Partial resistance of Southern Runner, *Arachis hypogaea*, to stem rot caused by *Sclerotium rolfsii*[1/]

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ABSTRACT

The susceptibility of 16 peanut (*Arachis hypogaea* L.) genotypes (eight virginia and eight runner types) to southern stem rot (*Sclerotium rolfsii* Sacc.) was evaluated in field tests over three years. Mean disease incidence for all cultivars was 10.0, 15.4 and 16.4 disease loci per 12.2 m row and average yields were 3488, 2826 and 3569 kg/ha in 1986, 1987 and 1988, respectively. Disease incidence averaged 14.3 disease loci per 12.2 m of row for both market types. The mean yield for the eight virginia types was 3287 kg/ha versus 3214 for the eight runner types. Culitvars within market types varied significantly in disease incidence and pod yield. Of the virginia types, NC 6 and Florigiant were the most susceptible with NC 9, VA 81B and Early Bunch being the most resistant. Incidence of stem rot in runner cultivars was high except for Southern Runner and Langley which had about 50% less disease than the most susceptible entries. There was a highly significant correlation ($P \leq 0.01$) between yields and disease incidence all three years. Overall, Southern Runner had the lowest disease incidence and highest pod yield of any cultivar. Compared to Florunner, the current industry standard for runner types, Southern Runner had about 50% less disease and yields were 1346 kg/ha higher.

Key Words: Southern Runner, *Sclerotium rolfsii*, Southern stem rot, peanut, disease resistance

Southern stem rot or white mold (*Sclerotium rolfsii* Sacc.) has been a major disease of peanut (*Arachis hypogaea* L.) in the southeastern United States for many years. Due to the high value of this crop, many growers have installed irrigation systems and are adopting shorter rotations or even planting peanuts every year. These practices have exacerbated the problem, and losses in Georgia alone were estimated to be \$30.6 and \$37.5 million in 1987 and 1988, respectively (personal communication, S. S. Thompson).

Although the search for peanut cultivars resistant to *S. rolfsii* originated in 1917 (7), a high degree of resistance has not been found (9). The early literature in this area was reviewed by Aycock in 1966 (2). Differences in partial resistance of peanut genotypes to *S. rolfsii* have been documented via field, microplot, and greenhouse evaluations. Valencia market types are significantly more susceptible than spanish, runner or virginia types (4). Shew *et al.* (11) indicated that resistance is associated with either canopy type (phenological suppression) or with structural barriers or active responses of the plant to infection (metabolic resistance). Evaluating for resistance in field plots may be the best way to verify expression of both types of resistance although they will be confounded.

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Branch and Csinos (4) discussed the importance of evaluating the yield potential of genotypes as well as their disease resistance. The relationship between *S. rolfsii* incidence and yield loss for peanut cv. Florunner has also been elucidated (10) and numerous Fungicide and Nematicide Reports document the yield increases associated with chemical control. This has been particularly evident since the introduction of newer fungicides such as the triazoles which have excellent activity against this pathogen. Unfortunately, these products are not labeled for use by growers, and it is therefore important that we continue to evaluate the performance of commercially available cultivars under conditions of high disease incidence and severity.

Southern Runner is a recently released cultivar developed for its partial resistance to late leafspot (*Cercosporidium personatum* (Berk. & Curt.) Deighton) of peanut (5). Industry acceptance of this cultivar has been slow due to concern over slow emergence and growth of seedlings, late maturity and differences between Southern Runner and other cultivars in shelling and blanching characteristics. However, it does offer the grower significant savings in leafspot fungicide costs, and preliminary observations indicate that it has some resistance to southern stem rot (1). With *S. rolfsii* becoming more of a problem in Georgia each year, such resistance would certainly make this cultivar more acceptable to peanut growers.

The purpose of this study was to determine 1) the relative white mold susceptibility of 16 peanut cultivars including Southern Runner and, 2) the yield response of those same cultivars when grown in fields with high populations of *S. rolfsii.*

Material and Methods

Sixteen peanut cultivars (eight runner and eight virginia market types) were evaluated over a period of three years in fields of Tifton loamy sand with high populations of *S. rolfsii*. The 1986 and 1988 studies were conducted in a field infested with laboratory-produced sclerotia of *S. rolfssi* in 1981 and planted to peanut every year prior to this study. The field used in 1987 had not been artificially infested, but previous peanut plantings indicated that it also had a high incidence of stem rot.

A randomized complete block design was used with four replicates in 1986, six in 1987 and five in 1988. Plots consisted of single beds (two rows) 6.1 m long by 1.8 m wide. Row spacing was 0.8m within plots and 1.0 m between adjacent plots. Seed were planted at five seed per 30 cm. Recommended production practices were followed (6), but no fungicides were applied to control soilborne pathogens. Planting dates were 6 May 1986, 26 May 1987 and 13 May 1988. Each cultivar was dug at physiological maturity as determined by visual examination of plants. Plots were mechanically harvested and peanuts dried to about 8% moisture. Pods were then hand-cleaned and weighed to obtain yields.

Stem rot incidence was rated immediately after peanuts were inverted by counting the number of disease loci per plot. A disease locus consisted of one or more infected plants in a 30-cm section of row. Data from each year were analyzed for variance, then combined across years. Waller-Duncan's multiple range test (k-ratio = 100) was used for mean separations (SAS Institute, Cary, NC).

Results and Discussion

Moderate to heavy disease incidence was observed at all test sites. The mean number of disease loci for all cultivars was found to be 10.0, 15.4 and 16.4 per 12.2 m of row in 1986, 1987 and 1988, respectively. Some damage from Rhizoctonia limb rot (*R. solani* Kühn anastomosis group 4) also occurred and was more severe in 1986 and 1988 than in 1987 (3).

The relative susceptibility of individual cultivars varied from year to year especially in 1986 when overall disease incidence was significantly ($P \leq 0.05$) lower than during the other two years (Table 1). For example, Langley had the highest incidence of stem rot in 1986 but had relatively low levels of disease in 1987 and 1988. Since there was a significant ($P \leq 0.05$) year x cultivar interaction, data for each year are analyzed separately. Although not analyzed, the three-year means for each cultivar are also listed (Table 1). Similar variation was observed by Branch and Csinos (4), causing them to recommend multiple-year evaluations. Shew et al. (11) recommended supplementing natural inoculum with colonized oat grains to ensure more uniform distribution of inoculum. This is probably beneficial, even in a field such as this with a very high incidence of *S. rolfsii*.

Table 1. Incidence of stem rot among 16 peanut cultivars grown in a field heavily infested with *Sclerotium rolfsii* Sacc.

Cultivar	Market Type[a]	Maturity[b]	Disease Loci (no./12.2m of row)[c] 1986	1987	1988	Mean across years
NC 6	Va	M	8.8 de	21.5 a	23.8 a	18.9
Florigiant	Va	M	8.0 de	21.0 ab	24.2 a	18.6
GK-7	Ru	M	12.8 bc	17.0 abc	22.8 abc	17.8
Okrun	Ru	M	12.8 bc	16.5 abc	18.4 c	16.1
Florunner	Ru	M	9.5 cde	17.7 abc	19.4 abc	16.1
Sunrunner	Ru	M	13.5 ab	16.0 abc	18.0 c	16.0
Sunbelt Runner	Ru	M-	9.8 cde	12.5 abc	23.6 ab	15.5
NC 7	Va	M-	11.0 bcd	15.7 abc	18.8 bc	15.5
Tifrun	Ru	M-	2.0 g	20.8 ab	18.2 c	14.9
NC 8C	Va	M+	6.8 ef	17.3 abc	18.2 c	14.8
GK-3	Va	M	4.2 fg	17.0 abc	19.8 abc	14.5
Early Bunch	Va	ME	12.8 bc	17.7 abc	4.8 e	12.1
VA 81B	Va	ME	11.2 bcd	14.2 abc	6.6 de	10.9
Langley	Ru	ME	17.0 a	7.8 bc	6.8 de	9.9
NC 9	Va	ME	11.5 bcd	8.3 abc	8.0 de	9.1
Southern Runner	Ru	ML	8.0 de	5.8 c	10.2 d	7.9
Mean within year			10.0 B	15.4 A	16.4 A	14.3

[a] Va = virginia and Ru = runner.

[b] Maturity classes are relative to Florunner. M = medium maturing, M- = -7 days, M+ = +7 days, ME = -14 days and ML = +14 days.

[c] Cultivar means within each column followed by the same letter do not differ significantly ($P \leq 0.05$) according to the Waller-Duncan k-ratio t test.

Mean pod yield values ranged from a low of 2779 kg/ha with NC 6 to a high of 4176 kg/ha with Southern Runner (Table 2.) As with disease incidence, there was a significant ($P \leq 0.01$) year x cultivar interaction for pod yields and therefore data for each year are analyzed separately. Three-year means are listed to demonstrate the relative productivity of the cultivars under a variety of environmental conditions (Table 2). The correlation between disease incidence and yield was significant ($P \leq 0.01$) all three years of the study but was highest in 1987. Coefficients of determination (r^2) were -0.38, -0.76 and -0.37 for 1986, 1987 and 1988, respectively. The 1987 test had less severe Rhizoctonia limb rot (a mean of 21.6%) than either 1986 or 1988 (47.3% and 47.8%, respectively). The lower levels of this confounding factor in 1987 may have contributed to the higher correlations of *S. rolfsii* incidence with yield, although other factors were probably involved since the 1986 and 1988 evaluations were conducted in a different field. Also, since none of the genotypes received a fungicide for soilborne disease control, incidence of *S. rolfsii* was uniformly high in most plots. A wider range of disease incidence may have provided better correlations with yield in all three tests.

Table 2. Pod yield performance among 16 peanut cultivars grown in a field heavily infested with *Sclerotium rolfsii* Sacc.

			Pod Yield (kg/ha)[c]			
Cultivar	Market Type[a]	Maturity[b]	1986	1987	1988	Mean across years
Southern Runner	Ru	ML	4196 abc	3892 a	4501 a	4176
Early Bunch	Va	ME	4651 a	2555 b	4296 ab	3695
NC 8C	Va	M+	3855 bcde	3051 ab	3928 bcd	3558
NC 9	Va	ME	4598 a	2599 b	3829 bcde	3542
Tifrun	Ru	M-	4314 ab	2907 ab	3654 cdef	3531
GK-3	Va	M	3925 bcd	2735 b	4143 abc	3522
NC 7	Va	M-	3709 bcde	3148 ab	3524 def	3423
Sunrunner	Ru	M	2457 g	3124 ab	3660 cdef	3125
Langley	Ru	ME	3281 def	2800 b	3348 efg	3111
Sunbelt Runner	Ru	M-	3837 bcde	2783 b	2900 g	3103
GK-7	Ru	M	2599 g	3059 ab	3358 efg	3036
Florigiant	Va	M	3268 ef	2560 b	3207 fg	2964
Florunner	Ru	M	2334 g	2823 ab	3234 fg	2830
VA 81B	Va	ME	3598 cde	2208 b	2900 g	2810
Okrun	Ru	M	2435 g	2641 b	3276 fg	2798
NC 6	Va	M	2742 fg	2334 b	3342 efg	2779
Mean within year			3488 A	2826 B	3569 A	3250

[a] Va = virginia and Ru = runner.

[b] Maturity classes are relative to Florunner. M = medium maturing, M- = -7 days, M+ = +7 days, ME = -14 days and ML = +14 days.

[c] Cultivar means within each column followed by the same letter do not differ significantly ($P \leq 0.05$) according to the Waller-Duncan k-ratio t test.

Cultivars evaluated in this test differed significantly in maturity resulting in digging dates that varied by several weeks. There was a trend toward lower disease incidence in the earlier maturing cultivars such as VA 81B, NC 9, Langley and Early Bunch. This may simply be an escape mechanism based on a shorter time of exposure to the pathogen. The one exception to this is Southern Runner which had both the latest maturity and the lowest disease incidence. Southern Runner has a runner or spreading growth-habit and produces dense foliage with a leaf area index (LAI) greater than 6.0 (8). In comparison, the LAI of Florunner is usually less than 5.0. Therefore it is unlikely that lower disease levels are due to canopy traits (phenological suppression). This cultivar may have some true metabolic resistance to *S. rolfsii*.

No significant differences between runner and virginia market types in terms of resistance to *S. rolfsii* or yield potential were found in an earlier study (4). That was verified in this test where mean disease incidence was 14.3 disease loci per 12.2 m of row for both market types. Mean pod yields were very similar also with runners averaging 3214 kg/ha and virginia types 3287 kg/ha. Using these results, we have identified significant differences among cultivars within these market types with regards to disease resistance and yield potential. Undoubtedly the most promising new cultivar for southeastern growers with stem rot problems is Southern Runner. Although it was developed for resistance to peanut leafspot, this cultivar has the potential to yield in excess of 4100 kg/ha when grown in fields with high populations of *S. rolfsii*. This yield level is particularly significant when compared with Florunner which is currently the predominant cultivar. Yields of Florunner averaged only 2830 kg/ha in our tests with a disease incidence approximately twice that of Southern Runner. The cultivar Southern Runner may be a valuable alternative for growers faced with increased soilborne disease problems and fewer options for disease management with chemicals.

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