Components of Resistance to Late Leafspot in Peanut. II. Correlations Among Components and Their Significance in Breeding for Resistance[1]

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ABSTRACT

A total of 116 peanut *(Arachis hypogaea* L.) genotypes, which included all market types, were evaluated for resistance to late leafspot *(Cercosporidium personatum* Berk. and Curt. (Deighton)) in three tests during 1986. Two tests were conducted in greenhouses at Gainesville and Quincy, Florida. The third test was conducted in the field near Marianna, Florida. Lesion number per leaf, percent leaf necrotic area, lesion diameter, spore production, and latent period were evaluated. Correlations were calculated between greenhouse and field studies. Contributions of each component of resistance to an overall plant appearance score was also determined.

Amount of sporulation, lesion size, and latent period were highly correlated with each other and with percent leaf necrotic area within tests. The rank of genotypes in the field was significantly correlated with the rank in the greenhouse for latent period ($r=0.57$), lesion diameter ($r=0.46$), and sporulation ($r=0.59$). Sporulation, lesion size, and latent period were the most important components contributing to visual plant appearance score. Sporulation accounted for most of the variability in the score.

Key Words: *Arachis hypogaea* L., peanut, groundnut, selection, late leafspot, *Cercosporidium personatum.*

Successful selection in peanut *(Arachis hypogaea* L.) for components of resistance to late leafspot *(Cercosporidium personatum* (Berk. and Curt. [Deighton]) (CP) depends on the magnitude of genetic and environmental variability present. In addition, if components have a strong positive association, then selection for one component would be expected to advance the other.

Nevill (8) and Walls *et al.* (13) reported significant differences in the amount of spore production among certain genotypes resistant to CP. Significant differences in lesion diameter on peanut genotypes have been reported under field conditions (12, 13, 14). Necrotic leaf area differences were noted by Iroume and Knauft (5).

Authors have reported high environmental variation for some components of resistance to late leafspot with examples that include lesion counts per leaf (3, 13) and percent necrotic leaf area (5, 12). Jogloy *et al.* (6) calculated narrow-sense heritabilities near zero for lesion size, latent period, lesion number, and sporulation in two peanut crosses designed to examine inheritance of late leafspot resistance.

Association among various components of resistance is important, as reported in wheat where resistant cultivars with few sporulating pustules had a longer latent period (8). In peanut, however, the effects of various components may not have a similar association. On some genotypes that do not defoliate severely, lesions sporulate sparsely, while on others they sporulate heavily (8). Conversely, some genotypes that defoliate severely do so before 50% of the lesions have begun sporulating, while others sporulate heavily before defoliating (8). Thus, a genotype classified as resistant may have only one or a few components of resistance.

Moderate correlations among components of resistance to late leafspot in peanut have been found within specific environments (9, 13). In field experiments, Johnson *et al.* (7) found that the area under disease progress curves for early leafspot *(Cercospora arachidicola* Hori) (CA) was more highly correlated with latent period, sporulating lesions, time to spore production, and time to leaflet defoliation than with infection frequency. Green and Wynne (2) studied 10 genotypes for CA resistance and found moderate field correlations between necrotic area and lesion number per unit area, and found high correlations between necrotic area and total lesion number and defoliation. Jogloy *et al.* (6) examined the F_2 genotypes from two crosses, using a detached leaf technique in the greenhouse. They obtained moderate negative correlations of latent period with lesion number, lesion size, defoliation, and sporulation. Lesion number was positively associated with lesion size, defoliation, and sporulation, and lesion size had a strong correlation ($r=0.81$) with sporulation.

Selection for resistance to CP would be more efficient if large numbers of genotypes could be evaluated in the greenhouse and only the best tested in the field. This would reduce the amount of time, labor, and resources needed. Such a strategy will be most successful if greenhouse rankings among genotypes for components of resistance are correlated with field rankings. Green and Wynne (2) reported that the only component of resistance to early leafspot with a significant correlation between field and greenhouse studies was necrotic area. In studies with late leafspot and a larger number of peanut genotypes, Walls *et al.* (13) found significant ($P< 0.05$) rank correlation for lesion number per 15 leaves in the field with lesion size, total lesion number, latent period, and spore production in the greenhouse. Subrahmanyam *et al.* (12) reported a significant correlation between late leafspot disease rating in the field and greenhouse evaluations for percent defoliation, lesion diameter, and sporulation.

The present studies were conducted to determine:

i) the relationships among components of resistance in each of two greenhouse tests and one field test,
ii) the correlation of genotype ranks for a given component in the greenhouse and in the field,
iii) the components of resistance that have the greatest impact on yield and on severity of late leafspot disease as rated by a visual plant appearance score.

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Materials and Methods

Experiment 1

Thirty genotypes, representing a range of variability for market type, plant type, and agronomic performance, were evaluated for resistance to late leafspot in the greenhouse at the University of Florida in Gainesville (Table 1). Florunner and Southern Runner were included as susceptible and partially resistant checks, respectively (1, 14). All other entries, except entries 15 and 27, were Florida breeding lines. Seed were planted on February 13, 1986 in a randomized complete block design with four replications. Single plants were grown in 16 cm diameter pots, using Metro-Mix 220 (Grace Corp., Milwaukee, WI) as a potting medium. The experiment was terminated when the plants were 90 days old.

Table 1. Identification of entries used in Gainesville greenhouse test to evaluate components of resistance to late leafspot in peanut.

Entry	Identification
1	72x93-6-1-1-b3-B (PI 203396 x Florunner)
2	72x93-6-1-2-b2-B
3	72x93-9-1-2-b3-B
4	72x100-12-1-1-b3-B (PI 306230 x Florunner)
5	72x100-17-1-1-b3-B
6	72x101B-2-3-2-b2-B (F439-17 x PI 306230-2-2)
7	72x101B-2-3-3-b2-B
8	72x32B-3-2-2-b2-B (Florigiant x PI 259785)
9	72x93-6-1-2-b2-B
10	72x31-11-1-1-b3-B (Florigiant x PI 145681)
11	72x100-17-1-1-b3-B (PI 306230-2-2 x Florunner)
12	72x100-12-1-1-b3-B
13	72x31-2-1-1-b2-B (Florigiant x PI 145681)
14	72x32-13-1-1-b4-B
15	PI 203396
16	72x93-6-1-1-b3-B
17	72x94-12-1-1-b2-B (PI 203396 x F427B-)
18	72x32B-10-1-1-b3-B (Florigiant x PI 259785)
19	72x31-11-1-2-b3-B
20	72x101B-2-3-2-b2-B
21	Florunner
22	72x83B-7-2-1-B (PI 121067 x Florunner)
23	72x93-6-3-1-B
24	72x83A-8-1-1-B
25	Dixie Runner
26	72x76-11-1-1-B (F439-17 x PI 259785)
27	NC 3033
28	72x83A-4-1-2-B (Florunner x PI 121067)
29	72x36B-15-3-1-b (Florunner x PI 261911)
30	72x67-14-4-1-B (439-16- x PI 145688)

Lesions on the greenhouse-grown, susceptible cultivar Early Bunch were used as the source of inocula for *C. personatum*. The original conidia to infect Early Bunch came from a single late leafspot lesion originally collected in the field near Marianna, FL. Conidia from sporulating lesions were obtained with a cyclone spore collector attached to a test tube with 5 mL of distilled water. Suspensions were diluted to 4000 conidia mL^{-1}, and a drop of Tween 80 100 mL^{-1} of mixture was added to aid in the spread of inoculum on the leaf surface. Conidial inoculum had a germination rate of 90 to 100%.

Forty-three days after planting, six healthy, fully expanded leaves from the middle region of the plant canopy were tagged and inoculated with the conidial suspension, using a Spra - Tool (Fisher Scientific Products, Pittsburgh, PA) which delivered 1 mL inoculum $second^{-1}$. The leaf was held on a small wooden board with the top of the leaf surface facing upwards and misted for one second with the spore suspension. After drying, target leaves were shielded and the remainder of the plant was inoculated by misting for 5 seconds. Inoculated plants were placed in a mist chamber for 48 hrs (mean temperature of 25 C) and pots were then placed on a greenhouse bench (temperature range of 19.8 — 30.8 C). Plants were kept well watered to prevent moisture stress.

Components of resistance that were assessed included: i) incubation period (IP), defined as days from inoculation to the appearance of the first lesion, ii) latent period in days from inoculation to the first sporulating lesion (LS_1) and the second sporulating lesion (LS_2), iii) latent period defined as days from inoculation to 50% of primary lesions sporulating (LS_{50}), iv) lesion counts per leaf (LC 21) at 21 days after inoculation (DAI), v) percent necrotic area per leaf (%NA) at 50 DAI, using a standardized pictorial chart (10), and vi) sporulation score (SSC) using a 1 - 5 scale, according to Subrahmanyam *et al.* (11).

Sporulating lesions were identified with the aid of a (20x) magnifying lens. Latent periods were determined by observing all target leaves on a daily basis. Sporulation score was determined at 40 and 50 DAI from nontarget leaves located in the middle of the canopy. Leaves were excised and placed in a moist chamber (petri dish with moist filter paper) under fluorescent light for 72 hr to enhance sporulation. Sporulation was rated for 10 randomly selected mature lesions using a dissecting microscope (70x) and secondary lesions were not scored.

Table 2. Identification of entries used in Quincy greenhouse test and Marianna field test with highest levels of one or more components of resistance to late leafspot in peanut.

Entry	Identification
1	73x20B-5-3-1-1-b2-B (439-16 x PI 268894)
4	72x32B-3-2-2-2-2-1-b3-B (Florigiant x PI 259785)
5	72x94-12-1-1-b2-B-3-b3-B (PI 203396 x 427B-)
6	W.C. Egret
8	US 29-b3-B
9	UF 563B (439-16- x PI 331326)
10	US 202b2
11	US 27A-b3
12	Makulu Red
14	NC 3033
30	PI 365553
33	PI 384498
34	PI 415881
35	PI 121067
38	PI 203395
39	PI 203396
40	PI 259641
44	PI 261893
51	PI 268913
58	UF 81206-1
59	UF 81206-2
61	72x94-14-1-1-1-2-1-3-B (PI 203396 x 427B-)
63	72x93-6-1-2-b2-B-FL-b3-B (PI 203396 x Florunner)
64	72x31-11-1-1-b3-B-b3-B (Florigiant x PI 145681)
65	76x5-1-2-2-1-b2-B (535B x PI 383424)
66	76x9-10-1-1-1-2-b2-B (GK19 x PI 383424)
68	UF 639B-5-1-B (519-4- x UF 81206-1)
70	76x5-3-2-3-1-1-1-b3-B
71	72x93-9-1-2-2-B-3-b2-B
72	72x93-9-1-2-3-B-2-b2-B
74	79x6B-10-3-3-b2-B [(72x38) x (72x83A)]
78	72x83A-4-1-1-1-1-1-b2-B (Florunner x PI 121067)
80	72x86A-10-1-1-3-1-1-3-b2-B (Tifspan x PI 203396)
83	76x9-10-4-1-2-b2-B (GK19 x PI 383424)
85	78x4A-6-1-2-b2-B (714021 x PI 383424)
88	77x1B-1-2-1-1-b3-B (PI 383424 x GK19)
95	PI 306230
96	72x31-2-1-1-b2-B
102	72x83A-8-1-1-B
103	72x83B-7-1-1-B

Experiment 2

This test was conducted in the greenhouse at North Florida Research and Education Center in Quincy Florida with 105 genotypes. Table 2 lists genotypes and their pedigrees for selected entries which showed the highest levels of resistance for at least one of the components from this test (1). A complete list of the genotypes may be obtained from the authors. Planting and inoculation procedures were the same as described for experiment 1. Experiment 2 had three replicates and five target leaves. High humidity was maintained with automatically controlled misting nozzles placed above the greenhouse ranged from 27 to 34 C. Target leaves were examined in the same manner as in experiment 1. Data were collected on IP, LS_1, LS_2, and lesion counts at 19 and 23 days (LC 19 and LC 23, respectively). Percent leaf necrotic area was determined on target leaves at 23 DAI (%NA23) and SSC was determined at 35 DAI in the same manner described for experiment 1. Lesion diameter (LD) was measured using a Finescale comparator, (Finescale Co. Orange, CA) assuming lesions to be circular. When plants were 90 days old, they were rated for disease using a 1 to 10 scale as noted in Table 3.

Experiment 3

The field test was conducted at Marianna (Dozier Boys School) and included the same 105 genotypes as in experiment 2. The test site had

Table 3. Leafspot resistance rating system used for plant appearance score.

Rank	Description
1	No disease
2	Very few lesions (none on upper canopy)
3	Few lesions (very few on upper canopy)
4	Some lesions with more on upper canopy than for rank of 3 and slight defoliation noticeable
5	Lesions noticeable even on upper canopy with noticeable defoliation
6	Lesions numerous and very evident on upper canopy with significant defoliation (50%+)
7	Lesions numerous on upper canopy with much defoliation (75%+)
8	Upper canopy covered with lesions with high defoliation (90%+)
9	Very few leaves remaining and those covered with lesions (some plants completely defoliated)
10	Plants dead

no history of peanut as a crop over the past 20 years and was isolated from commercial plantings of peanut. The design was a randomized complete block with two replicates with two row plots, each 6.1 m long and 91 cm wide with seed spaced 15 cm apart and inoculated with *Bradyrhizobium* at planting. The non-irrigated test was planted on May 22, 1986 and standard cultural practices were followed, except that no fungicide was applied for leafspot control. No infector or border plots were used.

At 60 days after planting (DAP) three representative plants were selected from each plot and marked with a stake. Three target leaves at the same stage of development were selected from the middle of the canopy and inoculated with a *C. personatum* conidial suspension standardized to 10,000 conidia mL^{-1}. The remainder of the plot was inoculated by dusting with finely shredded diseased plant material at a rate of 20 g per plot. Non-inoculated plots in the test were evaluated for presence of leafspot at the time of inoculation and symptoms were not found and did not occur until some time after inoculation of target leaves.

The test site received a total of 45.2 cm of rainfall during the growing period. Lesion counts per leaf were recorded at 15 and 19 DAI (LC 15 and LC 19, respectively), and %NA was determined at 25 DAI. Latent period was also recorded as the number of days from inoculation to the first (LS_1) and the second (LS_2) lesion sporulating. Lesion diameter and sporulation rating were determined in the same manner as for experiment 2. Plant appearance score (PAS) was rated on a 1 to 10 scale at 120 days after planting (PAS 120) and at 135 days after planting (PAS 135) on a whole plot basis, using the scale shown in Table 3.

Statistical Analysis

Analysis of variance was performed on the means of each component on a plot basis. Lesion counts per leaf and %NA were transformed using the square root transformation to normalize the data. Results of these analyses have been reported previously (1).

Tests of independence were conducted among the components within a specific trial using Pearson's correlation procedure (11), where:

$$r_{xy} = \frac{Cov_{xy}}{(V_x V_y)^{-1/2}}$$

where Cov_{xy} = the covariance of x and y.

r_{xy} = the correlation coefficient between two components, and

V_x and V_y = the variance of the means of component x and y respectively.

For components with significant differences at $P<0.05$ in two tests, genotypic rank correlations were determined for each pair of tests using Kendall's tau B correlation procedure (4). The components included in this calculation were latent period (days to first sporulating lesion), lesion diameter, and sporulation score.

The relative contributions of each component of resistance to plant appearance score were estimated using stepwise regression (11).

Results and Discussion

Means for each component of resistance in the three tests have been reported previously for all genotypes in the Gainesville test and for selected genotypes in the Quincy and Marianna tests (1).

Correlations within tests

Correlation coefficients among components of resistance to CP within each test are shown in Tables 4 through 6. Incubation period and lesion count per leaf were not correlated with other components. Latent periods LS_1 and LS_2 were significantly ($P<0.001$) correlated ($r = 0.989$) in the field and were equally effective

Table 4. Correlations among components of resistance to late leafspot in the greenhouse test at Gainesville, 1986.

Components	DF	LS_1	LS_{50}	SSC 40	SSC 50	LC
LS_1[w]	29	1.00	0.789**	-0.478**	-0.491*	-0.094NS
LS_{50}[x]	26		1.000	-0.492*	-0.499**	0.117NS
SSC 40[y]	30			1.000	0.919**	-0.153NS
SSC 50[y]	30				1.000	-0.034NS
LC[z]	30					1.000

[w] LS_1 - Latent period, days from inoculation to the first lesion sporulating.
[x] LS_{50} - Latent period, days from inoculation to 50% of primary lesions sporulating.
[y] SSC 40 and 50 - Sporulation score at 40 and 50 days after inoculation, respectively, on a 1 to 5 scale where 1=little or no sporulation and 5=dense stromata over most of lesion with heavy sporulation.
[z] LC - Lesion count per leaf at 21 days after inoculation.

Significance indicated by *, **, and *** at P=0.05, 0.01, and 0.001, respectively, and non-significance at P=0.05 by NS.

Table 5. Correlations among components of resistance to late leafspot rated in the greenhouse at the North Florida Agricultural Research and Education Center in Quincy, 1986.

Components	LS_1	LD	SSC
LS_1[x]	1.000	-0.677**	-0.771***
LD[y]		1.000	0.712***
SSC[z]			1.000

[x] LS_1 - Latent period, days from inoculation to the first lesion sporulating.
[y] LD - Lesion diameter at 35 days after inoculation.
[z] SSC - Sporulation score on a 1-5 scale.

Significance indicated by **, and *** at P=0.01 and P=0.001, respectively.

Table 6. Correlations among components of resistance to late leafspot in the field test at Marianna, 1986.

Components	IP	LS_1	LS_2	LS_{50}	%LNA	SSC	LD
IP[t]	1.000	0.109[NS]	0.151[NS]	0.105[NS]	-0.273***	0.048[NS]	-0.217[NS]
LS_1[u]		1.000	0.989***	0.950***	-0.466***	-0.815***	-0.618***
LS_2[v]			1.000	0.933***	-0.476***	-0.811***	-0.620***
LS_{50}[w]				1.000	-0.200[NS]	-0.846***	-0.483***
%LNA[x]					1.000	0.389***	0.607***
SSC[y]						1.000	0.708***
LD[z]							1.000

[t] Incubation period, days from inoculation to the first lesion appearing.
[u] Latent period, days from inoculation to the first lesion sporulating.
[v] Latent period, days from inoculation to the first two lesions sporulating.
[w] Latent period, days from inoculation to 50% of primary lesions sporulating.
[x] Percent leaf necrotic area rated at 35 days after inoculation.
[y] Sporulation score (1-5 scale) rated at 35 days after inoculation.
[z] Lesion diameter in mm measured at 35 days after inoculation.
[NS] Not significant at P=0.05.

Significance indicated by *, **, and *** at P=0.05, 0.001, and 0.001, respectively.

in rating these genotypes for resistance to CP. Latent period (LS_1) was significantly ($P<0.01$) correlated with latent period (LS_{50}) for the Gainesville test ($r=0.789$) and for the field test ($r=0.950$). The three methods of rating latent period were all useful in identifying resistant genotypes. The assessment of days to first sporulating lesion (LS_1) required fewer measurements than days to second sporulating lesion (LS_2) or days to 50% sporulating lesions (LS_{50}). The high correlation among the various appraisals of latent period would allow a researcher to use LS_1 to identify the longest latent periods among peanut genotypes.

Sporulation score showed a highly significant ($P<0.001$) negative correlation with latent period (LS_1) in the greenhouse test at Quincy and in the field test, with $r=-0.771$ and -0.815, respectively. In the Gainesville test, correlations for sporulation score with LS_1 and LS_{50}were significant ($P<0.05$) and negative but moderate ($r=-0.478$ and $r=-0.492$, respectively). These results are similar to those obtained by Jogloy *et al.* (6) who found a correlation between LS_{50} and sporulation score of -0.57. Temperatures in the Gainesville test were lower than those in either the Marianna or Quincy tests and may have contributed to the lower correlations.

Genotypes with long latent periods tended to have reduced sporulation. Assessment of sporulation score can be accomplished at a single measurement date after disease development has begun, whereas days to first sporulating lesion requires multiple readings. Sporulation score also should identify genotypes with longer latent periods.

Percent leaf necrotic area (%LNA) in the field was significantly ($P<0.001$) and negatively correlated with incubation period (IP), LS_1, and LS_2, but not LS_{50} (Table 3). The correlations of %LNA with other characteristics were relatively low ($|r|=0.200$ to 0.476), except with lesion diameter (LD). The high and significant ($P<0.001$) correlation of %LNA with LD ($r=0.607$) was expected, since the rating scale for %LNA is based on lesion number and lesion size. Percent necrotic area correlations with other components were relatively low. Selecting genotypes that had a low necrotic area and desirable levels of other resistance components would require separate selection for %LNA and the additional traits.

In the field, lesion diameter correlations were negative and highly significant ($P<0.001$) with LS_1 ($r=-0.618$), LS_2 ($r=-0.620$), and LS_{50} ($r=-0.483$). These results are also similar to those of Jogloy *et al.* (6) who found a correlation in the greenhouse between lesion diameter and LS_{50} of -0.44. Thus, selection of genotypes with longer latent periods would be expected to also identify genotypes with smaller lesions. Lesion diameter correlations with sporulation scores in the greenhouse at Quincy ($r=0.712$) and in the field ($r=0.708$) were highly significant and positive. Genotypes with larger lesions produced more spores, thus selection for reduced spore production among these genotypes should also identify genotypes that reduce CP lesion size.

Plant Appearance Score

Correlations of plant appearance score with components of resistance and yield in the field are listed in Table 7. Incubation period was not correlated with plant appearance score or with final yield. Genotypes with longer latent periods had less total disease, as rated by PAS 120 ($r=-0.715$, -0.716, and -0.718 for correlations with LS_1, LS_2, and LS_{50}, respectively). Sporulation and lesion size were negatively correlated with PAS 120 ($r=-0.742$ and -0.631, respectively). Genotypes on which CP produced more spores at 35 days after inoculation were more heavily infected with this pathogen at 120 days after planting.

The magnitude of correlation of plant appearance score at 135 days after planting (PAS 135) with components of resistance was generally lower than for PAS 120. Plant appearance score ratings at 120 days after planting were more closely related with components of resistance that reduced the rate of disease development than scores at 135 days after planting. Leafspot disease pressure in Florida field conditions is generally severe and can cause the death of susceptible genotypes. It may be that the intense disease pressure by 135 days after planting reduced the range of plant appearance scores at that date and caused a corresponding decrease in the correlation of scores with other parameters of disease resistance.

Yield

Many disease components were significantly correlated with yield ($P<0.05$), but the correlations were relatively low (Table 7). This suggests that, although the more susceptible genotypes had lower yields, disease

Table 7. Pearson's correlation coefficients relating components of resistance with plant appearance score at 120 and 135 days after planting (DAP), and pod yield at Marianna, 1986.

Component	120 DAP	135 DAP	Yield g/plant
IP[u]	0.012[NS]	0.096[NS]	-0.016[NS]
LS_1[v]	-0.715[***]	-0.531[***]	0.333[**]
LS_2[w]	-0.716[***]	-0.541[***]	0.306[**]
LS_{50}[x]	-0.718[***]	-0.544[***]	0.299[*]
% Necrotic area	0.323[**]	0.434[***]	-0.151[NS]
SSC[y]	-0.742[***]	0.619[**]	-0.346[**]
Lesion diameter	-0.631[***]	0.520[***]	-0.385[***]
PAS 120[z]	1.000	0.739[***]	-0.320[***]
PAS 135[z]		1.000	-0.183[*]
Yield in g/plant			1.000

[u] Incubation period, days from inoculation to appearance of the first lesion.
[v] LS_1 - latent period, days from inoculation to the first lesion sporulating.
[w] LS_2 - latent period, days from inoculation to the first two lesions sporulating.
[x] LS_{50} - latent period, days from inoculation to 50% of primary lesions sporulating.
[y] SSC - sporulation score on a 1 to 5 scale rated at 35 days after inoculation.
[z] PAS 120 and 135 - plant appearance score on a 1 to 10 scale where 1=no disease and 10=plants dead at 120 and 135 days after planting.
Significance indicated by *, **, and *** at p=0.05, 0.01, 0.001, respectively and NS=not significant at P=0.05.

resistance did not appear to be the major factor in yield determination among these genotypes under the disease pressure in this study.

Correlations between greenhouse and field tests

Kendall's tau B genotypic rank correlations for LS_1, lesion diameter, amount of sporulation, and plant appearance score are shown in Table 8. The rank of a genotype in the field for each component was significantly correlated with the rank of the genotype in the greenhouse test at Quincy. Correlations were positive, moderate, and highly significant ($P<0.001$). Sporulation in the field was the component most reliably predicted by the greenhouse rating ($r=0.588$). The use of greenhouse ratings to select resistant genotypes for these components would have only moderate reproducibility in the field, since a large amount of the variation between field and greenhouse scores was unaccounted for by the correlation between the two tests. These results are similar to those obtained by Green and Wynne (2) with early leafspot, using a smaller number of peanut genotypes. They found absolute rank correlations between 0.04 and 0.69 for components of resistance measured in the field and in the greenhouse.

Table 8. Kendall's tau B rank correlation coefficients relating the rank of a genotype for a component in the field test at Marianna (MN) with the rank in the greenhouse test at Quincy (QY), rank in the field at Marianna with rank in the greenhouse test at Gainesville (GV), and rank in the greenhouse test at Quincy with rank in the greenhouse test in Gainesville (QY-GV), 1986.

Components	MN-QY DF	MN-QY r	MN-GV DF	MN-GV r	QY-GV DF	QY-GV r
LS_1[w]	105	0.569***	14	-0.271[NS]	14	-0.323[NS]
LD[x]	105	0.465***	--	--	--	--
SSC[y]	105	0.588***	14	0.168[NS]	14	0.194[NS]
PAS 120[z]	105	0.461**	--	--	--	--

[w] LS_1 - latent period in days from inoculation to the first lesion sporulating.
[x] LD - lesion diameter, measured at 35 days after inoculation.
[y] SSC - sporulation score on a 1 to 5 scale where 1=little or no sporulation and 5=dense stromata over most of lesion with heavy sporulation.
[z] PAS - plant appearance score on a 1 to 10 scale at 120 days after planting (DAP) for the field test and at 90 DAP in the greenhouse test at Quincy.

Significance is indicated by **, and ***, at P=0.01, and 0.001 respectively, and NS is not significant at P=0.05.

The rank of a genotype in the greenhouse test at Gainesville for LS_1 and amount of sporulation was not correlated with the genotype rank in the Quincy greenhouse test ($P<0.05$). There was no significant rank correlation for any of the resistance components measured in this study for the field test at Marianna with the greenhouse test in Gainesville. This may have been caused by the lower temperatures in the greenhouse at Gainesville than in the other two tests. The results indicate that selection for field resistance to CP should not be based on greenhouse tests alone, especially when greenhouse tests are conducted with low or moderate temperature regimes.

Stepwise Regression

A summary of the results of stepwise regression of PAS 120 on components of resistance to CP in the field test are shown in Table 9. Sporulation score (SSC), latent period (LS_2), and lesion diameter (LD) were the most closely associated with plant appearance score. These three components accounted for 60% of the variation in plant appearance score. Partial regression of SSC and LS_2 on plant appearance score were highly significant ($P<0.01$), and the partial regression of lesion diameter on plant appearance score was significant ($P<0.05$). These three components were the most important in determining the plant appearance score at 120 days after planting. Spore production was the major factor, accounting for 92% of the variability associated with these components. The high proportion related to spore production reflects the high correlation between lesion diameter and amount of sporulation. Plants with a low plant appearance score would be expected to have lower spore production, longer latent periods, and smaller lesion sizes.

Table 9. Summary of stepwise regression procedure for the dependent variable, plant appearance score at 120 days after planting, using components of resistance in the field at Marianna 1986.

	B value	SE	MS[a]	F[b]
Step 1:	Sporulation score (SSC)			
Intercept	2.30			
SSC	0.80	+0.07	80.42	126.19***
Step 2:	SSC + latent period (LS_2)			
Intercept	4.50			
LS2[x]	-0.07	+0.03	4.83	8.10**
SSC[y]	0.54	+0.11	13.34	22.38***
Step 3:	SSC + LS_2 + lesion diameter (LD)			
Intercept	3.09			
LS_2[x]	-0.06	+0.03	3.99	6.91**
SSC[y]	0.42	+0.13	6.29	10.89**
LD[z]	0.54	0.26	2.44	4.23*

[x] LS_2 - latent period, days from inoculation to the first two lesions sporulating.
[y] SSC - sporulation score on a 1 to 5 scale where 1=little or no sporulation and 5=dense stromata over most of lesion with heavy sporulation.
[z] LD - lesion diameter measured at 35 days after inoculation.
[a] MS = mean square.
[b] Significance indicated by *, **, and *** at P=0.05, 0.01, and 0.001, respectively.

Conclusion

Sporulation was highly correlated with other components within a specific test, with greatest association between sporulation and latent period. Selection of genotypes with low sporulation would be expected also to identify genotypes with desirable levels of other resistance components. The three methods of measuring latent period, LS_1, LS_2, and LS_{50}, were equally consistent for isolating resistant genotypes, but LS_1 had the advantage of requiring the least number of readings. Greenhouse screening for resistance to CP among genotypes showed moderate association with field performance. A field plant appearance score, designed to rapidly assess overall leafspot resistance, was associated with longer latent periods, lower sporulation, and smaller lesion diameters.

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