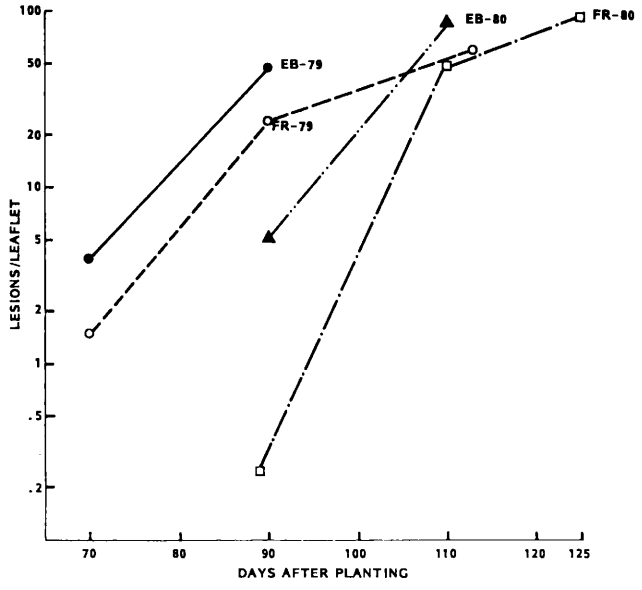

Fig. 2. Lesions/leaflet of *Cercosporidium personatum* at different times after planting on untreated Early Bunch (EB) and Florunner (FR) peanuts in 1979 and 1980.

(T2) was the best of the treatments applied at recommended rates (Fig. 3 and 4) for control of the two leafspot diseases (data for CA not shown) over the two years. In 1979 only treatments 1, 2, and 3 had sufficient foliage for taking lesion/leaflet data by 125 DAP. One replication of T3 was defoliated by that time. Disease was maintained at low levels on the treated check (T1) both years on the two

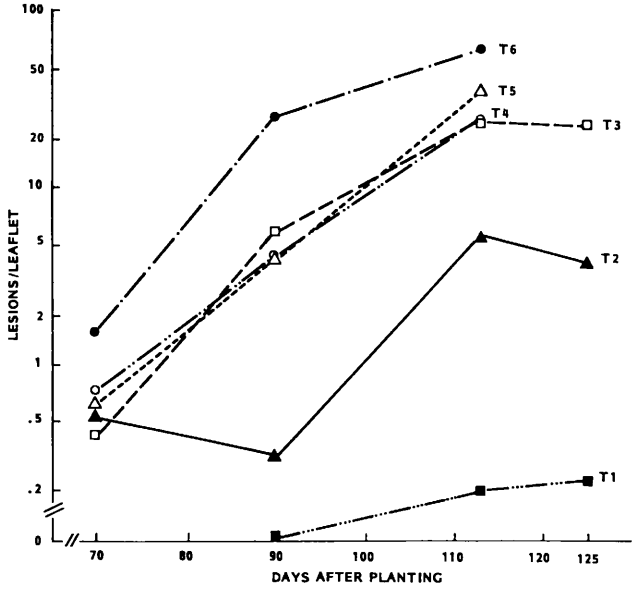

Fig. 3. Comparison of fungicides for control of *Cercosporidium personatum* on Florunner peanuts in 1979. T1 = 3.5 liters/ha rate of chlorothalonil + flowable S, T2 = 2.3 liters/ha rate of chlorothalonil, T3 = triphenyltin hydroxide + flowable S, T4 = flowable cupric hydroxide with sulfur, T5 = mancozeb + flowable S and T6 = untreated check.

cultivars. Pod yields did not differ significantly for the two cultivars in either year irrespective of fungicide treatment, but defoliation and yields were significantly different among fungicide treatments (Table 1).

Differences between the cultivars in mean number of

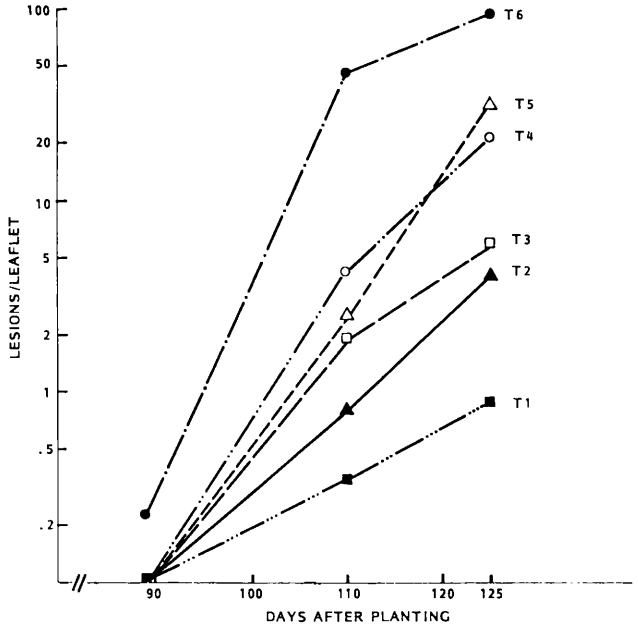

Fig. 4. Comparison of fungicides for control of *Cercosporidium personatum* on Florunner peanuts in 1980. T1 = 3.5 liters/ha rate of chlorothalonil + flowable S, T2 = 2.3 liters/ha rate of chlorothalonil, T3 = triphenyltin hydroxide + flowable S, T4 = flowable cupric hydroxide with sulfur, T5 = mancozeb + flowable S and T6 = untreated check.

Table 1. Defoliation at 125 days after planting and pod yields for Florunner and Early Bunch peanuts with six leafspot treatments in 1979 and 1980.

	Treatment[a]	% Defoliation[b] 1979	% Defoliation[b] 1980	Pod Yield (kg/ha)[b] 1979	Pod Yield (kg/ha)[b] 1980
	FLORUNNER				
T1	Chlorothalonil (1.5x) + flowable S	22 a	26 a	5538 a	4036 a
T2	Chlorothalonil	54 b	30 ab	4779 b	4004 a
T3	Triphenyltin hydroxide + flowable S	93 c	40 c	3738 c	3721 a
T4	Cupric hydroxide + S[c]	95 c	63 d	2553 d	3100 b
T5	Mancozeb + flowable S	96 c	38 bc	3028 d	3727 a
T6	Untreated Check	100 c	98 e	1571 e	1793 c
	EARLY BUNCH				
T1	Chlorothalonil (1.5x) + flowable S	21 a	32 a	5221 a	4923 a
T2	Chlorothalonil	60 b	63 b	4729 a	4818 a
T3	Triphenyltin hydroxide + flowable S	97 c	74 c	3740 b	4004 b
T4	Cupric hydroxide + S	99 c	79 c	2520 cd	3032 c
T5	Mancozeb + flowable S	97 c	78 c	3033 c	3662 bc
T6	Untreated Check	100 c	100 d	2103 d	1866 d

[a]Rate/ha for all treatments are as follows: T1 = 3.5 liters + 2.3 liters; T2 = 2.3 liters; T3 = 560g + 2.3 liters; T4 = 4.6 liters; T5 = 2.2 kg + 2.3 liters.

[b]Numbers for a given cultivar, within a column, followed by the same letter are not significantly different according to the Duncan's Multiple Range Test. (P = 0.05).

[c]Kocide 404S (Kocide Chemical Corp., Houston, Tx).

CP lesions were significant at 70 and 90 DAP in 1979 (Table 2) and at 110 DAP in 1980. Numbers of CA lesions were not significantly different for the two cultivars in either year. Comparison of the chlorothalonil fungicide treatments (T1 and T2) with T3, T4, and T5 revealed significant differences for three sample dates in 1979 for CA lesion counts but only for the last sample date in 1980 (Table 3). When comparing the same fungicide treat-

Table 2. Mean number of lesions/leaflet of *Cercospora arachidicola* (CA) and *Cercosporidium personatum* (CP) on Early Bunch and Florunner peanuts at different times after planting over all fungicide treatments in 1979 and 1980.

	Days After Planting[a]							
	70		89-90		110-113		125	
Cultivar	CA	CP	CA	CP	CA	CP	CA	CP
1979								
Florunner	0.2	0.5*	0.5	6.0**	0.7	24.6	----------[b]	
Early Bunch	0.2	1.2*	0.5	14.0**	0.8	33.0	----------	
1980								
Florunner	----------[c]		<0.1	0.1	0.1	10.2*	0.1	23.8
Early Bunch	----------		<0.1	1.8	0.1	23.7*	0.2	25.6

[a]Means for the two cultivars over all fungicide treatments are shown. Each value represents a mean of lesion counts for 10 leaflets/plot for each of four replications across six fungicide treatments. Values in the same column for a given year, followed by * are significantly different at P = .01, and ** indicates significance at P = .001.

[b]Mean comparisons were nonestimable because of extensive defoliation in many plots at 125 days after planting in 1979.

[c]No leafspots were observed on leaflets collected at 70 days after planting in 1980.

Table 3. Numbers of lesions/leaflet of *Cercospora arachidicola* (CA) and *Cercosporidium personatum* (CP) in plots treated with chlorothalonil (T1 and T2) compared to other fungicide treatments (T3-5).[a]

	Days After Planting							
	70		89-90		110-113		125	
Treatments	CA	CP	CA	CP	CA	CP	CA	CP
1979								
T1 and T2	<0.1**	0.2	<0.1**	<0.1***	0.4***	2.8***	----------[b]	
T3-5	0.3**	0.5	0.3**	4.4***	1.0***	28.3***	----------	
1980								
T1 and T2	----------[c]		0	<0.1	<0.1	0.6***	<0.1	2.5***
T3-5	----------		<0.1	<0.1	<0.1	2.9***	0.2*	19.9***

[a]Mean lesion counts for Early Bunch and Florunner combined. Each value represents a mean lesion count for 10 leaflets/plot for each of four replications. Values in the same column for a given year, followed by *, **, or *** are significantly different at P = .01, .001, and .0001, respectively.

[b]Mean comparisons were nonestimable because of missing data due to defoliation by 125 days after planting in plots treated with T4 and T5 in 1979.

[c]No lesions were observed on leaflets collected at 70 DAP in 1980.

ments, differences in CP lesion counts were highly significant at 90 and 113 DAP in 1979 and at 110 and 125 DAP in 1980. Defoliation in plots sprayed with less effective fungicides prevented sampling and thus comparisons of CP counts at 125 days in 1979, were not made.

Chlorothalonil provided good control of both leafspot organisms at the 14-day interval and even better control when used with sulfur at the 10-day interval. The next best treatment, triphenyltin hydroxide + flowable sulfur (T3) was inadequate for full-season use under high disease pressure from CP. Also, low levels of phytotoxicity were observed with this fungicide combination. In lower disease pressure conditions of 1980, mancozeb + flowable sulfur had defoliation ratings and yields comparable to T3.

Differences among fungicide treatments for control of CA leafspot were evident both years when the two chlorothalonil treatments T1 and 2 were compared with the other fungicide treatments T3, 4, and 5 (Table 4). These differences were even greater when compared for CP leafspot control. A significant interaction was evident when the two cultivars were compared for T1 and 2 versus T3, 4, and 5. This interaction was not significant for defoliation and pod yield in 1979 but it was significant in 1980. This may have been due to a similar response of the two

Table 4. Statistical significance of pairwise comparisons for number of *Cercospora arachidicola* (CA) and *Cercosporidium personatum* (CP) lesions/leaflet, defoliation and yield as related to cultivar and fungicide treatment.[a]

Variable[b]	Cultivar		T1,2 vs 3,4,5[c]		Interaction[d]	
	1979	1980	1979	1980	1979	1980
CA 70	NS	---[e]	**	---	NS	---
CA 89-90	NS	NS	**	**	NS	NS
CA 110-113	NS	**	***	NS	NS	NS
CA 125	---	*	---	NS	---	NS
CP 70	*	---	NS	---	NS	---
CP 89-90	**	NS	***	*	**	NS
CP 110-113	NS	*	***	***	*	***
CP 125	---	NS	---	***	---	**
Defoliation	**	*	***	***	NS	*
Pod Yield	NS	NS	***	***	NS	***

[a]NS = nonsignificance; *, **, or *** represent significance at P = .01, .001, and .0001, respectively.

[b]Number designations after CA and CP refer to the number of days after planting that the sample was collected for lesion counts.

[c]T1,2 vs 3,4,5 represent five fungicide treatments noted in Table 1.

[d]Interaction of cultivar by T1,2 vs 3,4,5. Cultivars are Early Bunch and Florunner.

[e]Significance was nonestimable because no lesions were observed on samples collected at 70 days after planting in 1980 and many plots were extensively defoliated by disease by 125 days after planting in 1979.

cultivars when subjected to the severe pressure from CP in 1979. The cultivar response differed in 1980. Because of dry weather during critical times in the growing season in 1980, the exponential phase of CP development was delayed two to three weeks. Early Bunch was defoliated more and yield differences were greater than with Florunner for the better treatments (T1 and 2) versus the less effective treatments (T3, 4 and 5) in 1980 (Table 1).

It appears from the disease data that Early Bunch may be more susceptible to late leafspot than Florunner, but that hypothesis does not seem to be supported by yield data from these tests. Early Bunch is reported to have a yield advantage over Florunner when grown under similar conditions (7). That yield advantage might be negated by greater leafspot severity and earlier defoliation. Hammons (2), however, has observed that differences in early and late maturing cultivars tend to disappear when disease assessment is made at the same physiological growth stage. Maturity differences therefore, could account for the apparent greater susceptibility of Early Bunch in our tests because it matures about two weeks earlier than Florunner (7). Our observations from other leafspot monitoring studies (author-unpublished) indicate that a switchover from mainly CA to mainly CP occurs about two weeks earlier on Early Bunch than on Florunner.

When the cultivar Early Bunch is grown in areas where CP is prevalent, scheduling of leafspot sprays early in the season with a highly effective fungicide may prevent severe yield loss. Maintaining the proper spray interval throughout the season to prevent rapid disease progress on either cultivar is advisable. In North Florida, where CP is the predominant leafspot pathogen, chlorothalonil was the most effective of the four fungicides evaluated in our studies.

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