White Mold and Rhizoctonia Limb Rot Resistance among Advanced Georgia Peanut Breeding Lines[1]

W. D. Branch* and T. B. Brenneman[2]

ABSTRACT

Sclerotium rolfsii Sacc. and *Rhizoctonia solani* Kuhn are soilborne pathogens causing two major diseases in peanut (*Arachis hypogaea* L.) production: white mold and limb rot, respectively. Chemical and cultural control has been relatively ineffective in the past, consequently disease resistance is actively being sought as an environmentally safer and cost efficient alternative. Seven advanced breeding lines were evaluated from the Georgia Peanut Breeding Program and compared to four commercial runner cultivars. Among the cultivars, Southern Runner was found to have the highest yield and resistance to white mold but not limb rot. GA T-2741 had the best overall yield and disease resistance to both white mold and Rhizoctonia limb rot of all cultivars and breeding lines.

Key Words: *Arachis hypogaea* L., groundnut, pathogens, runner cultivars, yield evaluation, southern blight, stem rot.

White mold or stem rot incited by *Sclerotium rolfsii* Sacc. and limb rot incited by *Rhizoctonia solani* Kuhn are the two most severe soilborne pathogen problems presently facing southeastern U.S. peanut (*Arachis hypogaea* L.) producers. In Georgia from 1987-91, estimated losses due to these diseases averaged nearly $60 million annually, not including chemical control cost (7).

Differential reaction among peanut genotypes have been reported for both of these pathogens (5, 6). Disease resistance would be cost effective, environmentally safe, and should lessen pesticide residue risks. Priority for resistance screening, identification, and subsequent utilization in the Georgia Peanut Breeding Program has been given to released cultivars followed by advanced breeding lines, unadapted germplasm, and the wild *Arachis* species.

Results from past studies with peanut cultivars strongly suggest that Toalson and Southern Runner have moderate levels of white mold resistance, and Toalson and VA 81B exhibited some Rhizoctonia limb rot resistance (1, 2, 3). The importance of multiple-year comparisons to identify genotypes with low disease incidence and high yield performance was found to be highly advantageous.

The purpose of this study was to proceed to the next phase of resistance evaluations involving advanced Georgia peanut breeding lines. Advanced breeding lines and cultivars are considered equally good sources or gene pools since both possess several desirable agronomic characteristics. Thus, selected Georgia breeding lines were evaluated in field tests for both *S. rolfsii* and *R. solani* resistance, as well as yield potential, under heavy disease pressure.

Materials and Methods

During 1990-92, seven advanced runner-type Georgia breeding lines (GA T-2741, GA T-2842, GA T-2843, GA T-2844, GA T-2845, GA T-2846, and GA T-2847) were compared to four commercial U.S. runner check cultivars (Florunner, Sunrunner, GK-7, and Southern Runner). Yield tests were conducted on a Tifton loamy sand soil (fine-loamy, siliceous, thermic Plinthic Kandiudult) at the agronomy research farm near the Coastal Plain Experiment Station, which has a continuous history of high soilborne pathogen incidence.

A randomized complete block design was used each year with six replications. Plots consisted of two 6.1 m long by 1.8 m wide rows (0.8 m within and 1.0 m between adjacent plots), and seed were spaced approximately 0.06 m apart within each row. Planting dates were 14 May 1990, 17 May 1991, and 8 May, 1992. Irrigation was applied during drought stress periods to ensure host-plant development. Recommended production practices were followed throughout each growing season, except fungicides were not applied to control soilborne pathogens. Individual test entries were harvested according to visual above-ground maturity in conjunction with shellout determinations based upon adjacent border plots.

White mold incidence and Rhizoctonia limb rot severity were determined immediately after peanuts were dug and inverted. A white mold disease hit consisted of one or more infected plants in a 30-cm section of row, whereas a visual rating of each plot was used to estimate the percentage of total vines (limbs) infected with *R. solani*. After combining, peanut pods were dried and cleaned before weighing for yield.

Data from each test were analyzed separately. T-test (least significant difference) was used for mean yield and disease separations.

Results and Discussions

Incidence of both peanut diseases (white mold and Rhizoctonia limb rot) varied greatly between years, which emphasizes the importance of multiple-year comparison for such soilborne pathogen studies. Highly significant genotype x year interactions ($P<0.01$) prohibited any combined statistical analyses.

Among the four commercial runner cultivars, Southern Runner showed a slight yield advantage over Sunrunner, Florunner, and GK-7 (Table 1). However, it was only significantly better than GK-7 in 1991. These results agree with previous peanut cultivar evaluations regarding relative yield rankings (3).

[1]Contribution from the University of Georgia, College of Agricultural and Environmental Sciences. This research was supported by state and hatch funds with grants from the Georgia Peanut Commission, and the Georgia Seed Development Commission.

[2]Professor and Associate Professor, Dept. of Crop and Soil Sciences and Plant Pathology, respectively, Coastal Plain Experiment Station, Tifton, GA 31793-0748.

*Corresponding author.

Table 1. Three year average pod yield performance of four runner peanut cultivars and seven Georgia breeding lines.

Genotype	Pod yield (kg/ha)* 1990	1991	1992	Mean (3-yr)
CULTIVARS:				
Southern Runner	2716 abc	4236 a	3492 bcd	3481
Sunrunner	2663 bc	3881 ab	3422 cd	3322
Florunner	2619 bc	3700 ab	3114 d	3144
GK-7	2598 bc	3137 b	3163 d	2966
BREEDING LINES:				
GA T-2741	3166 abc	4374 a	4208 a	3916
GA T-2845	3300 a	4320 a	3958 ab	3859
GA T-2842	3200 ab	3774 ab	4024 a	3666
GA T-2846	3093 abc	4280 a	3468 bcd	3614
GA T-2843	2553 c	3993 a	4096 a	3547
GA T-2844	2802 abc	3897 ab	3770 abc	3490
GA T-2847	3041 abc	4159 a	2172 e	3124

*Pod yield values within each column followed by the same letter are not significantly different at $P \leq 0.05$.

Each year, pod yield performance of all seven Georgia breeding lines, except for GA T-2847 during 1992, was comparable to Southern Runner, the best cultivar (Table 1). The two best yielding breeding lines, GA T-2741 and GA T-2845, averaged >10% higher yield than Southern Runner under these test conditions.

Southern Runner had only significantly fewer hits from white mold than GK-7 in 1990-91 and Florunner in 1991 (Table 2). Similar variability for Southern Runner was reported earlier in Georgia (3) and Texas (4). In this study, the three-year mean confirms the previous results of partial resistance for Southern Runner; however, overall disease pressure was much higher as compared to previous findings at this same location (3).

Individual year analyses also showed significant differences among the Georgia breeding lines for number of white mold hits (Table 2). GA T-2741 consistently had more resistance to white mold than the other breeding lines or cultivars; and, it was significantly better than Southern Runner in two out of the three years.

Table 2. Three year average white mold incidence among four runner peanut cultivars and seven Georgia breeding lines.

Genotype	White mold hits (no./plot)* 1990	1991	1992	Mean (3-yr)
CULTIVARS:				
GK-7	20.0 a	22.7 a	27.3 bc	23.3
Florunner	18.2 ab	23.0 a	26.8 bc	22.7
Sunrunner	17.7 ab	20.0 ab	27.0 bc	21.6
Southern Runner	14.0 bc	15.2 b	29.3 b	19.5
BREEDING LINES:				
GA T-2847	16.7 ab	15.8 b	34.8 a	22.4
GA T-2846	17.0 ab	17.7 ab	26.7 bc	20.5
GA T-2845	14.2 bc	18.0 ab	24.0 c	18.7
GA T-2843	15.8 abc	22.7 a	16.0 d	18.2
GA T-2844	14.8 abc	16.7 b	18.7 d	16.7
GA T-2842	13.8 bc	19.2 ab	7.7 e	13.7
GA T-2741	10.8 c	7.8 c	10.7 e	9.8

*Number of hits within each column followed by the same letter are not significantly different at $P \leq 0.05$.

In general, Rhizoctonia limb rot incidence was higher in 1991 than 1990 or 1992 (Table 3), which agrees with the overall state assessments of incidence for this particular disease (7). Southern Runner generally exhibited more susceptibility to Rhizoctonia limb rot than the other cultivars and breeding lines (Table 3). These results regarding susceptibility of Southern Runner agrees with an earlier report (1).

Table 3. Three year average Rhizoctonia limb rot severity among four runner peanut cultivars and seven Georgia breeding lines.

Genotype	Rhizoctonia rating (0-100%)* 1990	1991	1992	Mean (3-yr)
CULTIVARS:				
Southern Runner	25.0 a	40.0 a	36.7 a	33.9
Florunner	10.3 c	36.7 ab	11.7 cde	19.6
Sunrunner	9.7 c	34.2 abc	12.9 cd	18.9
GK-7	9.9 c	35.0 abc	10.0 de	18.3
BREEDING LINES:				
GA T-2847	16.0 b	34.2 abc	30.0 b	26.7
GA T-2844	3.8 e	36.7 ab	28.3 b	22.9
GA T-2845	9.9 c	32.5 bc	16.2 c	19.5
GA T-2846	14.9 b	30.0 bc	12.5 cde	19.1
GA T-2843	14.3 b	28.3 c	13.0 cd	18.5
GA T-2842	6.8 d	31.7 d	10.8 cde	16.4
GA T-2741	9.8 c	17.5 d	6.8 e	11.4

*Percentage of infected vines within each column followed by the same letter are not significantly different at $P \leq 0.05$.

Significant differences were also noted among the Georgia breeding lines for percentage of vines infected with Rhizoctonia limb rot (Table 3). GA T-2741 was found to be consistently less susceptible to Rhizoctonia limb rot across years, and significantly more resistant than all other cultivars and breeding lines during the high disease incidence observed in 1991.

Thus, genotypic differences were found between the commercial runner check cultivars and the Georgia peanut breeding lines for resistance to both white mold and Rhizoctonia limb rot. Among these four cultivars, Southern Runner had the highest yield and resistance to white mold, but it was susceptible to Rhizoctonia limb rot. Among the seven Georgia breeding lines, GA T-2741 had the highest yield and best resistance to both white mold and Rhizoctonia limb rot.

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Accepted July 31, 1993