Assessment of Six Peanut Cultivars for Control of Rhizoctonia Pod Rot When Sprayed with Azoxystrobin or Tebuconazole[1]

B.A. Besler*, W.J. Grichar, K.D. Brewer, and M.R. Baring[2]

ABSTRACT

Field studies were established in 1996 and 1997 in Atascosa Co. in south Texas to evaluate the response of six peanut cultivars to Rhizoctonia pod rot when sprayed with the fungicides azoxystrobin and tebuconazole. Compared to unsprayed plots, significant disease reduction occurred when cultivars were sprayed with either fungicide. Disease reductions were similar with both fungicides. Tamrun 96 displayed the lowest disease incidence both years with and without a fungicide application. Yields were significantly enhanced both years when either azoxystrobin or tebuconazole was applied to all six cultivars. Tamrun 96 was the highest yielding cultivar in 1996 when sprayed with azoxystrobin and in 1997 when sprayed with tebuconazole. Both fungicides improved grade (%TSMK) when compared to the unsprayed checks.

Key Words: *Arachis hypogaea*, disease incidence, control, *Rhizoctonia solani*, yield.

Rhizoctonia pod rot (caused by *Rhizoctonia solani* Kühn) can be a major factor limiting production of peanut (*Arachis hypogaea* L.) in south Texas. Because Rhizoctonia pod rot is favored by warm, wet soil conditions, producers in south Texas who irrigate may find relatively high levels of this disease. Rhizoctonia pod rot also is more prevalent in fields that are not adequately rotated. Populations of the pathogen can be reduced through cultural practices and crop rotation of 3 to 5 yr (Melouk and Backman, 1995).

Practices used in the suppression of soilborne plant pathogens include deep plowing and non-dirting cultivation (Garren, 1964). However, in fields with high populations of *R. solani* these practices are inadequate for suppression of pod rot. Currently, producers in south Texas rely heavily on fungicides, especially tebuconazole and flutolanil, for control of soilborne plant pathogens. Applications of tebuconazole at 0.23 kg/ha have shown excellent efficacy against southern stem rot (caused by *Sclerotium rolfsii* Sacc.) and moderate suppression of Rhizoctonia limb rot (Brenneman *et al.*, 1991; Besler *et al.*, 1996). Grichar and Jaks (1995) found that tebuconazole reduced Rhizoctonia pod rot from 17 to 70% over the untreated check, but control of Rhizoctonia limb rot can be inconsistent. In one study, three applications of tebuconazole did not control Rhizoctonia limb rot relative to the nontreated check. In another study, two midseason applications of tebuconazole reduced Rhizoctonia limb rot 38% compared to the untreated check (Brenneman *et al.*, 1991; Brenneman and Culbreath, 1994).

Continuous use of tebuconazole is discouraged because of the potential for selection of fungicide-resistant isolates (Köller and Scheinpflug, 1987). For this reason, tebuconazole application strategies on peanut include foliar spray programs where chlorothalonil is applied intially and at the end of the season with two to four applications of tebuconazole in the middle of the season, or alternating tebuconazole applications with chlorothalonil.

The fungicide azoxystrobin, which was registered in 1997, has shown excellent activity against southern stem rot and Rhizoctonia pod rot (Grichar *et al.*, 2000). A study conducted in 1994 found that azoxystrobin at 0.52 kg/ha reduced Rhizoctonia pod rot disease incidence 20 to 55% compared to tebuconazole and 13 to 49% compared to flutolanil (Grichar *et al.*, 1997). In another study, azoxystrobin applied two times during the growing season provided control of southern stem rot, Rhizoctonia pod rot, early leaf spot (caused by *Cercospora arachidicola* Hori) and late leaf spot [caused by *Cercosporidium personatium* (Berk & Curt.) Deighton] comparable to tebuconazole applied four times (Grichar *et al.*, 2000).

Under normal conditions, cultivars commonly grown in south Texas produce acceptable yields. However, under weather conditions conducive to Rhizoctonia disease development, pods and limbs of these cultivars have tended to deteriorate leading to reduced yields. The runner cultivar Tamrun 96 has exhibited moderate resistance to southern stem rot (Besler *et al.*, 1997; Smith *et al.*, 1998). The cultivars Toalson and Southern Runner are reported to have partial resistance to *S. rolfsii*; but because of their undesirable agronomic characteristics and low yield potential, they are no longer grown in the region (Smith *et al.*, 1989). Other cultivars commonly grown in south Texas include AT-108, Georgia Green, GK-7, and SunOleic 95R. AT-108 is known for its high yield potential, early maturity, erect mainstem, and jumbo size seed. Georgia Green is a high yielding runner cultivar with resistance to southern stem rot and tomato spotted wilt virus (TSWV) (Branch, 1996). SunOleic 95R is a runner cultivar high in oleic fatty acid and displays an exceptional shelf life. The objective of this study was to evaluate the response of several cultivars grown commercially in south Texas to tebuconazole and azoxystrobin in a location with a known history of Rhizoctonia pod rot.

Material and Methods

Field studies were conducted in 1996 and 1997 in Atascosa Co. in south Texas. The soil type was Duval loamy fine sand with 1% organic matter. Control of weeds and other management practices, including irrigation, followed closely the recommendations outlined by Texas Coop. Ext. (Lemon *et al.*, 2001). Irrigation in both years was supplied by a center pivot system. Peanuts had been grown in the field for more than 20 consecutive years, which had a history of Rhizoctonia pod rot

[1]Contribution No. 30526 from the Texas Agric. Exp. Sta., Texas A&M Univ., College Station, TX. Mention of a trademark 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 product was made possible through support provided by the Office of Agric., Bureau for Science and Technology, USAID Grant No. DAN-4048-G-00-0041-00. Recommendations do not represent an official position or policy of USAID.

[2]Res. Assoc., Res. Scien., and Tech., respectively, Texas Agric. Exp. Sta., Yoakum, TX 77995; Res. Assoc., Texas Agric. Exp. Sta., College Station, TX 77843.

*Corresponding author (email: b-besler@tamu-edu.).

due to lack of crop rotation. Different locations within the same field were chosen each year.

The experimental design was a split-plot in which peanut cultivars were the main plots and fungicides applications the subplots. The main plot treatments were arranged randomly in complete blocks with four replications. Subplots were two rows, spaced 91 cm apart, by 9.1 m long. The fungicides used were tebuconazole {alpha-[2-(4-chlorophenyl)ethyl]-alpha-(1,1-demethylethyl)-1H-1,2,4-triazole-1-ethanol} (Folicur 3.6 F, Bayer Crop Science, Research Triangle Park, NC) at 0.23 kg/ha and azoxystrobin {methyl (E)-2-[2-[6-(2-cyanophenoxy)pyrimidin-4-yloxy]phenyl]-3-methoxyacrylate} (Abound 2.08 F, Syngenta Crop Protection, Greensboro, NC) at 0.52 kg/ha. The subplot treatments included a control (unsprayed), two applications of azoxystrobin, and four applications of tebuconazole. No other fungicides were applied. GK-7, AT-108, Georgia Green, Tamrun 96, Southern Runner, and SunOleic 95R were planted using a precision vacuum planter 3 July 1996 and 1 July 1997 at the rate of 226 seed per 9.1 m of row. Azoxystrobin was applied 59 and 86 d after planting (DAP) in 1996 and 58 and 87 DAP in 1997. Tebuconazole was applied 59, 72, 86, and 101 DAP in 1996 and 58, 72, 87, and 101 DAP in 1997. All fungicides applications were applied with a backpack sprayer that had a hand-held boom with two D2 tips with #13 cores and slotted strainers. The fungicides were applied at a total output of 187 L/ha delivered at 345 kPa.

Rhizoctonia pod rot was identified based on the dark brown sunken cankers on the surface of the pod and the noticeable brown hyphae inside the peanut shell wall. Diseased pods exhibiting symptoms of Rhizoctonia pod rot were collected arbitrarily , biopsied, and surfaced sterilized using 10% V/V mixture of NaOCl and grown on a potato dextrose agar (PDA). Isolations of diseased pod tissue confirmed a positive identification of the fungus. After inversion, visual ratings within the entire plot were used to determine estimated percentage of pods infected with *R. solani*. Careful attention was made to eliminate the pathogen *S. rolfsii* as part of the evaluation. Plots were dug on 21 Nov. 1996 and 20 Nov. 1997. All cultivars were dug at the same time both years even though Southern Runner has a history of late maturation and AT-108 is an early maturing cultivar. Peanuts were allowed to field dry to 10% moisture before harvesting. Plots were harvested with a stationary thrasher on 3 Dec. 1996 and with a tractor-pulled peanut combine with a sack attachment on 1 Dec. 1997. Data were combined over years (1996 and 1997) and analyzed as a split plot design using analysis of variance and Fisher's Least Significant Difference (LSD; P = 0.05). A significant year x cultivar x spray interaction was found for disease incidence, yield, and grade. Both years then were analyzed separately and significant differences determined within years.

Results and Discussion

Rhizoctonia pod rot incidence was moderate to high in 1996 and 1997 (13.5 to 50.2% infection in the nontreated plots). Growing conditions were extremely dry in 1996, but excessive irrigation late in the season in combination with dense canopy growth provided an environment favorable for disease development. Above normal rainfall in 1997 provided excellent conditions for disease development season-long. Minimal damage from *S. rolfsii* and Rhizoctonia limb rot was observed but was not considered serious enough to impact yield or warrant evaluation. Although all six cultivars were dug at the same time both years, significant differences in grade probably were an indication of leaf spot control by fungicide applications and not maturity (Table 1). There were significant main effects of cultivar and treatment for pod rot incidence, yield, and grade within each year. There were no significant cultivar x treatment interactions for those parameters within each year.

1996. Rhizoctonia pod rot incidence was reduced substantially for all six cultivars when tebuconazole or azoxystrobin was applied (Table 2). All cultivars had significantly lower disease incidence when treated with tebuconazole or azoxystrobin compared to the unsprayed check. Disease incidence in plots that had been treated with either tebuconazole or azoxystrobin ranged from 5.0 to 20.7%. Tamrun 96 had low disease incidence in the absence of a fungicide application

Table 1. Effects of azoxystrobin and tebuconazole spray programs on peanut grade in six peanut cultivars.

	TSMK[a]							
	1996				1997			
Cultivar	Unsprayed	Azoxystrobin	Tebuconazole	Mean	Unsprayed	Azoxystrobin	Tebuconazole	Mean
	----------% ----------				----------% ----------			
AT-108	75	77	78	77	73	76	76	75
Georgia Green	78	80	80	79	74	76	76	75
GK-7	76	79	79	78	73	75	76	75
Southern Runner	75	78	77	77	72	74	75	73
SunOleic 95R	75	79	78	77	73	74	73	73
Tamrun 96	75	78	77	77	70	73	74	72
Mean	76	79	78		73	75	77	
LSD (0.05)[b]		0.9		1.0		2.8		1.6

[a]TSMK = total sound mature kernel.

[b]Fisher's Least Significant Difference was used to determine differences among main effects cultivar and treatment at P = 0.05.

Table 2. Effects of azoxystrobin and tebuconazole spray programs on incidence of Rhizoctonia pod rot in six peanut cultivars.

	Rhizoctonia pod rot rating[a,b]							
	1996				1997			
Cultivar	Unsprayed	Azoxystrobin	Tebuconazole	Mean	Unsprayed	Azoxystrobin	Tebuconazole	Mean
	----------% ----------				----------% ----------			
AT-108	27.8	16.8	15.3	20.0	42.6	19.4	19.5	27.2
Georgia Green	21.7	13.2	11.8	15.6	43.6	17.0	13.5	24.7
GK-7	28.5	20.7	12.0	20.4	41.4	15.4	14.4	23.7
Southern Runner	20.2	14.8	9.5	14.8	50.2	24.8	23.3	32.8
SunOleic 95R	28.5	13.3	17.2	19.6	35.3	14.9	15.3	21.8
Tamrun 96	13.5	5.0	5.3	7.9	22.0	9.3	13.2	14.8
Mean	23.4	14.0	11.9		39.2	16.8	16.5	
LSD (0.05)		4.5		3.2		6.7		4.4

[a]Two sprays of azoxystrobin @ 0.52 kg/ha for each application were applied approx. 60 and 88 d after planting (DAP); four sprays of tebuconazole @ 0.23 kg/ha for each application were applied approx. 60, 74, 88, and 102 DAP.

[b]Disease was defined as a percentage of pods infected with *Rhizoctonia solani* within the entire plot.

[c]Fisher's Least Significant Difference was used to determine differences among main effects cultivar and treatment at P = 0.05.

when compared to other cultivars. Levels of pod rot on unsprayed Tamrun 96 often were comparable to those on more susceptible cultivars that had been sprayed. Besler *et al.* (1997) previously reported resistance to southern stem rot on Tamrun 96.

Yields in 1996 were significantly greater with either fungicide compared to the unsprayed plots (Table 3). Yield increases over the unsprayed check ranged from 650 to 1990 kg/ha. Highest yields were obtained when Georgia Green was sprayed with tebuconazole or when Tamrun 96 was sprayed with azoxystrobin.

Late leaf spot probably suppressed yields of unsprayed plots in 1996, and yield reductions may have varied with cultivars (data not shown). Final mean leaf spot severity in the unsprayed plots ranged from 6.63 for SunOleic to 7.65 for GK-7 on the Florida scale of 1 to 10, where 1 = no leaf spot and 10 = plants completely defoliated and killed (Chiteka *et al.*, 1988). When plots were sprayed with either azoxystrobin or tebuconazole, leaf spot severity was less than 4 for all cultivars. Percentage total sound mature kernels (% TSMK) was higher in all cultivars when sprayed with a fungicide (Table 1). Georgia Green had a significantly higher grade than the other cultivars.

1997. Slightly warmer temperatures late in the growing season and excessive rainfall, including over 36 cm in Oct., allowed for greater Rhizoctonia pod disease incidence as compared to 1996. Rhizoctonia pod rot incidence in the nontreated plots of the six cultivars ranged from 22 to 50% (Table 2). Significant ($P \leq 0.05$) reductions in disease incidence occurred when azoxystrobin or tebuconazole was applied. Unsprayed Tamrun 96 displayed Rhizoctonia pod rot incidence comparable to that in cultivars that were sprayed with tebuconazole or azoxystrobin. Reductions in disease incidence were similar for both azoxystrobin and tebuconazole treatments. Mean late leaf spot severity was less than 5 in all unsprayed plots and was less than 3 on cultivars that received azoxystrobin or tebuconazole.

Mean yields in 1997 were significantly enhanced by treatment with either tebuconazole or azoxystrobin (Table 3). Yield increases generally were greater when tebuconazole was applied but the difference was not significant. AT-108, when sprayed with either azoxystrobin or tebuconazole, had the largest increase in yield compared to its respective unsprayed check. Yields within fungicide treatments were similar for the cultivars. Tamrun 96 and SunOleic 95R yielded the highest on average. Besler *et al.* (1997) reported that Tamrun 96 was the highest yielding cultivar in a 3-yr study under high levels of southern stem rot.

Grades improved significantly when a fungicide was applied (Table 1). Tamrun 96 graded significantly lower than most cultivars.

In summary, either azoxystrobin or tebuconazole provided good control of Rhizoctonia pod rot under moderate to high levels of disease. Leaf spots also were controlled by the treatments in both years. All six cultivars responded with consistently lower disease incidence, higher yields, and improved grade when sprayed with these fungicides. These results indicate that Tamrun 96 may have moderate resistance to Rhizoctonia pod rot as indicated by the low disease incidence in the unsprayed plots in both years. In earlier work, Besler *et al.* (1997) concluded that Tamrun 96 also exhibited moderate resistance to southern stem rot. No advantage resulted from using azoxystrobin (two applications) compared to tebuconazole (four applications), and fungicide effects on yield and grade were similar across cultivars. Applications of azoxystrobin should be made approximately 60 and 90 DAP and an additional fungicide such as chlorothalinil may be needed to achieve season-long leaf spot control. Applications of tebuconazole should be made approximately 60, 74, 88, and 102 DAP and should be used in a resistance management program. Based on application recommendations, the costs of applying these two fungicides within a growing season are similar. However, in a growing season where foliar and soilborne disease incidence is low, four applications of tebuconazole may not be required, thereby reducing the cost of application. Producers have at their disposal two possible management options that provide acceptable levels of control of Rhizoctonia pod rot. However, it is essential from an

Table 3. Effects of azoxystrobin and tebuconazole spray programs on peanut yield in six peanut cultivars.

Cultivar	Yield[a]							
	1996				1997			
	Unsprayed	Azoxystrobin	Tebuconazole	Mean	Unsprayed	Azoxystrobin	Tebuconazole	Mean
	kg/ha				kg/ha			
AT-108	3040	4060	4376	3825	3499	5349	5909	4919
Georgia Green	2634	4143	4624	3800	3782	5064	5392	4746
GK-7	2874	4258	4010	3714	4050	5034	5423	4836
Southern Runner	3482	4305	4132	3973	4173	5339	5812	5108
SunOleic 95R	3032	4248	4253	3844	4203	6095	5647	5315
Tamrun 96	3335	4689	4054	4057	5190	5204	6340	5578
Mean	3066	4284	4242		4150	5348	5754	
LSD (0.05)[b]		314		292		329		656

[a]Two sprays of azoxystrobin @ 0.52 kg/ha for each application were applied approx. 60 and 88 d after planting (DAP); four sprays of tebuconazole @ 0.23 kg/ha for each application were applied approx. 60, 74, 88, and 102 DAP.

[b]Fisher's Least Significant Difference was used to determine differences among main effects cultivar and treatment at P = 0.05.

economic and resistance management standpoint to know the field history before making cultivar and fungicide selections.

Acknowledgments

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

Literature Cited

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.

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

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. 78:866-872.

Chiteka, Z.A., D.W. Gorbet, F.M. Shokes, T.A. Kucharek, and D.A. Knauft. 1988. Components of resistance to late leaf spot in peanut. I. Levels and variability-implications for selection. Peanut Sci. 15:25-30.

Garren, K.H. 1964. Inoculation potential and differences among peanuts in susceptibility to *Sclerotium rolfsii*. Phtopathology 54:279-281.

Grichar, W.J., B.A. Besler, and A.J. Jaks. 1997. Abound for peanut disease control. Texas Agric. Exp. Sta. Ctr. Tech. Rep. 97-04.

Grichar, W.J., B.A. Besler, and A.J. Jaks. 2000. Use of azoxystrobin for disease control in Texas peanut. Peanut Sci. 27:83-87.

Grichar, W.J., and A.J. Jaks. 1995. Folicur and Tilt for peanut disease control. Texas Agric. Exp. Sta. Ctr. Tech. Rep. 95-01.

Köller, W, and H. Scheinpflug. 1987. Fungal resistance to sterol biosynthesis inhibitors: A new challenge. Plant Dis. 71:1066-1074.

Lemon, R.G., T.A. Lee, M. Black, W.J. Grichar, T. Baughman, P. Dotray, C. Trostle, M. McFarland, P. Baumann, C. Crumley, J.S. Russell, and G. Norman. 2001. Texas Peanut Production Guide. Texas Agric. Ext. Serv. Publ. 5-1514.

Melouk, H.A., and P.A. Backman. 1995. Management of soilborne fungal pathogens, pp. 75-82. *In* H.A. Melouk and F.M. Shokes (eds.) Peanut Health Management. Amer. Phytopath. Soc., St. Paul, MN.

Smith, O.D., T.E. Boswell, W.J. Grichar, and C.E. Simpson. 1989. Reaction of selected peanut (*Arachis hypogaea* L.) lines of southern stem rot and pythium pod rot under varied disease pressure. Peanut Sci. 16:9-14.

Smith, O.D., C.E. Simpson, M.C. Black, and B.A. Besler. 1998. Registration of 'Tamrun 96' Peanut. Crop Sci. 38:1403.