Effects of Chemigated and Conventionally Sprayed Tebuconazole and Tractor Traffic on Peanut Diseases and Pod Yields

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ABSTRACT

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Tebuconazole (252 g a.i./ha) was applied as Folicur 1.2 EC seven times to Florunner peanuts via ground sprays or center-pivot irrigation (chemigation). Tebuconazole applied via chemigation was diluted in water or nonemulsifiable oil and applied in 25.4 kl/ha of water. Chemigated plots either did or did not receive tractor traffic after each application. Plants in nontreated plots were defoliated by late leaf spot (*Cercosporidium personatum*) in 1987 and 1988. Significant Rhizoctonia limb rot (*R. solani* AG-4) was present only in 1987 and symptoms were reduced by all fungicide treatments; plants in plots not receiving tractor traffic had the least limb rot. Ground sprays and chemigation using the oil diluent gave the best control of leaf spot. Mean yields of chemigated plots were 6,137 kg/ha vs. 5,792 and 2,808 kg/ha for the ground-sprayed and nonsprayed plots, respectively.

Cultivars of peanut (*Arachis hypogaea* L.) are susceptible to numerous serious diseases. In Georgia, the most damaging foliar disease is late leaf spot, caused by *Cercosporidium personatum* (Berk. & Curt.) Deighton. Several soilborne diseases also cause major yield reductions, with the greatest losses coming from Rhizoctonia limb rot, caused by *R. solani* Kühn anastomosis group (AG) 4, and southern stem rot, caused by *Sclerotium rolfsii* Sacc. Crop losses to these three diseases in Georgia were estimated at $64 million in 1987 (15). With growers utilizing shorter rotations, particularly on irrigated land, these losses may continue or increase.

Because of the high economic value of the crop, numerous control measures are used, with fungicides playing a central role. Chlorothalonil is applied on a 14-day schedule to control leaf spot, and PCNB, alone or combined with insecticides, is applied to control *S. rolfsii*. No effective chemical is available for Rhizoctonia limb rot. Although not presently labeled on peanut, several new ergosterol biosynthesis inhibiting fungicides (EBIs) have been tested. They appear promising because they are often active against several major diseases (4). One such compound, tebuconazole (= ethyltrianole = HWG 1608), controls leaf spot (12) and southern stem rot (11) and is systemic in peanut via apoplastic movement (8). The manufacturer, Mobay Chemical Corporation, is currently seeking registration of this product for use on peanut.

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Peanut fungicides are applied by various types of ground sprayers and aerial applicators and, in some cases, by injection through an irrigation system, usually a center pivot. The latter method, referred to as chemigation, is currently being used on a limited basis in Georgia. Chemigation offers significant economic and technological benefits (6) and has performed well in other peanut-growing areas such as Texas (T. A. Lee, Jr., *personal communication*). With approximately 50–60% of their peanut acreage under irrigation, Georgia farmers are in a good position to take advantage of this technology.

Previous research has shown that an insecticide formulated in oil prior to injection in irrigation water may result in increased efficacy (17). Other research has indicated that simply traveling a field with a tractor may influence peanut fruiting patterns (10) and reduce pod yields (9). The objectives of this research were to evaluate: 1) the efficacy of chemigated vs. ground-applied tebuconazole for foliar and soilborne disease control in peanut, 2) changes in efficacy of tebuconazole due to addition of a nonemulsifiable oil to the fungicide prior to injection, and 3) the effects of tractor traffic on yield and/or disease development in chemigated plots. An abstract of the first year's results has been published (2).

MATERIALS AND METHODS

The study was initiated in 1987 in a field of Pelham loamy sand (thermic Arenic Paleaquult) at the Bowen research farm, Tifton, Georgia, in one quadrant (0.15 ha) of a single-tower center-pivot irrigation system; the test was repeated in 1988 in an adjacent quadrant. Both tests followed soybean the previous year, and rye was planted as a winter cover crop in 1987. The land was moldboard-plowed, disked, and bedded. Florunner peanut was planted in single rows 0.91 m apart at 123 kg/ha of seed in 1987 and 112 kg/ha of seed in 1988. Planting date was 18 May both years, and standard management practices of the Georgia Cooperative Extension Service were followed (7). No tractor traffic entered the field after peanut vines closed the rows except where specified as a prescribed treatment. Plots were single raised beds (7.6 × 1.8 m in 1987 and 6.1 × 1.8 m in 1988) with two rows per bed. Two border rows and 2.1-m alleys were used between plots. A completely randomized design with four replications was utilized.

All treated plots received tebuconazole applied as Folicur 1.2 EC (252 g a.i./ha) on a 14-day schedule beginning about 5 wk after planting (seven applications). Application methods were: 1) nonsprayed control, no tractor traffic; 2) chemigation with water as diluent (1:3.7 fungicide:water, v/v), no tractor traffic; 3) chemigation with water as diluent (1:3.7 fungicide:water, v/v), tractor traffic; 4) chemigation with 11N Sunspray oil (Suntech Inc.) as diluent (1:1.7 fungicide:oil, v/v), no tractor traffic; and 5) ground spray. All chemigation applications were applied in 25.4 kl/ha of water via impact sprinklers, and the oil-diluted treatment was mechanically agitated to maintain a uniform suspension. The entire field received 129 kl/ha of water the evening before each application. During chemigations, plots not being treated were covered with either plastic sheets or elevated fiberglass shelters. A Ford 2910 tractor weighing approximately 2,500 kg was used to travel the plots in treatments three and five. Ground sprays were applied with a CO_2-pressurized backpack sprayer with three D2-13 nozzles per row to deliver 124.4 L/ha of spray at 345 kPa. Equivalent amounts of fungicide were applied to each plot regardless of application method.

Several leaf spot ratings were made during the season using the Florida 1–10 scale, which accounts for both lesion incidence and defoliation (3). Peanuts were dug 28 September 1987 and 5 October 1988 and harvested 5–7 days later. Rhizoctonia limb rot was rated immediately after digging by visually estimating the percentage of vines and leaves infected at each of six randomly selected areas per plot. Yields were based on weight of pods at 7–8% moisture (w/w), and crop values were determined from a single composite sample from all replicates in accordance with Federal-State Inspection Service methods (14).

RESULTS AND DISCUSSION

Severe levels of late leaf spot developed both years, but the epidemic occurred later in 1988 than in 1987 (Fig. 1). By harvest, plants in nonsprayed plots were almost totally defoliated and many were dead. This resulted in substantial yield reductions both years (Tables 1 and 2).

Ground sprays controlled peanut leaf spot most effectively, with defoliation at harvest not exceeding 11% (Fig. 1). Chemigation with water as the diluent

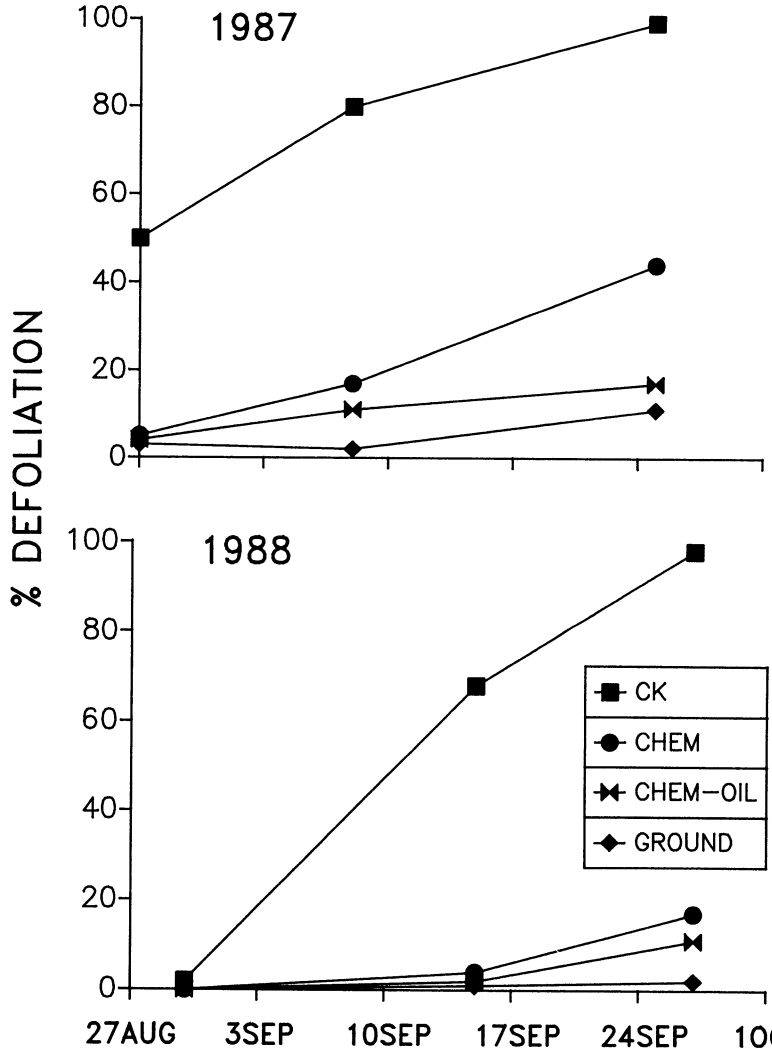

Fig. 1. Disease progress curves (defoliation) for late leaf spot (*Cercosporidium personatum*) with several application methods of tebuconazole (252 g a.i./ha, seven applications). CK = control; CHEM = chemigation, water diluent; CHEM-OIL = chemigation, 11N oil diluent; and GROUND = ground spray.

provided acceptable control of leaf spot in 1988, but with a more severe epidemic in 1987, those plots were 44% defoliated at harvest. Defoliation occurred late in the season, however, and did not impact on yield. In 1987 there was a significantly higher leaf spot rating at harvest in the chemigated plots receiving tractor traffic than in those not receiving tractor traffic. The reason for this is not known, and no differences were observed in 1988.

Use of oil as the diluent increased the activity of tebuconazole on leaf spot both years, with defoliation at harvest not exceeding 17% (Fig. 1). This was superior ($P = 0.05$) to chemigation with water as the diluent and indicates that oil can increase the activity of systemic compounds such as tebuconazole. This could be due to improved penetration of the lipid layer of foliage as a result of altering the partition coefficient (16). Alternatively, the addition of oil could increase the efficacy of the fungicide by reducing its dispersion in the large volume of water applied as well as increasing its affinity for the plant surface (5). A fungicide such as tebuconazole with potential for root uptake conceivably would not have benefited from addition of oil, since the plant could possibly salvage that portion of fungicide flooded over the plant and into the soil. That did not occur to an effective degree in the soil environment in these experiments.

Significant levels of Rhizoctonia limb rot were present in 1987, with 22.3% of peanut limbs in nonsprayed plots showing visible symptoms by harvest (Table 1). The predominant fungus isolated from stem lesions was *R. solani* AG-4. All fungicide treatments reduced ($P = 0.05$) severity of limb rot. There was a trend toward less limb rot where plots did not receive tractor traffic. The significant difference between chemigated treatments (water diluent) with and without traffic indicates that traffic may predispose plants to infection. In 1988 there was very little limb rot but the trend was similar to that in 1987. In 1988 the control plots were not rated for limb rot because of severe defoliation and plant death from leaf spot (Table 2). Traffic did not influence yield significantly in either year. Rhizoctonia limb rot is similar to Sclerotinia blight of peanut, caused by *S. minor* (Jagger) Kohn, in that both fungi infect primarily lateral stems in proximity to the soil. It is of interest that both wounding and tractor tire injury have been demonstrated to be significant factors for infection with that disease (1,13).

Large yield increases were obtained both years with all fungicide treatments (Tables 1 and 2). Chemigated plots had consistently higher yields than did the ground-sprayed plots, thus confirming the earlier findings of Littrell (9). Higher yields in chemigated plots should not have been due to additional water applied during treatment, since only 25.4 kl/ha was used. The application of 129 kl/ha of water the evening before each treatment also helped minimize this effect. Yield differences ranged from 163 to 544 kg/ha but were not significant ($P = 0.05$). The value of pods from treated plots was \$1,579–\$2,941/ha higher than that of pods from nonsprayed plots.

Chemigation offers peanut growers a number of advantages, including reduced soil compaction, reduced mechanical damage to the crop, prescription application, and reduced application costs. There are certainly safety factors that must be considered, and a high level of management is required, but the benefits of chemigation should outweigh the disadvantages for many growers (7).

Tebuconazole has demonstrated activity against two major peanut diseases and can be effectively applied via chemigation, particularly as an oil suspension. Other oil additives or formulations of this fungicide may be even better suited to chemigation. Considering the economics of application along with the other benefits, chemigation with tebuconazole could be considered a viable option for peanut disease control in the southeastern United States.

Table 1. Disease ratings, pod yields, and crop values of peanuts treated with tebuconazole applied via ground sprays or center-pivot irrigation system, 1987[v]

Treatment	Leaf spot[w] rating	Rhizoctonia[x] limb rot	Yield (kg/ha)	Percent TSMK[y]	Value[z] ($/ha)
Nonsprayed	9.3 a	22.3 a	3,188 b	78	2,375
Chemigation, no traffic, water diluent	6.2 b	12.7 c	5,919 a	79	4,457
Chemigation, traffic, water diluent	5.4 c	17.5 b	5,765 a	75	4,149
Chemigation, no traffic, 11N oil diluent	4.8 d	13.3 bc	5,765 a	75	4,140
Ground spray, traffic	4.4 d	16.0 bc	5,375 a	77	3,954

[v] Seven applications of Folicur 1.2 EC, 252 g a.i./ha.
[w] Rated at harvest using Florida 1–10 scale (3). Column mean separation is by Duncan's multiple range test ($P = 0.05$).
[x] Rating based on mean of six locations per plot, averaged over four plots. Rating is an estimate of the percentage of vines and leaves infected at each location.
[y] Indicates percentage of sound mature kernels plus sound split kernels determined according to Federal-State Inspection Service methods (14).
[z] Value was determined from a composite sample from each replicate in accordance with Federal-State Inspection Service methods.

Table 2. Disease ratings, pod yields, and crop values of peanuts treated with tebuconazole applied via ground sprays or center-pivot irrigation system, 1988[v]

Treatment	Leaf spot[w] rating	Rhizoctonia[x] limb rot	Yield (kg/ha)	Percent TSMK[y]	Value[z] ($/ha)
Nonsprayed	9.1 a	...	2,429 b	74	1,758
Chemigation, no traffic, water diluent	4.8 b	0.2 b	6,373 a	74	4,611
Chemigation, traffic, water diluent	4.8 b	1.1 a	6,505 a	73	4,664
Chemigation, no traffic, 11N oil diluent	4.4 c	0.2 b	6,495 a	74	4,699
Ground spray, traffic	3.3 d	0.6 ab	6,210 a	72	4,383

[v] Seven applications of Folicur 1.2 EC, 252 g a.i./ha.
[w] Rated at harvest using Florida 1–10 scale (3). Column mean separation is by Duncan's multiple range test ($P = 0.05$).
[x] Rating based on mean of six locations per plot, averaged over four plots. Rating is an estimate of the percentage of vines and leaves infected at each location; nonsprayed plots could not be rated because of severe defoliation and plant death.
[y] Indicates percentage of sound mature kernels plus sound split kernels determined according to Federal-State Inspection Service methods (14).
[z] Value was determined from a composite sample from each replicate in accordance with Federal-State Inspection Service methods.

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