Reaction of Selected Peanut Varieties and Breeding Lines to Southern Stem Rot[1]

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ABSTRACT

Eight Texas and one Georgia breeding lines, four accessions from Burkina Faso (West Africa), and six runner and two spanish-type cultivars were compared for yield, grade, and susceptibility to *Sclerotium rolfsii* Sacc. for 3 yr under irrigated field conditions. The spanish-type cultivar Tamspan 90 and runner-type breeding line TX896100 (recently released as Tamrun 96) consistently had the lowest disease incidence for all 3 yr. Averaged over years, TX896100 was the highest yielding entry. Four breeding lines resulted in a 2 to 16% yield increase over Okrun, the highest yielding cultivar. The African accessions, in general, produced low yields and low grades with no advantages in disease resistance.

Key Words: Cultivar, *Sclerotium rolfsii* Sacc., disease incidence, southern blight, white mold, *Arachis hypogea* L.

Southern stem rot, caused by *Sclerotium rolfsii* Sacc., is among the most important soilborne diseases of peanut (*Arachis hypogea* L.) in the southwestern and southeastern U. S. (1,4,5). Annual yield losses can be severe with continual increase in natural inoculum (2). Suppression of southern stem rot can be effective with combinations of fungicides (8,10,11), crop rotation, deep plowing, and nondirting (9) but such control can be costly (13). Therefore, screening and identifying sources of disease resistance for employment in variety development is important due to cost effectiveness, pesticide reduction, and environmental soundness (3).

Cooper and Muheet *et al.* (6,12) reported that characteristics such as growth habit could be associated with resistance to *S. rolfsii*. Varied results have been reported from other studies on the association of growth habit with resistance and susceptibility to *S. rolfsii*. Runner-type cultivars were reported to have more resistance to the disease than virginia-type or spanish-type peanut (6). Spanish-type cultivars were more susceptible than virginia types. Valencia-type peanuts are highly susceptible to *S. rolfsii* (4,6,7).

Several peanut cultivars and breeding lines have partial resistance to *S. rolfsii* including Southern Runner and the spanish cultivar Toalson (4,5,15,16). Smith and coworkers (16) reported that TXAG-3, a selection of PI 365553, was more resistant than Toalson. Partial resistance to *S. rolfsii* was found also in the two breeding lines, TX798716 and TX798396 (from which Tampspan 90 was selected). The concern in breeding is to identify lines with good resistance to *S. rolfsii* that compete favorably with commercial cultivars. The objective of this study was to evaluate selected breeding lines and four West African accessions for yield, grade, and resistance to *S. rolfsii* under field conditions.

Materials and Methods

Twenty-one breeding lines or cultivars were evaluated for yield, grade, and resistance to southern stem rot for 3 yr in south central Texas. Tests were conducted at the Texas Agric. Res. Stn. near Yoakum in fields with histories of moderate to severe disease incidence. The soil type for the 1992 and 1993 tests was a Straber loamy sand (fine, mixed, thermic Aquic Palenstafs) with 1% organic matter and pH 7.0 and 6.4, respectively. In 1994, the soil was a Tremona loamy fine sand (clayey, mixed, thermic Areneic Palenstafs) with pH 7.6 and 1% organic matter.

Each site had been in continuous peanut production for a period of 25 yr. Following harvest each year, the test sites were broadcast fertilized, tilled with a tandem disk, and seeded with annual ryegrass (*Lolium multiflorum* Lam.) at a rate of 28 kg ha^{-1}. In early spring, the ryegrass was deep turned with a moldboard plow to a depth of 30 to 38 cm. Plot areas were tandem disked, bedded, and maintained until time for planting. Prior to planting, the beds were leveled to a maximum height of 10 cm and treated with herbicides. Preplant herbicides applied each year were as follows: trifluralin (0.56 kg ha^{-1}) and imazethapyr (0.07 kg ha^{-1}) as a tank mix in 1992; trifluralin (0.56 kg ha^{-1}) alone in 1993; and imazethapyr (0.07 kg ha^{-1}) and pendimethalin (0.84 kg ha^{-1}) in 1994. The herbicides were incorporated with a power-tiller to a depth of 7.5 cm. Postemergence herbicides (acifluorfen and bentazon) were applied all 3 yr for mid- to late season grass and broadleaf weed control. Chlorothalonil was applied at 2-wk intervals for leaf spot control. Conditions did not warrant the use of insecticides. No fungicides for control of soilborne pathogens were applied.

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The test was comprised of one Georgia and eight Texas breeding lines, four accessions from West Africa, and eight runner- or spanish-type cultivars. Parents of the Texas breeding lines are shown in Table 1. Parental origins are as follows: PI 365553 (Bolivia), US 224 (Brazil), and 57-422 (Senegal). Germplasm sources reported for the West African lines (Dr. Philippe Sankara, Burkina Faso, personal commun.) were: C-113 = 59-426 (Senegal), C-297 (Nigeria Zaria), and C-301 = Tessaoua 1 and C-304 = Tessaoua 4 (Burkina Faso).

Table 1. Parents of Texas breeding lines used in southern stem rot study.

Breeding line	Parents
TX896012 TX896014	Langley, Florunner, PI 365553
TX896030 TX896076 TX896092	TP 107-11 (sister selection of Langley), Florunner, PI 365553
TX896062	TP 107-11, Florunner, US 224
TX896100	Langley, Florunner, US 224
TX874337	57-422, Early Bunch

Two-row plots spaced 0.9 m apart were 6.1 m long in 1992 and 1993 and 7.6 m long in 1994. Entries were arranged in a randomized complete block design with four replications. Seed were planted at a rate of 16.4 m^{-1} using a cone planter. Planting dates were as follows: 19 June 1992; 19 May 1993; and 11 May 1994. Spanco and Tamspan-90 were dug 119 to 139 d after planting (DAP). TX874337, TX896100, and C-304 were dug 124 to 138 DAP and all other entries were dug 139 to 147 DAP.

Isolates of *S. rolfsii* were collected from peanut plant tissue in a Yoakum field with a history of moderate to severe southern stem rot pressure. Cultures were grown on autoclaved oat seed and then incubated in closed glass containers for 3 to 4 wk at room temperature (25 to 27 C). Following incubation, the inoculum was air dried, screened to break up large particles, and applied at a rate of 43 g $plot^{-1}$. The inoculum was hand broadcast in a 25-cm band over the row canopy 70 to 82 DAP each season.

Infection sites of *S. rolfsii* were counted immediately after digging. Identification of southern stem rot was determined by dead or wilted branches with visible mycelial growth and the presence of sclerotia. A disease locus was defined as ≤ 30 cm of consecutive plants in a row damaged by stem rot as described by Rodriquez-Kabana *et al.* (14). Positive identification of the fungus was obtained through biopsy of diseased tissue on potato dextrose agar (PDA) in 9-cm diameter petri dishes.

After inverting, peanut plants were dried in the field 3 to 5 d prior to harvest. Pods were harvested with a stationary thresher. Peanut pods were forced-air dried to 10% moisture and cleaned by hand to remove inert matter, stems, and pegs. Grades were obtained by randomly selecting a 200-g sample from each plot and applying the grading procedures of the Federal-State Inspection Service. All data were subjected to analysis of variance, and Duncan's Multiple Range Test was used to separate the means for interpretation of the data.

Results and Discussion

Due to a significant entry by year interaction for all parameters measured, data for each year were summarized separately. This interaction can be attributed to extremely heavy rainfall early in the 1993 and 1994 growing seasons followed by high temperatures. Growing conditions were furthered hampered in 1993 with below normal fall temperatures. Means for all entries are listed in each table to give a comparison over entries.

In 1993, disease incidence was high due to optimum conditions for growth of *S. rolfsii* late in the season. In 1992 and 1994, positive identification of *S. rolfsii* could only be made upon inversion of the peanut plants. Although minimal damage from *Rhizoctonia solani* Kuhn did occur, this disease was not considered serious enough to warrant evaluation.

Among cultivars, Tamspan-90 had low disease incidence (0.5-1.3 loci per plot) all 3 yr. Georgia Runner, GK-7, and Okrun were very susceptible each of the 3 yr with Okrun having the most disease incidence averaged over test years (Table 2). Southern Runner, previously reported as partially resistant (4,5,15,16), averaged second to Georgia Browne, but seldom had significantly fewer disease loci than the other runner cultivars. Georgia Browne consistently had the lowest disease incidence among the runner-type cultivars. C-301 had the highest disease incidence in 2 yr and in the 3 yr average. In 1992, TX874337 which has virginia type parentage, had the highest disease incidence, but was considerably lower than most breeding lines and cultivars in 1993. TX896030 and TX896014, progenies of TXAG-3 which has good resistance (16), had high disease incidence in 1993 and 1994 and ranked just below C-301. TX896100 had the lowest disease incidence of all breeding lines and was better than all runner varieties except for Georgia Browne in 1993 and 1994. Only three spanish compared to 18 runner entries were tested, but in 2 of 3 yr the disease incidence in the spanish entries averaged lower than in the runner. Additionally, the lowest albeit not significant at $P \leq 0.05$ disease score for each of the 3 yr was for the spanish cultivar Tamspan 90. Hence the generalization that spanish peanut is more susceptible than runner peanut to southern blight (6) is not supported by these data.

Yields for most cultivars relative to each other were inconsistent during the 3 yr (Table 3). Georgia Browne was among the highest yielding cultivars in 1992 and 1993 but was exceeded by Okrun in 1994. Averaged over test years, Okrun and Georgia Browne ranked first and second, respectively, among cultivars. No correlation of yield and disease incidence was found although yield loss from southern stem rot is well recognized. Spanco was lower in pod yield than all cultivars except Tamspan 90 in 1992 and had one of the lowest yields in 1993. In 1994, Tamspan 90 yielded poorly but apparently not as a result of this disease. Although an attempt was made to dig all

Table 2. Number of infection sites of *Sclerotium rolfsii* for 21 peanut breeding lines and cultivar at Yoakum, TX, 1992-1994.

Entry	Disease loci[a] 1992	1993	1994	Mean
	———— no. m^{-1} ————			
Runner				
Florunner	4.8 c-f	12.0 ab	6.8 a-c	7.9
Georgia Browne	1.3 ef	4.0 d-f	2.3 de	2.5
Georgia Runner	6.0 cd	13.8 a	6.5 a-c	8.8
GK-7	10.5 ab	12.5 ab	5.8 a-d	9.6
Okrun	5.5 c-e	14.8 a	9.3 a	9.9
Southern Runner	3.8 c-f	9.0 a-e	6.5 a-c	6.4
C-113	2.8 d-f	9.5 a-e	3.8 c-e	5.4
C-297	3.0 d-f	13.8 a	6.5 a-c	7.8
C-301	4.3 c-f	15.3 a	8.5 ab	9.4
GAT-2842	3.8 c-f	9.3 a-e	7.0 a-c	6.7
TX874337	11.5 a	4.5 c-f	6.3 a-d	7.4
TX896012	5.3 c-e	10.3 a-c	7.5 a-c	7.7
TX896014	4.5 c-f	14.8 a	7.0 a-c	8.8
TX896030	5.8 c-e	14.8 a	7.0 a-c	9.2
TX896062	4.3 c-f	10.0 a-d	3.8 c-e	6.0
TX896076	3.8 c-f	6.8 b-f	4.5 b-e	5.0
TX896092	3.5 c-f	12.3 ab	3.8 c-e	6.5
TX896100	1.3 ef	2.0 f	3.5 c-e	2.3
Spanish				
Spanco	8.0 a-c	3.8 ef	3.8 c-e	5.2
Tamspan-90	0.5 f	1.3 f	1.3 e	1.0
C-304	7.0 b-d	3.8 ef	4.8 b-e	5.2
Average	4.8	9.4	5.5	

[a]Plot lengths in 1992 and 1993 were 6.1 m long and 7.6 m long in 1994. Means within each column followed by the same letters are not different ($P \le 0.05$) according to Duncan's Multiple Range Test.

Table 3. Pod yields for 21 peanut breeding lines and cultivars at Yoakum, TX, 1992-1994.

Entry	Yield[a] 1992	1993	1994	Mean
	———— kg ha^{-1} ————			
Runner				
Florunner	2846 b-d	3242 c-f	2069 d-h	2719
Georgia Browne	2765 b-d	3888 a-c	2104 d-h	2919
Georgia Runner	2602 cd	3211 c-f	2183 c-g	2665
GK-7	2805 cd	3186 c-f	2396 c-f	2796
Okrun	2765 b-c	3699 b-d	2505 c-e	2990
Southern Runner	2439 cd	3471 b-e	1858 e-i	2589
C-113	894 g	2876 cf	2507 c-e	2092
C-297	1545 f	2617 fg	1760 f-i	1974
C-301	1586 f	2556 fg	1633 g-i	1820
GAT-2842	3252 ab	4482 a	2292 c-f	3342
TX874337	2195 de	2652 fg	3292 a	2713
TX896012	2724 b-d	3419 b-e	2035 d-h	2726
TX896014	2846 b-d	3395 b-e	2771 a-c	3004
TX896030	2521 cd	3145 c-f	1963 e-i	2543
TX896062	3334 a	4030 ab	2429 c-e	3264
TX896076	2521 cd	497 b-e	2027 d-h	2682
TX896092	2907 bc	3618 b-e	2664 b-d	3063
TX896100	2846 bc	4390 a	3145 ab	3460
Spanish				
Spanco	1748 f	2556 fg	2351 c-f	2218
Tamspan-90	1951 cf	3014 d-f	1386 i	2117
C-304	734 g	2093 g	1453 h-i	1427
Average	2373	3287	2228	

[a]Means within each column followed by the same letters are not different ($P \le 0.05$) according to Duncan's Multiple Range Test.

entries at optimum maturity each year, earlier than optimum digging of Southern Runner, a later maturing cultivar, might have occurred because of extraneous factors which might have affected yield and/or grade.

Among the Texas breeding lines the two derivatives of US 224, TX896100, and TX896062, produced the highest average yields although both failed to make the highest statistical group in one of the 3 yr. The situation was similar for GAT-2842. Somewhat surprising was the good comparative yield of the moderately large podded TX894337 in 1994 with 6.3 m^{-1} disease hits while in 1993 both the disease incidence and yield were low compared to most of the runner varieties. The four breeding lines GAT-2842, TX896062, TX896092, and TX896100 averaged 2 to 16% higher yield than Okrun, the highest yielding cultivar. No indication of useful resistance to southern stem rot was apparent in the Africa "C" selections which yielded poorly all 3 yr.

Peanut grades, in general, were low averaging 70 to 62% among years (Table 4). Grades of Florunner, GK-7, Georgia Runner, and Okrun exceeded the test average in all 3 yr while those of other varieties fluctuated among years. Poor grades for Georgia Browne can probably be attributed to the small seed size of the cultivar. Grades of TX896012, TX896014, and TX896100 consistently exceeded the test average. The C-lines tended to grade low.

The high average yield, acceptable grade (relative to other cultivars), and low disease incidence for TX896100 give indication of potential benefit to Texas peanut producers. Recently released as Tamrun 96 by the Texas Agric. Exp. Stn., it shows potential as a runner variety with southern stem rot resistance superior to runner cultivars that are prominent in the state. It should complement Tamspan 90 in providing added protection from loss to southern stem rot and increase the stability of peanut production for Texas.

Table 4. Total sound mature kernels (TSMK) for 21 peanut breeding lines and cultivars at Yoakum, TX, 1992-1994.

Entry	TSMK[a] 1992	1993	1994	Mean
	%			
Runner				
Florunner	74 ab	64 a-c	64 a-g	67
Georgia Browne	68 de	59 a-c	60 e-h	62
Georgia Runner	75 a	64 c-e	65 a-f	68
GK-7	75 a	64 a-c	65 a-g	68
Okrun	73 a-c	64 a-c	68 a-d	68
Southern Runner	70 b-e	64 a-c	60 d-h	64
C-113	60 g	60 b-e	60 d-h	60
C-297	63 fg	62 a-d	60 e-h	62
C-301	69 c-e	61 b-d	57 h	62
GAT-2842	72 a-d	63 a-d	62 c-h	65
TX874337	74 a	60 b-e	71 a	69
TX896012	74 a	65 a-c	64 a-h	68
TX896014	75 a	64 a-c	69 ab	69
TX896030	67 de	63 a-d	57 gh	63
TX896062	66 ef	59 c-e	58 f-h	61
TX896076	69 b-e	68 a	59 f-h	65
TX896092	72 a-c	62 a-d	63 b-h	66
TX896100	73 a-c	65 a-b	68 a-c	69
Spanish				
Spanco	73 a-c	58 de	67 a-e	66
Tamspan-90	73 a-c	60 b-e	60 d-h	64
C-304	59 g	55 e	63 b-h	59
Average	70	62	63	

[a]Means within each column followed by the same letters are not different ($P \leq 0.05$) according to Duncan's Multiple Range Test.

Acknowledgments

A special thanks is extended to Kevin Brewer, Travis Boone, and Bill Klesel for their assistance with field work, cleaning and grading of samples.

Literature Cited

1. Ashworth, L. J. Jr., B. C. Langley, and W. H. Thames, Jr. 1961. Comparative pathogenicity of *Sclerotium rolfsii* and *Rhizoctonia solani* to spanish peanut. Phytopathology 51:600-605.
2. Aycock, R. 1966. Stem rot and other diseases caused by *Sclerotium rolfsii* or the status of Rolfs' fungus after 70 years. N. C. Agric Exp. Stn. Tech. Bull. 1974.
3. Branch, W. D., and T. B. Brenneman. 1993. White mold and rhizoctonia limb rot resistance among advanced Georgia peanut breeding lines. Peanut Sci. 20:124-126.
4. Branch, W. D., and A. S. Csinos. 1987. Evaluation of peanut cultivars for resistance to field infection by *Sclerotium rolfsii*. Plant Dis. 71:268-270.
5. Brenneman, T. B., W. D. Branch, and A. S. Csinos. 1990. Partial resistance of Southern Runner, *Arachis hypogaea*, to stem rot caused by *Sclerotium rolfsii*. Peanut Sci. 18:65-67.
6. Cooper, W. E. 1961. Strains of, resistance to, and antagonists of *Sclerotium rolfsii*. Phytopathology 51:113-116.
7. Garren, K. H. 1964. Inoculum potential and differences among peanuts in susceptibility to *Sclerotium rolfsii*. Phytopathology 54:279-281.
8. Grichar, W. J., and O. D. Smith 1992. Variation in yield and resistance to southern stem rot among peanut (*Arachis hypogaea* L.) lines selected for pythium pod rot resistance. Peanut Sci. 19:55-58.
9. Gurkin, R. S., and S. F. Jenkins. 1985. Influence of cultural practices, fungicides and inoculum placement on southern blight and Rhizoctonia crown rot of carrot. Plant Dis. 69:477-481.
10. Hagan, A. K., J. R. Weeks, and K. L. Bowen. 1991. Effects of application timing and method on control of southern stem rot of peanut with foliar-applied fungicides. Peanut Sci. 18:47-50.
11. Minton, N. A., A. S. Csinos, R. E. Lynch, and T. B. Brenneman. 1991. Effects of two cropping and two tillage systems and pesticides on peanut pest management. Peanut Sci. 18:41-46.
12. Muheet, A., L. S. Chandran, and O. P. Agrwall. 1975. Relative resistance in groundnut varieties for Sclerotial root rot (*Sclerotium rolfsii* Sacc.). Madras Agric. J. 62:164-165.
13. Porter, D. M., D. H. Smith, and R. Rodriquez-Kabana. 1982. Peanut plant diseases, pp. 326-340. *In* H. E. Pattee and C. T. Young (eds.) Peanut Science and Technology. Amer. Peanut Res. Educ. Soc., Inc., Yoakum, TX.
14. Rodriguez-Kabana, R., P. A. Backman, and J. C. Williams, 1975. Determination of yield losses to *Sclerotium rolfsii* in peanut fields. Plant Dis. Rep. 59:855-858.
15. Simpson, C. E., O. D. Smith, and T. E. Boswell. 1979. Registration of Toalson peanut. Crop Sci. 19:742-743.
16. Smith, O. D., T. E. Boswell, W. J. Grichar, and C. E. Simpson. 1989. Reaction of selected peanut (*Arachis hypogaea* L.) lines to southern stem rot and pythium pod rot under varied disease pressure. Peanut Sci. 16:9-14.

Accepted 20 Sept. 1996