

Web Blotch Resistance in *Arachis hypogaea*¹

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ABSTRACT

Seventeen genotypes of peanut, *Arachis hypogaea* L., consisting of Spanish, Runner, and Virginia market types were evaluated for resistance to web blotch caused by *Phoma arachidicola* Marasas, Pauer and Boerema in small plot field tests. Disease ratings were obtained by determining percentages of infected attached leaflets and abscinded leaflets. Marked differences in disease resistance were observed, and three levels of susceptibility were evident. Entries of the Virginia and Runner market types were generally more resistant to web blotch than the Spanish. Definitive yield and grade effects were not discernible, but indications were that yield and kernel size were affected.

Key Words: Peanut, groundnut, foliar diseases, net blotch, hostplant resistance, disease control, epidemiology, *Phoma arachidicola*, *Mycosphaerella argentinensis*, *Didymosphaeria arachidicola*.

Pettit et al. (4) reported the first occurrence of *Ascochyta* web blotch of peanuts in Texas during the 1972 growing season, and we have observed it during each season since. Prolonged periods of leaf wetness are conducive to web blotch development according to Blamey et al. (2) and Philley et al. (5). Although Pettit et al. (4) described the causal fungus as a species of *Ascochyta*, Marasas et al. (3) studied an apparently identical fungus and named it *Phoma arachidicola*. Philley (6) concluded that *Mycosphaerella argentinensis* Frezzi was the appropriate name for the perfect state of the fungus. Subsequently, Alcorn et al. (1) reported either this disease or a similar foliar disease in Queensland, and coined the name "net blotch" to describe the symptoms.

Pettit et al. (4) and Philley (5) reported differences in susceptibility to web blotch among peanut genotypes but provided no statistical estimates for error with their data. Alcorn et al. (1) reported that Spanish and Valencia-type cultivars were affected more by the disease than the Virginia-types.

The purpose of this paper is to report the existence of peanut genotypes with resistance to web blotch. Quantitative data were obtained in naturally infested fields during 1974 and 1976.

Materials and Methods

Seventeen genotypes including Spanish, Runner and Virginia

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market type peanuts were grown in yield tests near Pearsall, Texas in 1974 and 1976. Eight of the genotypes were included in both tests. Four replications of four row plots 5.0 m long spaced one meter apart arranged in a randomized complete block design were seeded near April 1 each year at commercial rates on soil of the Duval-Webb series. Benefin (N-Butyl-N-ethyl- α , α , α -trifluoro-2, 6-dinitro-p-toluidine) and vernolate (S-propyl dipropylthiocarbamate) were uniformly incorporated into the soil prior to planting at rates of 1.12 and 2.80 kg a.i. per hectare, respectively. Cultural practices were in accordance with recommended irrigated peanut production except for foliar fungicide applications. Benomyl and a benomyl-maneb oil emulsion were applied in 1974 while no fungicide was applied until 112 days after planting in the 1976 test. Border plants were removed from both ends of each plot at harvest, and 4.6 m of each of the two center rows were harvested for yield and grade determinations.

Foliar disease readings were made 126 and 118 days after planting for the 1974 and 1976 tests, respectively. The number of leaflets that were still attached but showing disease symptoms, the number of abscinded leaflets, and the number of leaflet positions per stem were recorded for five randomly selected main stems from each plot. The percentages of infected attached leaflets (IAL), defoliation (DEF), and IAL plus DEF were computed on a plot basis. Disease indices data were analyzed statistically after arcsin transformation and the means compared by the Duncan's New Multiple Range Test.

Results and Discussion

In 1974, the rainfall totalled 24.1 cm with a total of 13 rainy days during the 4 month period from April to July. During a 5 day cloudy period, June 10-14, 8.2 cm of rain fell and daily maximum temperatures ranged from 29-35 C. July was dry with only 8 mm of rainfall recorded. In 1976, 57 cm of rain fell on a total of 40 days between April 2, and July 29. Rainfall was recorded on 9 of 11 continuous days beginning July 4, and temperatures ranged from 34.4 to 39.4°C. These prolonged periods of warm and moist conditions apparently provided conditions highly favorable for infection and web blotch development. Blamey et al. (2) and Philley et al. (5) observed similar relationships between environmental factors and web blotch.

Although other foliar diseases were observed in 1974, web blotch was the predominant disease. DEF ratings may have been biased upwards because of defoliation associated with causes other than web blotch; however, the IAL ratings should not have been affected. In 1976 web blotch was virtually the only foliar disease in the test at the time of the ratings, and this facilitated a unique opportunity to evaluate peanut genotypes in the presence of an epidemic of web blotch.

The disease indices for the entries in the two tests are shown in Tables 1 and 2. The mean and range in DEF for the two tests were similar. Among the eight entries included in both tests, 'Starr' and 'Spancross' were the most susceptible

Table 1. Web blotch disease indices for cultivars and breeding lines at Pearsall, TX, 1974.

| Cultivar or Selection | Market type | Pearsall | | |
|------------------------|-------------|----------|-----------|------------------|
| | | IAL+ (%) | DEF++ (%) | IAL plus DEF (%) |
| Spancross ^o | S | 10.3 ab* | 27.4 ab | 37.7 a |
| Starr ^o | S | 12.9 a | 24.0 bc | 37.1 ab |
| NC-Fla 14 | V | 2.0 de | 31.7 a | 34.4 ab |
| Spanhoma | S | 10.9 ab | 21.4 bcd | 32.4 abc |
| Spantex ^o | S | 9.9 ab | 21.9 bcd | 32.1 abc |
| Tamnut 74 ^o | S | 11.7 ab | 18.5 cde | 30.3 abc |
| Comet ^o | S | 9.6 ab | 19.8 bcde | 29.8 abcd |
| Tifspan | S | 7.4 abc | 21.3 bcd | 29.2 abcd |
| Toalson ^o | S | 6.7 bc | 21.3 bcde | 27.0 bcde |
| Ga 116 | S | 6.2 bc | 16.7 cdef | 23.1 cde |
| GK-19 ^o | R | 0.5 ef | 19.9 bcde | 20.4 def |
| Ga 123 | R | 4.1 cd | 14.7 def | 19.2 ef |
| Goldin 1 | R | 0.7 ef | 17.3 cdef | 18.6 ef |
| GK 53 | S | 1.3 def | 13.0 ef | 14.8 fg |
| Florunner ^o | R | 0.1 f | 10.9 f | 11.0 g |
| Mean | | 5.6 | 20.0 | 27.1 |

✓ S = Spanish, R = Runner, V = Virginia

+ infected attached leaflets

++ abscinded leaflets (defoliation)

^o entries in 1974 and 1976 tests

* values within columns bordered by common letters are not different at the 95% probability level (DNMR).

Table 2. Web blotch disease indices for cultivars and breeding lines at Pearsall, TX, 1976.

| Cultivar or Selection | Market type | IAL+ (%) | DEF++ (%) | IAL plus DEF (%) |
|------------------------|-------------|----------|-----------|------------------|
| Spancross ^o | S | 36.4 ab* | 35.9 a | 72.4 a |
| Comet ^o | S | 45.3 a | 22.7 bcd | 68.6 ab |
| Starr ^o | S | 44.5 ab | 23.6 bcd | 68.2 ab |
| Toalson ^o | S | 34.7 bc | 26.9 abc | 67.7 ab |
| Spantex ^o | S | 41.1 ab | 24.0 bcd | 65.2 ab |
| Tamnut 74 ^o | S | 42.4 ab | 17.4 de | 60.4 bc |
| GK-3 | V | 27.1 c | 22.2 bcd | 49.6 cd |
| Florigiant | V | 27.1 c | 17.8 cde | 45.1 d |
| Early Bunch | V | 10.1 d | 17.0 de | 27.3 e |
| GK-19 ^o | R | 8.4 de | 12.5 ef | 21.1 ef |
| Florunner ^o | R | 5.2 e | 7.8 f | 13.7 f |
| Mean | | 28.4 | 20.7 | 50.8 |

✓ S = Spanish, R = Runner, V = Virginia

+ = infected attached leaflets

++ = abscinded leaflets (defoliation)

^o = entries in 1974 and 1976 tests

* = values within columns bordered by common letters are not different at the 95% probability level (DNMR).

to web blotch, whereas 'GK-19' and 'Florunner' were the most resistant. In general, the typical Spanish-type entries had more defoliation than other entries, but this might be partially attributable to variations in maturity among entries at the date of evaluation. However, the high DEF recorded for 'NC-Fla 14' was in contrast with other entries of the Virginia botanical type, but runner market type, and might suggest a hypersensitive reaction.

The IAL values were much higher for the 1976 than for the 1974 tests. The typical Spanish entries were higher in percentage IAL than all other entries. Although the percentage IAL was low for all entries in the 1974 test, distinct and significant differences were recorded among entries; those with the dark green, more typically Virginia botanical type of foliage being more resistant. The low readings for Florunner and GK-19 in both tests are noteworthy. 'Early Bunch' was significantly lower in percentage of IAL than the other two Virginia market type entries, i.e. 'Florigiant' and 'GK-3', in the 1976 test. The latter varieties seem to comprise an intermediate level of resistance among the entries in these tests.

Reasonable consistency in IAL plus DEF values is apparent in the relative performance of the eight entries included in the two tests. The superior resistance of Florunner compared with the Spanish entries is obvious. Although GK-19 was statistically different (.05 level) from Florunner in the 1974 test, it was not in 1976. This difference, as those among the typical Spanish entries, is probably unimportant. Early Bunch showed good resistance in 1976 compared with the other Virginia and the Spanish entries largely because of a lower IAL percentage. The high IAL + DEF reading shown for NC-Fla 14 is because of a high DEF compared with all other entries.

The effect of the disease on yield and grade is pertinent. Higher yields were obtained from the more resistant entries with Virginia and Runner foliage characteristics than from the typical Spanish entries (Table 3). Superior yields by the Virginia and Runner entries have been noted in other South Texas tests in the absence of the disease. However, the extent of the yield difference is somewhat greater than expected. The yield advantage of the Virginia-Runner over the Spanish entries in this test averaged 65 percent. This is nearly twice the yield advantage expected based on data from other tests in this area (7). The coefficients of regression for yield on IAL + DEF were not significantly different from zero within either the typical Spanish or the other entries in the test. Apparently the effects of the disease were not sufficient in either magnitude or consistency of yield associations within those groups of entries. Nevertheless, we believe that the large yield difference between the Virginia-Runner and the Spanish entries is at least partially associated with

Table 3. Yield and grade data for cultivars and breeding lines at Pearsall, TX, 1976.

| Cultivar or Selection | Pods (kg/ha) | SMK & ✓ SS (%) | DK ° (%) | OK + (%) |
|---------------------------|--------------|-------------------|-------------|-------------|
| Early Bunch ⁺⁺ | 5134 a* | 68.8 cde | 5.1 c | 2.6 a |
| GK-3 | 4939 ab | 72.0 abc | 1.6 ab | 1.5 a |
| Florunner | 4648 bc | 73.8 ab | 2.2 ab | 4.8 b |
| Florigiant | 4225 cd | 72.3 abc | 2.3 ab | 1.4 a |
| GK-19 | 3445 d | 75.1 a | 1.3 ab | 2.6 a |
| Comet ⁺⁺ | 3276 e | 70.1 cd | 1.3 ab | 5.9 bcd |
| Tamnut 74 ⁺⁺ | 3254 e | 67.2 de | 2.0 ab | 6.3 cd |
| Toalson ⁺⁺ | 2984 e | 66.1 e | 0.6 a | 6.3 cd |
| Starr ⁺⁺ | 2854 ef | 66.5 e | 1.0 ab | 7.1 d |
| Spancross ⁺⁺ | 2479 fg | 70.7 bc | 2.7 b | 5.2 bc |
| Spantex ⁺⁺ | 2143 g | 70.7 bc | 2.1 ab | 7.1 d |

* Values within columns bordered by the same letter are not different at the 95% probability level.

✓ Sound mature plus sound split kernels

° Damaged kernels

+ Other kernels

++ Harvested 19 August (139 days after planting), other entries harvested 3 September

the severe web blotch injury to the Spanish entries.

The sound mature kernel percentages (SMK) of the Virginia entries were equal to or higher than most of the Spanish entries. In most of our tests the SMK of the Spanish entries has exceeded that of the large-podded entries. The other kernel percentages (OK) were high for the Spanish entries even though they were not dug until 139 days after planting. This suggests that kernel size may have been affected, resulting either from the depletion of photosynthate for later developing pods or a general retardation in the development of the plants.

We conclude that there is considerable resistance to web blotch in the Virginia and Runner market types of peanuts. These data indicate that there were three levels of resistance among the entries tested, and at least two levels of resistance among the Virginia botanical group. All of the typical Spanish entries tested were heavily diseased, but some genotypes having darker foliage color and small, Spanish-like pods (e.g. 'GK-53' and 'Ga 116') appeared to have a satisfactory level of resistance. We believe that web blotch may have a marked economic effect on yield and grade.

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