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Reaction of Spanish-Type Peanut Genotypes to Cylindrocladium Black Rot[1]

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ABSTRACT

Twelve peanut (*Arachis hypogaea* L.) genotypes of the Spanish botanical type and two of the Valencia botanical type were compared for reaction to the soilborne pathogen, *Cylindrocladium crotalariae* (Loos) Bell & Sobers, that causes Cylindrocladium black rot (CBR) in peanuts. In Virginia, experiments were conducted in three fields (two in 1974 and one in 1975) with a history of severe CBR in previous peanut crops. The Spanish genotypes included all current cultivars grown commercially in the United States. Valencia genotypes (PI 355982 and 355987) were included as reference standards because of their known susceptibility to CBR.

Differences among genotypes were significant on the bases of percent diseased plants and visual scores of root and pod damage at each field and combined across fields. Differences also were significant among fields for percent diseased plants and pod damage score and for the genotype by field interaction for percent diseased plants. All Spanish genotypes were significantly lower in percent diseased plants than the Valencia checks. Pod and root damage scores indicated that different genetic mechanisms might control pod and root resistance to CBR. A high degree of resistance is available in Spanish genotypes, but critical progeny selection for both pod and root resistance might be necessary for transfer of resistance in successive generations of a breeding program.

Key Words: groundnuts, peanut breeding, disease resistance, *Calonectria crotalariae*, *Arachis hypogaea*.

The destructive soilborne disease Cylindrocladium black rot (CBR) of peanuts (*Arachis hypogaea* L.) was first discovered in Georgia in 1965 (1). The first case of CBR in Virginia was reported in 1970 (4) and by 1975 the disease was epidemic in the Virginia peanut-growing area (3). CBR is caused by *Calonectria crotalariae* (Loos) Bell & Sobers (*Cylindrocladium crotalariae* (Loos) Bell & Sobers) (1). CBR causes a rot of all underground peanut plant parts, including the fruiting structures as well as the root system.

The first screening test for resistance to CBR was conducted in Georgia (2). In the 1-year test with one Spanish-type (Argentine) and one Virginia-type (Early Runner) cultivar, Bell *et al.* (2) concluded the Spanish-type cultivar, Argentine, was more resistant. In a 1-year test in North Carolina with several Spanish, Virginia and Valencia genotypes, Rowe *et al.* (9) also concluded that Spanish types were least susceptible. Wynne *et al.* (10) also reported that Spanish types were generally less susceptible than either Virginia or Valencia types. However, the most resistant line in these tests was a Virginia type (NC 3033). Garren and Coffelt (3), in a screening test of 11 Virginia and 1 Spanish-type cultivars, found the Spanish type significantly less susceptible than the Virginia types. They also found variability among the 11 Virginia-type cultivars under light disease pressure. However, under high disease pressure there were no significant differences among the Virginia-type cultivars. Phipps and Beute (8) reported that Argentine and NC 3033 were more resistant than Florunner, Florigiant and NC-FLA 14. Morton and Baxter (7) reported significant differences among six susceptible and one resistant Virginia-type peanuts for root necrosis and yield in CBR infested soil.

Most previous studies suggested that Spanish peanuts are resistant, but none evaluated all of the Spanish cultivars that are currently grown in the United States. In this paper the reactions are reported of the nine Spanish cultivars grown in this country, three Spanish-type breeding lines and two Valencia-type checks.

Materials and Methods

The design of the experiment was a randomized complete block with six replications. In southeast Virginia, two fields (A & B) were planted in 1974 and one field (C) was planted in 1975. Prior to the experiment CBR was severe in peanuts grown in all fields. Peanuts were planted in 2-row plots, 1.8 m wide and 7.6 m long in 1974 and 6.1 m long in 1975.

There were 14 entries at each location: 12 Spanish genotypes (Spancross, Spanhoma, Chico, Comet, Argentine, Au-3, PI 311264, Tifspan, Tamnut 74, Starr, Goldin-I and GA 207-3) and two Valencia genotypes (PI 355982 and PI 355987). All Spanish peanut cultivars of commercial significance in the United States were tested.

Degree of susceptibility was expressed as the percentage of diseased plants per plot at harvest in all fields. In fields B and C a visual score also was assigned to each plot for the amounts of pod and root damage due to CBR. The disease rating was: 1 = slight or none, 2 = intermediate, and 3 = 75-100% pod or root damage. Data from each field and combined across fields were evaluated by analysis of variance and Duncan's New Multiple Range Test. Linear regression and correlation coefficients were computed for percent diseased plants versus pod and root damage and pod versus root damage for combined data from fields B and C.

Results and Discussion

Significant ($P=0.05$) differences among genotypes occurred for percent diseased plants (Table 1), root damage scores (Table 2) and pod damage scores (Table 3) at all fields and combined across fields. Significant differences also occurred among

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Table 1. Percent CBR diseased plants of 14 peanut genotypes at 3 fields (A and B in 1974 and C in 1975).

	Field			
Genotype	A	B	C	Mean
Spancross (S)*	5.8 d**	1.3 bc	1.4 d	2.9 c
Spanhoma (S)	6.5 d	2.3 bc	4.8 d	4.5 c
Chico (S)	11.5 d	1.7 bc	0.8 d	4.7 c
Comet (S)	11.7 d	1.7 bc	1.7 d	5.0 c
Argentine (S)	12.2 d	2.3 bc	4.4 d	6.3 c
AU-3 (S)	14.7 cd	1.8 bc	3.0 d	6.5 c
PI 311264 (S)	14.7 cd	0.7 c	2.3 d	5.9 c
Tifspan (S)	15.5 cd	1.8 bc	1.3 d	6.2 c
Tamnut 74 (S)	16.0 cd	2.2 bc	1.0 d	6.4 c
Starr (S)	16.7 cd	3.2 bc	1.2 d	7.0 c
Goldin-I (S)	24.0 bc	5.0 bc	12.9 c	14.0 b
GA 207-3 (S)	27.0 b	6.7 b	12.9 c	15.5 b
PI 355982 (V)	43.5a	16.3a	23.4 b	27.8a
PI 355987 (V)	45.5a	18.5a	31.1a	31.7a
MEAN	18.9A	4.7 C	7.3 B	

* S and V equal Spanish and Valencia plant types, respectively.

** Means within a column followed by the same letter are not significantly different at the 5% level according to Duncan's New Multiple Range Test.

Table 2. Root damage scores for 14 peanut genotypes at 2 fields (B in 1974 and C in 1975).

	Field		
Genotype	B	C	Mean
Spancross (S)*	1.2 e**	1.3 e	1.3 d
Spanhoma (S)	1.3 de	1.5 de	1.4 d
Chico (S)	1.9 bcde	2.2 bcd	2.0 bc
Comet (S)	1.3 de	1.5 de	1.4 d
Argentine (S)	1.3 de	2.0 cde	1.6 cd
AU-3 (S)	2.3abc	2.2 bcd	2.3ab
PI 311264 (S)	1.5 de	1.7 de	1.6 cd
Tifspan (S)	1.8 cde	1.3 e	1.5 cd
Tamnut 74 (S)	1.3 de	1.3 e	1.3 d
Starr (S)	1.5 de	1.3 e	1.4 d
Goldin-I (S)	2.8a	1.8 de	2.3ab
GA 207-3 (S)	2.6ab	2.7abc	2.7a
PI 355982 (V)	2.0 bcd	2.8ab	2.4ab
PI 355987 (V)	2.5abc	3.0a	2.7a
MEAN	1.8A	1.9A	

* S and V equal Spanish and Valencia plant types, respectively.

** Means within a column followed by the same letter are not significantly different at the 5% level according to Duncan's New Multiple Range Test.

Table 3. Pod damage scores for 14 peanut genotypes at 2 fields (B in 1974 and C in 1975).

	Field		
Genotype	B	C	Mean
Spancross (S)*	1.8abcd**	2.0 bcd	1.8 cd
Spanhoma (S)	1.6 bcd	2.2abcd	1.9 bcd
Chico (S)	2.2ab	2.8a	2.5a
Comet (S)	1.8abcd	2.0 bcd	1.9 bcd
Argentine (S)	1.6 bcd	2.2abcd	1.9 bcd
AU-3 (S)	1.8abcd	2.2abcd	2.0 bcd
PI 311264 (S)	1.3 d	1.3 e	1.3 e
Tifspan (S)	2.1abc	2.2abcd	2.2abc
Tamnut 74 (S)	1.5 cd	1.7 de	1.6 de
Starr (S)	2.0abc	1.8 cde	1.9 bcd
Goldin-I (S)	1.9abcd	2.2abcd	2.0 bcd
GA 207-3 (S)	1.5 cd	2.8a	2.2abc
PI 355982 (V)	2.2ab	2.5abc	2.4ab
PI 355987 (V)	2.3a	2.7ab	2.5a
MEAN	1.8 B	2.2A	

* S and V equal Spanish and Valencia plant types, respectively.

** Means within a column followed by the same letter are not significantly different at the 5% level according to Duncan's Mew Multiple Range Test.

Table 4. Symbols representing the 14 peanut genotypes studied used in Figures 1, 2, and 3.

Genotype	Symbol*
Spancross	⊙
Spanhoma	⊡
Chico	×
Comet	+
Argentine	◬
AU-3	⛛
PI 311264	◈
Tifspan	⬩
Tamnut 74	⌓
Starr	◡
Goldin-I	➤
GA 207-3	⮟
PI 355982	⮜
PI 355987	⮝

* Each symbol represents the mean of 12 observations (6 replications at each of 2 locations).

fields for percent diseased plants (Table 1) and pod damage scores (Table 3). Analysis of variance for the genotype x field interaction for percent diseased plants gave a highly significant (P = 0.01) F value. These results agree with previous screening tests (2, 3, 7, 8, 9, 10).

Percent diseased plants was significantly (P=0.05) lower for all Spanish genotypes than for the two Valencia checks, but varied among the Spanish types. Goldin-I and GA 207-3 were significantly higher in percent diseased plants than the other Spanish-type entries at field C and for the combined data from all fields (Table 1). Percent diseased plants was similar for these genotypes at fields A & B (Table 1) and for Virginia-type cultivars that had been grown in the same fields (3). Some evidence (no flowering on the mainstems and darker leaf color) suggests that these genotypes might be more correctly classified botanically as Virginia types (*A. hypogaea* subsp. *hypogaea* var. *hypogaea*) than as Spanish types (*A. hypogaea* subsp. *fastigata* var. *vulgaris*); however, they are sold commercially as Spanish types. The screening results support this possibility.

Linear regression, Y = BO + B1(X), and correlation coefficients (r^2) were computed for mean percent diseased plants versus mean root damage (Fig. 1), mean diseased plants versus mean pod damage (Fig. 2), and mean root damage versus mean pod damage (Fig. 3) for combined data from fields B and C of the 14 peanut genotypes. All "r" values were significant (P=0.05). Root damage and pod damage scores generally corresponded in severity with each other and to percent diseased plants (Tables 1, 2, 3; Fig. 1, 2, 3). However, pod damage scores for Chico and Tifspan and root damage scores for AU-3 and Chico were above the average pod and root damage scores, respectively, while the percent diseased plants was below the average for the four genotypes. These inconsistencies indicate that different genetic mechanisms might be involved in pod and root resistance to CBR. These results indicate that in breeding for resistance, knowledge of the reaction of both roots and pods to CBR would be important in selection of parents.

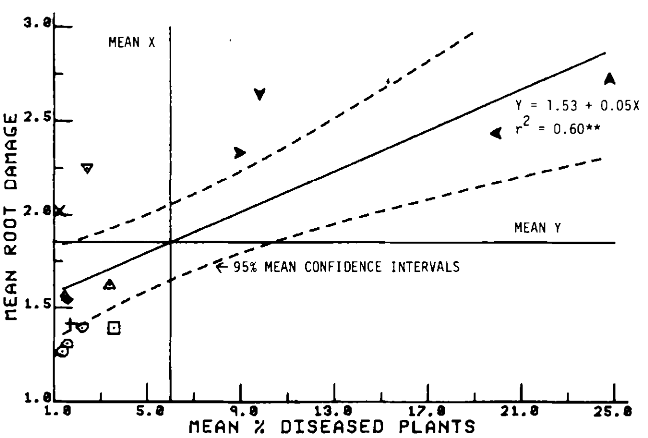

Fig. 1. Linear regression of means of percent diseased plants and root damage scores of 14 peanut genotypes at two locations. (See Table 4 for symbol key).

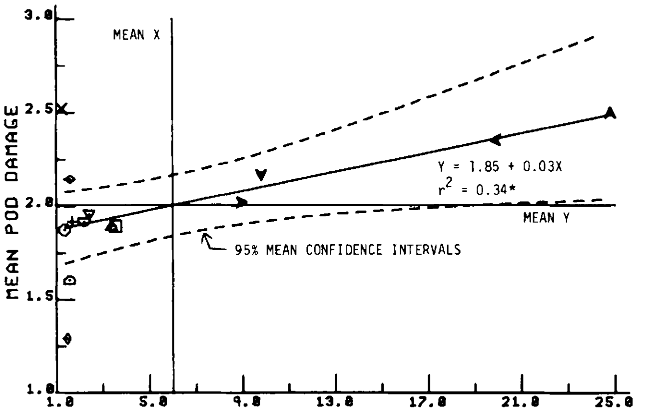

Fig. 2. Linear regression of means of percent diseased plants and pod damage scores of 14 peanut genotypes at two locations. (See Table 4 for symbol key).

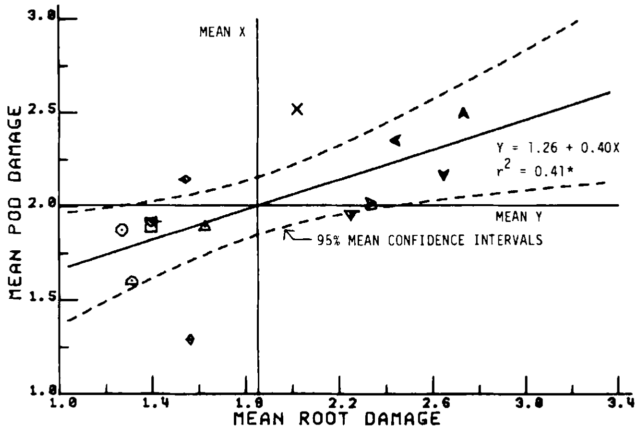

Fig. 3. Linear regression of means of root damage scores and pod damage scores of 14 peanut genotypes at two locations. (See Table 4 for symbol key).

Significant differences between locations were previously reported (3, 10). Such differences, plus the significant genotype x field interaction for percent diseased plants, might be due to differences in physiological races of the pathogen, inoculum levels, environments, or a combination of two or more of these or other factors (3). The differences observed in the present study were probably due to environmental factors, initial inoculum levels or, more probably, a combination of these factors, although Hadley *et al.* (5) have suggested that the potential exists for race development in *C. crotalariae*.

Hadley *et al.* (6) reported heritability estimates ranging from 0.48-0.65 for CBR resistance and attributed resistance to additive genetic effects. The present data also indicate that resistance to CBR is appreciably heritable. Two cultivars (Spancross and Tifspan) with Argentine as one parent in common were as resistant as Argentine (Table 1). Spanhoma, which was selected from Argentine, also maintained a high level of resistance (Table 1). Tamnut 74, which has Starr as one parent, and Comet, which was selected from Starr, were as resistant as Starr (Table 1). Resistance was present in these cultivars without selection for resistance. Therefore, breeders might be able to select for acceptable agronomic and marketing traits in early generations and for resistance in later generations.

Present data indicate that although the Spanish genotypes tested provide a wide germplasm base (at least four germplasm groups), all of the Spanish genotypes tested have a relatively high degree of resistance to CBR. These genotypes should provide a good source of germplasm for introducing CBR resistance into other peanut types.

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