Resistance to *Cercosporidium Personatum* Within Peanut Germplasm[1]

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ABSTRACT

Late leafspot, caused by *Cercosporidium personatum*, is prevalent in the southeastern United States and causes extensive defoliation and peanut yield losses if fungicides are not applied. Some sources of resistance to late leafspot have already been identified in the United States peanut germplasm collection. In screening 500 peanut plant introductions from the Southern Regional Plant Introduction Station, Experiment, Georgia, 33 genotypes with partial resistance to *C. personatum* were identified. These lines were evaluated for leafspot resistance and yield without fungicide protection from 1989 through 1991. Although PI 215695, PI 215696 and PI 215724 were significantly more resistant than all other genotypes over the three years, pod yields were low. During years of high disease severity, resistant selections PI 203396 and PI 162529 had the highest yields. Significant positive correlation occurred between late leafspot ratings and shelling percentage (r = 0.43 and 0.47) in 1990 and 1991. Evaluation of the main-stems of plants during the growing season revealed that the three most resistant genotypes had significantly less defoliation than Southern Runner, the only cultivar grown with resistance to late leafspot. There are important genes for resistance present in the United States peanut germplasm collection and there is a need for evaluation of the entire collection for useful resistance to leafspot and other pests.

Key Words: Late leafspot, early leafspot, *Cercospora arachidicola*, partial resistance.

Late leafspot caused by *Cercosporidium personatum* (Berk. & Curt.) Deighton, can cause total defoliation and greatly reduced peanut (*Arachis hypogaea* L.) yields (10). It is the most prevalent foliar disease of peanut in the southeastern United States. Numerous and costly fungicide applications are required during most years to control the disease (2, 6, 10). Southern Runner is presently the only commercially available cultivar with resistance to late leafspot (5, 6, 8). This cultivar can be successfully grown with fewer applications of highly effective fungicides, or with full-season schedules of less effective but less expensive fungicides (4). Southern Runner was developed in Florida (7) from a cross between Florunner and a plant introduction (PI) 203396, that has partial resistance to late leafspot (1). However, most of the peanut plant introduction collection (over 7,400 genotypes) has not been screened for late leafspot resistance. Other peanut plant introductions are needed with greater resistance, earlier maturity and higher yield potential than PI 203396 for development of superior leafspot resistant cultivars. In addition, different sources of resistance may constitute a larger gene pool which could enhance and stabilize resistance to late leafspot.

The objectives of this study were to 1) identify peanut plant introductions with resistance to late leafspot, 2) assess yield and fruit characteristics of the most resistant genotypes, and 3) compare disease progress of the most resistant genotypes to the cultivars Florunner and Southern Runner.

Materials and Methods

Field Evaluation

During the summer of 1987, an initial set of 500 peanut plant introductions (PIs) were planted in a randomized complete block design (RCB) with two replications for leafspot evaluation at the Georgia Coastal Plain Experiment Station (CPES) Gibbs Farm, Tifton, Georgia. Plots consisted of two 1.5 m-long rows spaced 0.9 m apart and were evaluated twice before digging. The 33 PI lines with the lowest late leafspot rating on a one to ten scale (3, 8) were used for subsequent evaluation. Seed of these PI lines were increased in 1988.

The 33 resistant PI lines listed in Table 1, Florunner (susceptible check) and Southern Runner (partially resistant check) were planted in a randomized complete block design with three replications on 19 May 1989, 8 May 1990, and 21 May 1991. Plots consisted of two 4.6 m-long rows spaced 0.9 m apart and seed density was 16.4 seed per meter. No leafspot fungicide was used and plants were grown using standard cultural practices.

Late leafspot severity was evaluated on all plants as described above. Leafspot ratings were recorded on 22 Sept. (125 days after planting (DAP) and 5 Oct. (139 DAP) in 1989, 19 Sept. (134 DAP) in 1990, and on 23 Sept. (125 DAP) and 7 Oct. (139 DAP) in 1991.

Main-stems of PI 215695, PI 215696, PI 215724, Florunner, and Southern Runner were harvested randomly from all replicates on 31 July, 14 August, and 28 August 1989. These three PI lines were selected due to their high leafspot resistance. Five main-stems from each plot on each sampling date were used to evaluate defoliation and the incidence of late and early (*Cercospora arachidicola* Hori) leafspot. Total number of nodes, number of nodes that were defoliated, partial defoliation (1-3 leaflets missing), number of late leafspot lesions on remaining leaves, and number of early leafspot lesions on remaining leaves were recorded for each main-stem. From this data, the percentage defoliation (100 x (number of leaflets) / (number of nodes x 4 leaflets/node)) and the average numbers of early and late leafspot lesions per leaflet were calculated for each stem.

Plots were dug and inverted on 9 October 1989 (143 DAP), 25 September

Table 1. Peanut plant introductions evaluated for late leafspot resistance and yield, 1989-91.

Plant introduction	Growth habit	Country of origin
123643	Erect (Valencia)	India
145681	Spreading Runner	Egypt
162529	Spreading Bunch	Argentina
162531	Spreading Runner	Argentina
162532	Spreading Bunch	Bolivia
162866	Bunch	Sudan
163147	Spreading Bunch	Brazil
179842	Spreading Runner	India
179843	Spreading Runner	India
188998	Spreading Bunch	Ghana
196610	Spreading Runner	Senegal
196625	Spreading Runner	Senegal
196628	Spreading Bunch	Nigeria
196631	Spreading Bunch	Nigeria
196632	Spreading Bunch	Madagascar
196636	Spreading Bunch	Madagascar
196648	Spreading Bunch	Guinea
196651	Spreading Bunch	Ivory Coast
196654	Spreading Bunch	Ivory Coast
196657	Spreading Bunch	Ivory Coast
196662	Spreading Bunch	Ivory Coast
196663	Spreading Bunch	Ivory Coast
196670	Spreading Bunch	Ivory Coast
196677	Spreading Runner	Guinea
196694	Spreading Bunch	Turkey
196695	Spreading Runner	Dahomey
203396	Spreading Runner	Brazil
210827	Spreading Bunch	Bolivia
210831	Spreading Bunch	Bolivia
210832	Spreading Bunch	Bolivia
215696	Erect	Peru
215724	Erect	Peru
215695	Erect	Peru

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1990 (140 DAP), and 9 October 1991 (141 DAP). Yield was obtained by drying and weighing the pods from each plot. A 100-pod sample from each plot was weighed and shelled. Seeds from the 100 pods were weighed, the shelling percentage was calculated (seed weight/pod weight) x 100, and 100-seed weights were determined.

Analyses of variance (ANOVA) were performed on leafspot ratings, yield, shelling percentage, and 100-seed weight by combining data over years (9). Means across years were ranked after exclusion of year and genotype x year interaction sum of squares, using the Waller-Duncan K-ration t-test (11). Product moment correlations (9) were calculated over traits within years and genotypes. ANOVAs were performed for percentage defoliation and average number of early and late leafspot lesions on the 1989 main-stem data. References to statistical significance mentioned herein are for $P \leq .05$ unless otherwise indicated.

Greenhouse Evaluation

Seed of Florunner, Southern Runner, PI 215695, PI 215696 and PI 215724 were planted on 3 Dec. 1988 in 20cm diameter pots in the greenhouse. Five replications of three plants per replication were arranged in a randomized complete block design on greenhouse benches. Conidia of *C. personatum* were collected as inoculum with a cyclone spore collector (Eri Machine Shop, Iowa State Univ., Ames) from diseased Florunner leaves collected from the field and stored under refrigeration in sealed vials at 4 C. Conidia were suspended in deionized water (approximately 6,600 spores/mL) containing one drop of Tween 80 per 100 mL. Plants were inoculated on 12 Jan. 1989 by spraying each plant for four seconds using a Spra-Tool aerosol dispenser (Crown Ind. products Co., Hebom, Ill). Immediately after inoculation, each plant was covered with a plastic bag for five days to maintain high humidity. Bags were than removed and plants were left at ambient conditions in the greenhouse (18-35 C).

The number of lesions and the number of sporulating lesions were recorded every two or three days starting at 15 days after inoculation. The percentage of lesions sporulating was calculated and adjusted for defoliation by excluding lost leaflets as the experiment continued. The GLM procedure (9) and the Waller-Duncan multiple range test were used to analyze the percentage of lesions sporulating.

Results

Field Tests

Year, genotype, and genotype x year (G x Y) effects were significant ($p \leq 0.001$) for leafspot and yield over three years (Table 2 and 3). The incidence of late leafspot was severe during 1989 and 1991 and resulting yields were low. Drought conditions occurred during 1990 which reduced leafspot damage significantly, and yields were much higher than in 1989 and 1991. Shelling percentage was also affected by year (Table 3). Genotype and genotype x year effects were significant for shelling percentage and 100-seed weight.

Over half of the plant introductions had lower leafspot ratings than Southern Runner including its resistant parent PI 203396 (Table 4). The genotypes PI 215724, PI 215696, and PI 215695 consistently had the lowest leafspot ratings, but their yields were low compared to the other genotypes. Pod yield of Southern Runner was highest in 1990 when disease incidence was low (Table 5). Yields of PI 203396 and PI 162529 were not significantly different from Southern Runner, even during years of high disease incidence. The yield of Florunner varied greatly between years of high and low leafspot incidence.

Florunner, Southern Runner, PI 179842, and PI 196628

Table 2. Mean squares for late leafspot rating 1 and yield over years (1989-1991).

Source	df	Leafspot rating 1*	Yield
Year(Y)	2	90.58**	108439473**
Error 1	4	0.96	567452
Genotype(G)	34	9.34**	1746295**
GxY	68	1.51**	285493**
Error 2	204	0.21	126384

*Leafspot rated at 125 DAP using the Florida 1-10 scale (Chiteka et al. 1988).
** Significant at the 0.001 probability level.

Table 3. Mean squares for late leafspot rating 2, shelling percentage and 100 seed weight over two years (1990-1991).

Source	df	Leafspot rating 2*	Shelling %	100 seed weight
Year(Y)	1	79.24**	1566.2**	35.0
Error 1	2	0.05	13.0	48.3
Genotype(G)	34	3.05**	71.7**	1107.8**
GxY	34	0.34**	21.3**	34.2**
Error 2	127	0.16	8.6	12.6

*Leafspot rated at 139 DAP using the Florida 1-10 scale (Chiteka et al. 1988).
** Significant at the .001 probability level.

Table 4. Late leafspot reactions of 33 plant introductions and 2 cultivars in 1989, 1990 and 1991 at Tifton, GA.

Plant introduction	1989		1990	1991		Mean	
	1[a]	2	1	1	2	1	2
215724	4.3	6.0	1.0	5.5	6.3	3.61 a*	6.17 a*
215696	4.7	5.8	1.0	5.3	6.0	3.67 a	5.92 a
215695	4.7	5.7	1.0	5.5	6.2	3.72 a	5.92 a
210831	5.8	6.2	2.8	6.0	7.7	4.89 b	6.92 bc
203396	5.5	6.2	3.5	6.0	7.2	5.00 b	6.67 b
162531	5.7	6.7	3.3	6.2	7.3	5.06 b	7.00 b-d
210832	5.8	6.5	3.5	6.3	8.2	5.22 bc	7.33 d-f
196663	5.5	6.3	4.5	6.5	7.8	5.50 cd	7.08 c-e
210827	6.0	6.5	3.7	6.8	8.2	5.50 cd	7.33 d-f
162532	5.8	6.8	4.7	6.7	8.2	5.72 de	7.50 f-h
196662	5.8	6.7	5.2	6.5	8.2	5.83 d-f	7.42 e-g
162866	5.8	6.8	5.3	6.5	8.3	5.90 ef	7.58 f-i
196654	5.8	6.5	5.5	6.5	8.2	5.94 e-g	7.33 d-f
196694	6.0	7.3	5.3	6.7	8.2	6.00 e-h	7.75 g-k
196670	6.2	7.0	5.2	6.8	8.3	6.06 e-i	7.67 f-j
196651	5.8	6.7	5.7	6.8	8.2	6.11 f-i	7.42 e-g
196636	6.2	7.5	5.5	6.7	8.2	6.11 f-i	7.83 h-l
163147	5.7	6.7	5.5	7.2	8.3	6.11 f-i	7.50 f-h
196657	5.8	6.8	5.7	7.3	8.3	6.28 g-j	7.58 f-h
196695	6.0	7.2	6.2	6.8	8.3	6.33 h-k	7.75 g-k
Southern Runner	6.0	7.3	5.8	7.2	7.8	6.33 h-k	7.58 f-i
196648	6.5	7.4	6.8	6.7	8.2	6.33 h-k	7.75 g-k
196677	6.0	7.5	6.0	7.2	8.5	6.39 i-k	8.00 j-m
188998	6.0	7.0	6.5	7.2	7.8	6.56 jk	7.42 e-g
196610	6.2	7.0	6.2	7.3	8.3	6.56 jk	7.67 f-j
196631	6.0	6.8	6.2	7.7	8.3	6.61 j-l	7.58 f-i
196628	5.8	6.5	6.5	7.5	8.2	6.61 j-l	7.33 d-f
196625	6.2	7.3	6.2	7.5	8.8	6.61 j-l	8.08 k-m
162529	6.0	7.3	6.7	7.3	8.5	6.67 k-m	7.92 i-l
179843	6.0	7.2	6.2	7.8	8.8	6.67 k-m	8.00 j-m
123643	6.0	7.2	6.0	8.5	9.0	6.94 lm	8.08 k-m
179842	6.2	7.3	6.8	8.0	9.3	7.00 m	8.33 mn
145681	6.2	7.3	6.7	8.3	9.0	7.00 m	8.17 l-n
196632	7.0	7.8	7.2	8.8	9.2	7.67 n	8.50 n
Florunner	7.8	9.5	7.8	9.5	10.0	8.39 o	9.75 o

*Means followed by the same letter are not different (P=0.01) according to the Waller-Duncan K-ratio t-test.

[a]1 and 2 refer to rating times during the year.

Table 5. Yield (kg/ha) of 33 late leafspot resistant peanut plant introductions and 2 cultivars for 1989, 1990 and 1991.

Plant introduction	1989	1990	1991	Mean
Southern Runner	2373	4295	2027	2898 a*
203396	2218	3686	2353	2714 a
162529	2474	3511	1810	2598 ab
210831	2062	3516	1615	2398 bc
196662	1494	3545	1272	2104 cd
163147	1321	2962	1087	1878 de
196654	1409	3166	851	1809 d-f
179843	732	3236	1266	1804 d-f
Florunner	475	4071	382	1800 d-g
210827	1145	2848	1362	1785 e-g
196625	1071	3023	924	1766 e-h
196663	1453	2497	1227	1726 e-h
196695	837	3106	1223	1722 e-h
1962532	1023	2714	1227	1654 e-i
210832	858	2597	1456	1637 e-j
215724	1014	2698	913	1620 e-k
196677	925	3124	739	1596 e-l
188988	833	2616	1090	1513 f-m
179842	770	2933	786	1496 g-n
196670	931	2636	920	1496 g-o
196636	870	2784	750	1466 h-p
196648	396	2996	828	1406 i-q
196610	927	2101	1169	1399 i-q
162529	824	2539	757	1373 i-q
196651	703	2481	907	1364 i-q
215696	1032	2410	553	1332 j-q
162532	958	2154	642	1327 k-q
215695	1144	2056	741	1314 l-q
196657	833	2194	873	1300 l-q
196694	992	2174	643	1270 m-q
196628	844	2116	683	1214 m-q
196631	510	2481	611	1200 n-q
145681	1066	2381	602	1190 o-q
196632	394	2459	453	1183 pq
123643	447	2219	479	1123 q

*Means followed by the same letter are not different (P=0.01) according to the Waller-Duncan K-ratio t-test.

Table 6. Shelling percentage and 100-seed weight of late leafspot resistant peanut plant introductions for 1990 and 1991 in Tifton, GA.

Plant introduction	Shelling percentage 1990	Shelling percentage 1991	Shelling percentage Mean	100-seed weight 1990	100-seed weight 1991	100-seed weight Mean
123643	74.6	68.6	71.6 f-i*	50.6	47.2	48.9 f-h
145681	77.2	73.4	74.9 a-e	64.4	68.4	66.4 cd
162529	78.3	70.6	74.4 a-f	47.7	50.3	49.0 f-h
162531	73.4	74.5	74.5 a-f	94.5	88.9	91.7 a
162532	78.5	71.5	74.3 a-f	69.7	66.3	68.3 c
162866	76.4	68.1	71.4 f-i	51.1	46.8	49.4 f-h
163147	75.7	64.6	69.0 i-j	43.7	44.6	44.0 j-m
179842	78.4	74.4	76.4 ab	43.2	42.8	43.0 k-n
179843	76.6	70.5	72.9 c-f	41.6	43.3	42.3 l-n
188998	75.9	70.9	73.4 a-f	39.0	41.2	40.1 no
196610	78.6	72.5	75.6 a-e	37.4	44.6	41.0 m-o
196625	77.8	71.2	73.9 a-g	37.5	39.5	38.3 o
196628	79.5	72.7	76.1 a-c	42.0	42.4	42.2 l-n
196631	77.7	70.5	74.1 a-f	40.6	43.7	42.1 l-n
196632	76.3	72.9	74.3 a-f	55.2	52.7	54.2 e
196636	77.5	71.4	74.4 a-f	50.1	46.6	48.4 g-i
196648	75.3	71.0	73.2 b-g	53.9	54.5	54.2 e
196651	75.2	63.9	69.5 h-k	45.0	48.3	46.7 g-k
196654	75.8	71.4	73.6 a-g	47.5	44.8	46.1 h-k
196657	76.4	70.3	73.3 b-g	44.0	46.1	45.0 i-l
196662	76.1	65.3	70.7 g-j	43.1	44.0	43.5 k-n
196663	75.3	70.0	72.7 e-h	42.3	39.7	41.0 m-o
196670	77.7	67.6	72.6 e-h	51.3	48.9	50.1 fg
196677	67.3	68.0	67.6 j-l	85.6	77.1	81.3 b
196694	71.9	62.4	67.2 k-m	49.0	48.1	48.6 g-i
196695	78.0	70.9	74.4 a-f	41.7	44.4	43.0 k-n
203396	72.3	74.0	73.1 c-g	95.6	88.2	91.9 a
210827	78.4	67.2	72.8 d-g	62.1	64.8	63.5 d
210831	66.9	64.5	65.7 l-n	71.9	59.8	65.8 cd
210832	77.9	69.4	73.7 a-g	62.7	69.4	66.0 cd
215696	61.2	64.3	62.8 n	53.5	41.4	47.5 g-j
215724	73.5	64.1	67.9 j-l	54.1	57.7	55.6 e
215695	63.1	65.4	64.3 nm	52.4	43.1	47.8 g-i
Southern Runner	79.4	72.7	76.0 a-d	50.6	54.1	52.3 ef
Florunner	80.4	74.2	76.7 a	56.1	51.6	54.3 e

*Means followed by the same letter are not different (P=0.01) according to the Waller-Duncan K-ratio t-test.

Table 7. Product moment correlation coefficients for late leafspot ratings, yield, and seed traits among 35 genotypes tested in 1991 at Tifton, GA.

	Leafspot rating 1	Leafspot rating 2	Yield	Shelling percentage
Leafspot rating 2	0.88**			
Yield	-0.35**	-0.26*		
Shelling percentage	0.50**	0.60**	0.13	
100-seed weight	-0.11	-0.07	0.46**	-0.07

*,** Significant at the 0.01 and the 0.001 probability levels, respectively.

were among the highest in shelling percentage (Table 6). High shelling percentage is a desirable trait indicative of full seed set and thin shells. Shelling percentages were, in general, higher in 1990 when disease incidence was low. The 100-seed weight was consistent over years (Table 6). The highest seed size was noted with PI 162531 and PI 203396 while Florunner and Southern Runner produced seed sizes typical of runner-type peanuts.

The first and second leafspot ratings were positively correlated ($p \leq .01$) in 1989 ($r = 0.82$) and 1991 ($r = 0.88$). Significant negative correlations were obtained between leafspot ratings and yield in 1989 (r = -0.30 to -0.33) and 1991 (r = -0.26 to -0.35) but not in 1990 when leafspot severity was low. Leafspot ratings and shelling percentage were positively correlated ($p \leq .01$) in 1990 ($r = 0.43$) and 1991 ($r = 0.50$). Similar trends occurred when correlations were performed within genotypes over years. In all genotypes except PI 188998, leafspot ratings were negatively correlated with yield (r = -0.14 to - 0.96). First leafspot ratings were positively correlated ($p \leq .01$) with shelling percentage within all genotypes (r = 0.31 to 0.99) except PI 162531 (r = -0.25), PI 215695 (r = -0.25), and PI 215696 (r = -0.23).

The percentage defoliation of the three most resistant genotypes was significantly lower ($p \leq .01$) than Southern Runner and Florunner during the first and third sampling dates (Fig. 1), but was similar across all genotypes for the second sampling date (Fig. 1). The trend was the same for the average number of *C. personatum* lesions per leaflet (Fig. 2). The number of late leafspot lesions recorded 28 August was almost three times higher on Florunner than those on Southern Runner and the resistant genotypes. Susceptibility to early leafspot caused by *C. arachidicola*

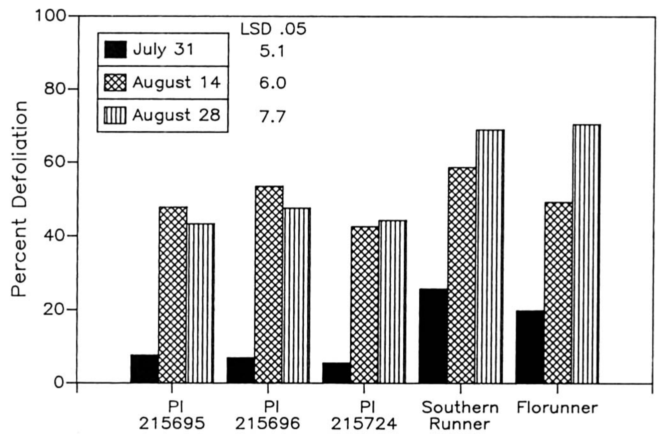

Fig. 1. Percent defoliation from main–stems harvested from three sampling dates in 1989.

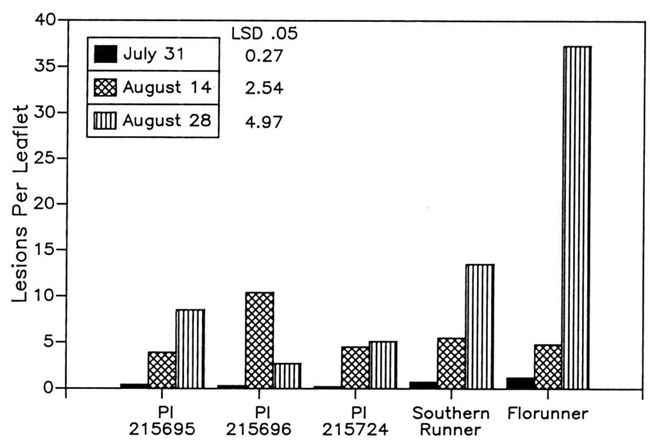

Fig. 2. Average number of *Cercosporidium personatum* (late leafspot) lesions per leaflet from three sampling dates in 1989.

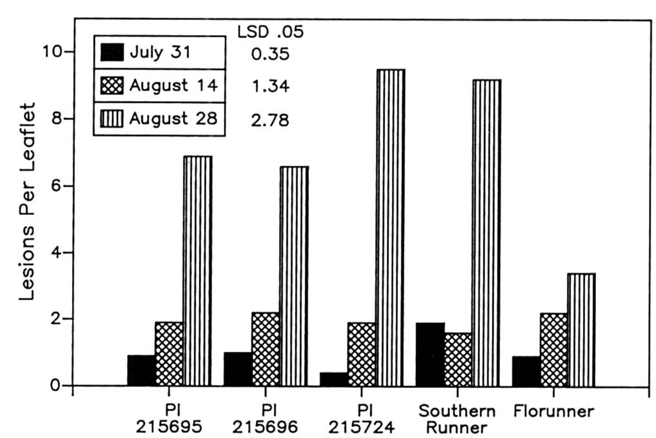

Fig. 3. Average number of Cercospora arachidicola (early leafspot) lesions per leaflet from three sampling dates in 1989.

was not significantly different across genotypes (Fig. 3). The low numbers of lesions recorded on Florunner (< 4 lesions/leaflet) 28 August were, in part, attributed to the competition with *C. personatum*.

Greenhouse Test

Lesion numbers for the five genotypes involved in the greenhouse experiment did not significantly differ. Lesions failed to sporulate for all genotypes until 20 days after inoculation (DAI). The percentage of lesions sporulating indicated a longer latent period and generally a low level of sporulation for PI 215695 and PI 215696 (Table 8). Even when lesions were observed to be sporulating after 25 days the level of sporulation per lesion was minimal. Over 50% of lesions on Florunner and Southern Runner sporulated between 20 and 22 DAI, and at 22 DAI, respectively. Fifty percent of lesions on PI 215724 plants were sporulating at 25 DAI while percentage of lesions sporulating on PI 215695 and PI 215696 never exceeded 10% before the experiment was discontinued after 30 DAI.

Table 8. Percentage of *Cercosporidium personatum* lesion sporulating and latent periods from 1989 greenhouse experiment of five peanut genotypes.

Genotype	Percentage Sporulating Lesions 22 DAI*	25 DAI	Latent Period
PI 215695	0.00a[a]	0.00a	> 30 days
PI 215696	0.00a	0.00a	> 30 days
PI 215724	6.67a	63.28b	24 days
Southern Runner	66.53b	87.42c	21 days
Florunner	96.35c	100.00d	21 days

*DAI = Days after inoculation.
[a]Means followed by the same letter are not different (P=0.01) according to the Waller-Duncan K-ratio t-test.

Discussion

Screening 500 of the over 7,400 peanut plant introductions identified sources of apparent resistance to late leafspot and indicated variability within the collection. Many of the 33 most resistant genotypes had not been previously identified as being resistant. None were superior to PI 203396. Screening the remainder of the genotypes should identify more sources of resistance that can be used in a given cultivar development program.

The genotype with the highest resistance and yield combined was PI 203396, a parent of Southern Runner. However, significantly greater resistance was found in three other genotypes from Peru (Table 4). Of the three genotypes, PI 215724 had the highest yield potential (Table 5). Another genotype that may be useful in cultivar development is PI 162529 which yielded well when leafspot incidence was high, indicating a tolerance to *C. personatum*. Both PI 215724 and PI 162529 appear to have acceptable seed size and the latter had a shelling percentage comparable to Florunner and Southern Runner. With less than 10% of the total *A. hypogaea* germplasm tested, it is likely that other accessions will be found with resistance to *C. personatum*.

Average yield of all genotypes was reduced almost 75% in 1989 and 1991 due to the heavy infestation of leafspot. Yields of resistant genotypes were reduced both years but not to the degree of the susceptible genotype Florunner. None of the genotypes yielded higher than Southern Runner. Plants with high disease ratings generally had higher shelling percentages in 1990 and 1991. This could be due to an undesirable genetic linkage between pod filling and resistance or between pod thickness and resistance. For example, PI 162531, PI 215695, and PI 215696, which had negative correlation coefficients between leafspot and shelling percentage, have thick hulls and late maturity. A physiological response was observed by the generally high positive correlation coefficients within genotypes over years. As disease progressed on the plant, there was less photosynthate to develop new pods and the available photosynthate was directed toward maturing pods. A higher proportion of mature pods will give a higher shelling percentage. However, the mean for shelling percentage across all genotypes in 1991 was lower than in 1990. This may also be due to the greater loss of mature pods from leafspot at harvest for most genotypes (8), but could also be caused by thinner hulls which typically occur in droughty years, such as 1990.

The resistance of PI 215695, PI 215696, and PI 215724 was most noticeable on main-stems collected on 28 August. Although significant differences in resistance were observed on 31 July, the disease had not fully developed. By 28 August, both late leafspot incidence and leaf defoliation had increased for Florunner and Southern Runner while the more resistant genotypes retained leaves longer and had fewer late leafspot lesions. The presence of early leafspot 31 July and 14 August may have masked the resistance of the plant introductions to late leafspot. The genotypes resistant to *C. personatum* did not appear to be resistant to *C. arachidicola*, and a higher proportion of early to late leafspot may have been responsible for the early leaf defoliation across all genotypes 31 July and 14 August. By 28 August, late leafspot had become the prominent foliar disease and differences among genotypes were more pronounced. The greenhouse experiment indicated that at least some components of resistance were long latent periods and low sporulation. These combine to reduce the rate of secondary infection and slow disease progress. Genes for these traits need to be identified and transferred into higher yielding genotypes.

Results indicate the presence of important genes for resistance within the U.S. peanut germplasm collection. Combining genes from different sources may increase overall resistance. However, breeders also need sources of resistance that have higher yield potential and improved fruit characteristics than those identified here. As the peanut germplasm collection is evaluated for resistance genes and acceptable agronomic traits, other plant introductions may be used as parents in crossing programs. This should expand the current gene pool and ultimately improve the pest resistance in peanut cultivars.

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