Response of Peanut Cultivars to Full and Reduced Spray Programs of Tebuconazole for Control of Southern Stem Rot[1]

B. A. Besler*[2], W. J. Grichar[2], O. D. Smith[1], and A. J. Jaks[2]

ABSTRACT

Eleven commercially grown peanut cultivars were evaluated for disease and yield response to two and four applications of tebuconazole under moderate disease pressure (< 12 hits/12.2 m) by southern stem rot (*Sclerotium rolfsii*). The incidence of southern stem rot was reduced in all cultivars when treated with two and four sprays of tebuconazole. Tamrun 96 and Southwest Runner had the lowest disease incidence. Cultivars responded with higher yields when sprayed with two and four applications of tebuconazole compared to the unsprayed plots. Peanut grade (SMK + SS) was not affected by tebuconazole. Georgia Runner and Tamrun 96 produced the highest grade while Southwest Runner was the lowest.

Key Words: Disease incidence, *Sclerotium rolfsii*.

Peanut producers in south Texas, like their counterparts in the Southeast, are faced with southern stem rot problems caused by *Sclerotium rolfsii* Sacc. The level of southern stem rot incidence in these areas can be caused by a number of factors which include the inability to rotate crops, excessive rainfall and/or irrigation, warm and wet conditions beginning in mid to late season, lush vine growth, and vine damage by equipment (Besler *et al.*, 1996, 1997; Bowen *et al.*, 1997).

South Texas peanut producers typically do an efficient job in controlling southern stem rot, and tebuconazole has been the fungicide of choice by most producers for control of southern stem rot (authors' pers. obs.). The advantages of tebuconazole in controlling southern stem rot and improving yield and grade have been well documented. Brenneman *et al.* (1991) reported that full season applications of tebuconazole reduced stem rot disease incidence 70 to 90% and improved grades over the untreated check. Bowen *et al.* (1997) stated that the number of tebuconazole applications were directly related to increased yields. They determined that three to four applications of tebuconazole provided optimum disease control. Damicone and Jackson (1994) found that three applications of tebuconazole on a 14-d schedule provided 70% control of southern stem rot compared to 56% control with pentachloronitrobenzene (PCNB). In Alabama, tebuconazole along with flutolanil and diniconazole across three sites significantly reduced the incidence of southern stem rot and increased yield when compared to the untreated check (Hagan *et al.*, 1991). Besler *et al.* (1996) found in south Texas, that tebuconazole reduced southern stem rot by as much as 53% when compared to the untreated check and increased yield up to 66%. In a similar study, Grichar (1995) found that three to five applications of tebuconazole reduced southern stem rot significantly over the untreated check and increased yields by 31 to 46%. A significant concern regarding the use of tebuconazole and other ergosterol biosynthesis inhibitors (EBI) fungicides is the potential for resistance development. For this reason, applications of tebuconazole are recommended in a sequence in which chlorothalonil is applied for the first two sprays followed by four sprays of tebuconazole and a final application of chlorothalonil (Noegel, 1992).

Another approach for managing stem rot is through the use of resistant cultivars. Peanut breeding lines and cultivars have been evaluated for resistance to southern stem rot. Numerous studies have documented the moderate resistance of Southern Runner to southern stem rot (Arnold *et al.*, 1988; Jacobi and Backman, 1989; Brenneman *et al.*, 1990; Branch and Brenneman, 1993). Arnold *et al.* (1988) found that Southern Runner had less stem rot infection sites than Florunner. Brenneman *et al.* (1990) found that, despite the late maturity of Southern Runner, it still had the lowest incidence of southern stem rot. Branch and Brenneman (1993) reported that Southern Runner had significantly fewer hits of southern stem rot than GK-7 and Florunner. However, industry has been slow to accept this cultivar due to concern over its slow emergence, late maturity, and unacceptable shelling and blanching characteristics (Brenneman *et al.*, 1991). Tamrun 96, a runner cultivar adapted to south Texas, showed superior resistance to southern stem rot when compared to other commonly grown cultivars and was the highest yielding cultivar averaged across a 3-yr period (Besler *et al.*, 1997).

The purpose of this study was to evaluate 11 commercially grown peanut cultivars and their response to full and reduced applications of tebuconazole. Unsprayed plots of each cultivar were included for comparison of disease incidence and the yield response to treated plots with various levels of tebuconazole input.

Materials and Methods

Eleven commercial peanut cultivars were evaluated alone and in combination with two and four spray applications of tebuconazole at 0.23 kg/ha. Field trials in 1995 and 1996

[1]Contribution from the Texas Agric. Exp. Sta., Texas A&M Univ., College Station, TA No. 30526. Mention of a trade mark or proprietary product does not constitute a guarantee or warranty of the product and does not imply its approval to the exclusion of other products that may be suitable. This production was made possible through support provided by the Office of Agric., Bureau for Sci. and Tech., USAID, Grant No. DAN-4048-G-00-0041-00. Recommendations do not represent an official position or policy of USAID.

[2]Res. Asso. and Res. Scien., Texas Agric. Exp. Sta., Yoakum, TX 77995; Prof., Texas A&M Univ., College Station, TX 77843; and Res. Asso., Texas Agric. Exp. Sta., Yoakum, TX 77995, respectively.

*Corresponding author (email: b_besler@tamu.edu).

were established at two locations at the Texas Agric. Exp. Sta. in Yoakum, TX. The fields had been in continuous peanut for several years prior to this study and had a history of severe southern stem rot pressure. The soil type in 1995 was a Hallettsville fine sandy loam (fine, montmorillonitic, thermic, Undertic Palenstalfs), while in 1996 the soil type was a Strabor loamy sand (fine, mixed, thermic Aquic Palenstalfs). After harvest each year, the test sites were fertilized, disked, and seeded with annual rye grass (*Lolium multiflorum* Lam.) Ryegrass was then moldboard plowed to a depth of 30 to 35 cm in early spring. Prior to planting each year, a tank mix of trifluralin (0.56 kg/ha) and imazethapyr (0.07 kg/ha) was applied over the beds and incorporated with a power tiller approximately 7.5 cm deep. Grass and broadleaf weeds were controlled throughout the growing season with postemergence applications of sethoxydim and bentazon. Chlorothalonil was applied four times in 1995 and five times in 1996 at the rate of 1.26 kg/ha over all test plots to eliminate foliar diseases as a factor in this study.

The tests were arranged as a split plot design using four replications with tebuconazole treatments as main plots and cultivars as subplots. Main plots were 22 rows by 6.1 m while subplots consisted of two rows by 6.1 m. Each cultivar was planted at the rate of 100 seeds/plot using an experimental cone planter on 7 June 1995 and 29 May 1996. Each cultivar was dug based on its maturity. Southwest Runner, AT-108, Andru-93, and Georgia Green were dug 126 to 130 d after planting (DAP). SunOleic and Southern Runner were dug 139 to 142 DAP. Georgia Runner, Florunner, Tamrun 96, GK-7, and Tamrun 88 were dug 134 to 140 DAP.

Southern stem rot was enhanced in 1995 by infesting plots with field isolates of *S. rolfsii*. The isolates were collected at the Yoakum Exp. Sta. in a field with a history of severe southern stem rot of peanut. Cultures were grown on autoclaved oat seed and incubated in a glass container for a period of 3 to 5 wk. After incubation, the inoculum was dried, broken into small particles, and banded over each row (10 g/6.1 m) at 54 DAP. The test was not inoculated in 1996 because of a high natural infestation of southern stem rot.

The two spray program for tebuconazole in 1995 was applied on 7 Aug. (60 DAP) and 4 Sept. (88 DAP), and the four spray program was applied on 7 Aug. (60 DAP), 21 Aug. (74 DAP), 4 Sept. (88 DAP), and 18 Sept. (102 DAP). In 1996, the two spray program was applied on 29 July (61 DAP) and 26 Aug. (89 DAP), and the four spray program was applied 29 July (61 DAP), 12 Aug. (75 DAP), 26 Aug. (89 DAP), and 13 Oct. (107 DAP).

The incidence of southern stem rot was determined by inversion of plants and counting the number of disease loci within each row. A disease locus was defined as ≤ 30 cm of consecutive southern stem rot damage of plants in a plot row (Rodriquez-Kabana *et al.*, 1975). Plots were dried in the field and harvested using a stationery thresher. Peanuts were then further dried to approximately 10% moisture and stems, pegs, and inert matter removed during the cleaning process. Grades were determined by randomly collecting 200 g of pods as outlined by the Federal-State Inspect. Serv.

All parameters were analyzed using Fisher's least significant difference test. Simple correlation coefficients were used to determine the possible association between the incidence of southern stem rot and peanut yield. An analysis of variance was used to detect if year × cultivar × treatment interactions existed for all parameters measured.

Results and Discussion

Disease. Southern stem rot pressure in 1995 and 1996 was moderate (< 12 hits/12.2 m) with disease onset occurring later than usual due to dry weather early in the season followed by excessive rainfall and above normal temperatures later in the growing season. No other soil or foliar-borne diseases were at levels that warranted evaluation. Analysis of variance for disease incidence indicated no significant year × fungicide effects or cultivar × fungicide treatment interaction. The effect of fungicide and cultivars alone was significant; therefore, data were combined over years.

Four tebuconazole sprays reduced southern stem rot incidence when compared with two tebuconazole sprays or no spray (Table 1). Other studies have reported similar results (Hagan *et al.*, 1991; Brenneman and Culbreath, 1994; Bowen *et al.*, 1997). Brenneman and Culbreath (1994) also reported that the timing of tebuconazole sprays influenced the effectiveness against southern stem rot. Concern over the four-block spray for use of tebuconazole on peanut has been expressed due to the possible development of fungicide resistance (Backman, 1992; Bowen *et al*, 1997). Bowen *et al.* (1997) also suggested that, in years where southern stem rot is low and peanut yield potential is high, fewer than three tebuconazole sprays may be needed.

Andru-93, Southern Runner, and SunOleic had the highest level of disease incidence. Arnold *et al.* (1988) reported that Southern Runner had some resistance to

Table 1. Effects of tebuconazole spray programs on incidence of southern stem rot among 11 peanut cultivars.[a]

Cultivar	Disease incidence/12.2 m[b]			
	Control	Two sprays	Four sprays	Mean
	no.	no.	no.	no.
Andru-93	11.0	8.9	8.4	9.4 a
AT-108	9.0	7.1	5.6	7.2 bc
Florunner	7.4	5.9	5.0	6.1 c
Georgia Green	5.8	6.5	5.3	5.9 c
GK-7	6.9	6.1	5.3	6.1 c
Georgia Runner	8.3	5.9	5.3	6.5 c
Southern Runner	9.0	7.9	8.1	8.5 ab
Southwest Runner	4.3	3.0	2.4	3.2 d
SunOleic	11.3	7.4	7.0	8.6 ab
Tamrun 88	9.3	7.3	5.1	7.2 c
Tamrun 96	3.8	2.5	2.3	2.9 d
Mean	7.8 a	6.2 b	5.4 c	

[a]Two sprays of tebuconazole @ 0.23 kg/ha were applied approx. 60 and 88 DAP; four sprays of tebuconzole @ 0.23 kg/ha were applied approx. 60, 74, 88 and 102 DAP.

[b]Disease was defined as < 30 cm of consecutive plants in a row damaged by southern stem rot. Main effect followed by the same letter are not different (P ≤ 0.05) according to Fisher's Least Significant Difference test.

southern stem rot. Currently, Southern Runner is the only commercially available cultivar with partial resistance to late leaf spot [*Cercosporidium personatum* (Berk. and M.A. Curtis) Deighton] (Gorbet *et al.*, 1987; Knaft *et al.*, 1988; Culbreath *et al.*, 1991). Unsprayed plots of Tamrun 96 displayed excellent resistance (< 3 hits/12.2m) to southern stem rot. This corroborates the results of a study conducted by Besler *et al.* (1997) who found that Tamrun 96 consistently had the lowest disease incidence over a 3-yr period. Southwest Runner, known for its field resistance to sclerotinia blight [*Sclerotinia minor* (Jagger)] (Kirby *et al.*, 1994), performed equally well. Georgia Green, a cultivar with resistance to tomato spotted wilt virus (Branch, 1996), exhibited 37% less disease incidence than Andru-93.

Peanut Yield. Analysis of variance for yield indicated significant main effects of cultivar and fungicide treatments. Year × cultivar and cultivar × fungicide interactions were not significant; therefore, data were combined over years. Yields were negatively correlated to disease incidence $r = -0.40$ ($P = 0.05$). Cultivars responded with higher yields when sprayed with two and four applications of tebuconazole compared to the unsprayed plots (Table 2). Four applications of tebuconazole provided an 8% increase in yield over the unsprayed plots while two tebuconazole applications resulted in a 5% increase over the unsprayed plots. Bowen *et al.* (1997) reported that less than three tebuconazole sprays may be needed in years of low southern stem rot pressure. They reported that maximum yields were obtained with 2.8 to 4.8 (× 3.7) applications of tebuconazole.

Tamrun 96 outyielded all other cultivars. Besler *et al.* (1997) also found that Tamrun 96, under moderate disease pressure from southern stem rot, was the highest yielding cultivar compared to other cultivars including Florunner and Southern Runner. Georgia Green produced the lowest yield. Georgia Runner, Southern Runner, GK-7, and Florunner were intermediate in yield. This is similar to previous research in Texas (Besler *et al.*, 1997). AT-108 produced yields above 3200 kg/ha. However, where AT-108 has been left in the field for an extended period of time due to bad weather, heavy pod loss has been noted (authors' pers. obs.).

Peanut Grade. No significant improvement occurred in grade with two and four applications of tebuconazole (Table 3). Brenneman and Culbreath (1994) concluded that tebuconazole would increase grades by inhibiting stem rot, therefore, preventing pod loss. Jacobi and Backman (1991) reported similar findings. Southwest Runner, a small seeded cultivar, had significantly lower grades than all other cultivars.

This study revealed that tebuconazole provided control of southern stem rot for most cultivars evaluated when it was applied two and four times during the growing season. In a season where environmental conditions are conducive to early season development of the disease, a greater response using tebuconazole may be expected. Under moderate to heavy southern stem rot disease pressure, tebuconazole significantly reduced southern stem rot (Brenneman *et al.*, 1991; Hagan *et al.*, 1991; Grichar, 1995; Besler *et al.*, 1996) and some significant yield increases were observed. In the current

Table 2. Effects of tebuconazole spray programs on peanut yield among eleven peanut cultivars.[a]

Cultivar	Yield[b]			
	Control	Two sprays	Four sprays	Mean
	kg/ha	kg/ha	kg/ha	kg/ha
Andru-93	3000	3248	3515	3254 bc
AT-108	3281	3169	3370	3273 b
Florunner	2968	2925	3338	3077 cd
Georgia Green	2858	2733	2720	2770 e
GK-7	3012	3107	3045	3055 bcd
Georgia Runner	2762	3050	3148	2987 cde
Southern Runner	2567	3308	3413	3096 bcd
Southwest Runner	3149	3211	3308	3223 bc
SunOleic	2858	3110	3360	3109 bcd
Tamrun 88	2759	3041	2871	2890 de
Tamrun 96	3771	4156	4003	3977 a
Mean	3010 b	3175 a	3249 a	

[a]Two sprays of tebuconazole @ 0.23 kg/ha were applied approx. 60 and 88 DAP; four sprays of tebuconzole @ 0.23 kg/ha were applied approx. 60, 74, 88 and 102 DAP.

[b]Main effect followed by the same letter are not different ($P \leq 0.05$) according to Fisher's Least Significant Difference test.

Table 3. Effects of tebuconazole spray programs on grade of 11 peanut cultivars.[a]

Cultivar	TSMK[b]			
	Control	Two sprays	Four sprays	Mean
	%	%	%	%
Andru-93	72.9	72.4	71.3	72.2 ab
AT-108	71.4	73.0	71.5	72.0 ab
Florunner	72.6	72.8	71.8	72.4 ab
Georgia Green	73.0	72.3	71.1	72.1 ab
GK-7	71.8	73.9	71.3	72.3 ab
Georgia Runner	73.0	72.9	73.5	73.1 a
Southern Runner	71.1	71.4	71.5	71.3 b
Southwest Runner	66.1	61.8	65.6	64.5 c
SunOleic	73.6	71.5	72.4	72.5 ab
Tamrun 88	72.5	73.1	72.5	72.7 ab
Tamrun 96	72.8	73.5	72.9	73.0 a
Mean	71.9	71.7 a	71.4 a	

[a]Two sprays of tebuconazole @ 0.23 kg/ha were applied approx. 60 and 88 DAP; four sprays of tebuconzole @ 0.23 kg/ha were applied approx. 60, 74, 88 and 102 DAP.

[b]Main effect followed by the same letter are not different ($P \leq 0.05$) according to Fisher's Least Significant Difference test. TSMK = total sound mature kernel.

study, peanut cultivars varied in their response to disease pressure. In a year when disease incidence is low to moderate, fungicide applications may be greatly reduced or eliminated depending on which cultivar is used. It is important for economical and resistance management reasons to consider the field history of southern stem rot and select adapted cultivars that may require fewer fungicide applications.

Acknowledgments

We would like to thank Kevin Brewer, Travis Boone, and Bill Klesel for their assistance in maintaining plots and harvesting.

Literature Cited

Arnold, J. E., R. K. Spinkel, D. W. Gorbert, and J. King. 1988. Resistance of the peanut variety 'Southern Runner' to white mold, *Sclerotium rolfsii*. Proc. Amer. Peanut Res. Educ. Soc. 20:34 (abstr.).

Backman, P. 1992. Application strategies for minimizing resistance build-up to sterol inhibitor fungicide in southern peanuts. Proc. Amer. Peanut Res. Educ. Soc. 24:56 (abstr.).

Besler, B. A., W. J. Grichar, and A. J. Jaks. 1996. Southern blight and leaf spot control in peanut using selected fungicides. Texas J. Agric. Nat. Resour. 9:105-114.

Besler, B. A., W. J. Grichar, and O. D. Smith. 1997. Reaction of selected peanut cultivars and breeding lines to southern stem rot. Peanut Sci. 24:6-9.

Bowen, K. L., A. K. Hagan, and J. R. Weeks. 1997. Number of tebuconazole applications for maximizing disease control and yield of peanut in growers' fields in Alabama. Plant Dis. 81:927-931.

Branch, W. D. 1996. Registration of 'Georgia Green' peanut. Crop Sci. 36:806.

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.

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. 17:65-67.

Brenneman, T. B., and A. K. Culbreath. 1994. Utilizing a sterol demethylation inhibiting fungicide in an advisory program to manage foliar and soilborne pathogens of peanut. Plant Dis. 78:866-872.

Brenneman, T. B., A. D. Murphy, and A. S. Csinos. 1991. Activity of tebuconazole on *Sclerotium rolfsii* and *Rhizoctonia solani*, two soilborne pathogens of peanut. Plant Dis. 75:744-747.

Culbreath, A. K., T. B. Brenneman, and F. M. Shokes. 1991. Quantitative comparison of stem lesions caused by *Cercosporidium personatum* in Florunner and Southern Runner. Peanut Sci. 18:116-121.

Damicone, J. P., and K. E. Jackson. 1994. Factors affecting chemical control of southern blight of peanut in Oklahoma. Plant Dis. 78:482-486.

Gorbet, D. W., A. J. Nordon, F. M. Shokes, and D. A. Knauft. 1987. Registration of 'Southern Runner' peanut. Crop Sci. 27:817.

Grichar, W. J. 1995. Control of southern blight and rhizoctonia pod rot of peanut with Moncut. Texas Agric. Exp. Sta. Ctr. Tech. Rep. 95-02.

Hagan, A. K., J. R. Weeks, and K. Bowen. 1991. Effects of application timing and method on control of southern stem rot of peanut with foliar-applied fungicide. Peanut Sci. 18:47-50.

Jacobi, J. C., and P. A. Backman. 1989. Disease management of Southern Runner and Florunner peanut. Proc. Amer. Peanut Res. Educ. Soc. 21:26 (abstr.).

Jacobi , J. C., and P. A. Backman. 1991. Effects of tebuconazole on seed quality and fungal colonization on two cultivars of peanut. Phytopathology 81:812.

Kirby, J. S., H. A. Melouk, D. J. Banks, J. R. Sholar, and T. E. Stevens, Jr. 1994. Southwest Runner—A small-seeded runner for the Southwest. Proc. Amer. Peanut Res. Educ. Soc. 26:35 (abstr.).

Knauft, D. A., D. W. Gorbet, and A. J. Norden. 1988. Yield and market quality of seven peanut genotypes grown without leafspot control. Peanut Sci. 15:9-13.

Noegel, K. A. 1992. Application strategies for use of tebuconazole on peanut. Proc. Amer. Peanut Res. Educ. Soc. 24:58 (abstr.).

Rodriguez-Kabana, Jr., P. A. Backman, and J. C. Williams. 1975. Determination of yield losses to *Sclerotium rolfsii* in peanut fields. Plant Dis. 59:855-858.