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Diniconazole's Effect on Peanut (*Arachis hypogaea* L.) Growth and Development

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Abstract. Greenhouse nutrient solution studies demonstrated that diniconazole will decrease peanut (*Arachis hypogaea* L.) shoot growth when either root or shoot applied. Root growth and development were decreased by root and, to a lesser extent, by shoot uptake of diniconazole. Diniconazole is apparently xylem translocated, but not phloem translocated. Concentrations of 200 ppb ES isomer of diniconazole in nutrient solution (root uptake) increased specific leaf weight and starch deposits in the leaf. Field applications of 193 g ES isomer ha^{-1} of diniconazole reduced main stem height by 33%, leaf area index by 16%, and total vegetative dry weight by 19%, but had no effect on average leaf size. Decreased germination of seeds from plants treated with 1435 g ha^{-1} diaminozide was associated with increased seed dormancy. Seed dormancy was counteracted by either ethylene gas or storage for 150 days after harvest. Soil applications of diniconazole were more effective than foliar appliations in reducing vine growth. Diniconazole's ER isomer is a broad spectrum fungicide that reduced damage (when compared to the control) by *Sclerotium rolfsii* and *Rhizoctonia solani*. The reduced damage by these diseases was thought to be the primary reason for the significant pod yield increase (when compared to the control) observed with the diniconazole treatments. In drought-stressed plots, populations of the two-spotted spider mite (*Tetranychus urticae*) were increased by diniconazole.

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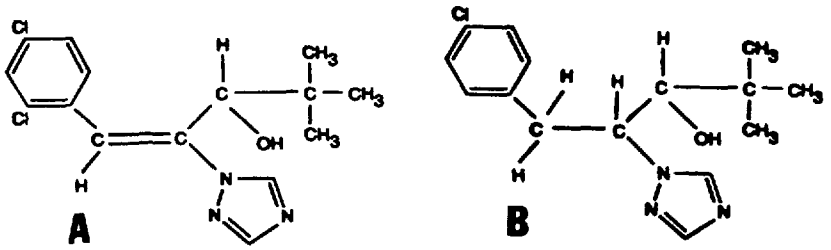

Fig. 1. Structures of diniconazole (A) and paclobutrazol (B)

Diniconazole, (E)-1-(2,4-dichlorophenyl)-4,4-dimethyl-2-(1,2,4-triazol-1-yl)-1-pentane-3-ol (S3308, XE779), is a fungicide and plant growth regulator (PGR) that is similar in structure to paclobutrazol (2RS,3RS)-1-(4-chlorophenol)-4,4-dimethyl-2(1,2,4-triazol-1-yl)pentane-3-ol) (PP-333) (Fig. 1; Koller 1987). Diniconazole is a vinylazole that has two geometrical isomers and one asymmetric carbon atom. Biological activity of diniconazole is highly restricted to the E conformation, fungicide activity is restricted to the R(−) enantiomer, plant growth-regulating activity is expressed by the S(+) enantimoer, and, like paclobutrazol, diniconazole is a sterol demethylation inhibitor (Funaki et al. 1983).

A major use of plant growth-retarding chemicals in the Southeast United States is in the control of excess peanut (*Arachis hypogaea* L.) vine growth. Since peanut is a perennial (Hoehne 1940) with an indeterminate fruit set pattern and season-long shoot growth, harvesting and disease problems often result from excessive vine growth. The objective of this study was to determine diniconazole's effect on peanut growth and development, and compare its effects to those of the currently used peanut vine retardant, daminozide [butanedioic acid mono(2,2-dimethylhydrazide)].

Materials and Methods

Diniconazole was provided by Chevron Chemical Company (Richmond, CA) and daminozide was provided by Uniroyal Chemical Company (Middleburg, CT) for these studies. "Florunner" peanuts were used for both greenhouse and field studies. A formulation of diniconazole consisting of a mixture of ES (16%) and ER (84%) enantiomers was used in these studies. Exact amounts of each isomer are listed in Tables 1–3. Since PGR activity is highly restricted to the ES isomer (Funaki et al. 1983), discussions on PGR rates will be based on ES isomer concentrations.

Greenhouse Study

A greenhouse study was designed to determine and compare effects of root versus foliar absorption of diniconazole on peanut growth. A randomized com-

Table 1. Effect of foliar and root absorption of diniconazole on the root and shoot growth of greenhouse-grown Florunner peanut.

Diniconazole concentration		Leaf				Stem				Root				Nodule rating[d]	
		Area[c]		Dry wt		Height		Dry wt		Area		Dry wt.			
ES[a]	ER	R[b]	S	R	S	R	S	R	S	R	S	R	S	R	S
ppb		cm^{-2}		g		cm		g		cm^{-2}		g		g	
0	0	231		0.90		13		0.39		232		0.49		7	
0.2	1	220	210	0.91	0.90	11	11	0.36	0.37	253	221	0.47	0.48	8	8
2	10	210	193	0.91	0.83	7	9	0.28	0.26	220	218	0.52	0.47	6	6
20	100	163	196	0.89	0.82	4	9	0.22	0.28	247	196	0.50	0.46	2	7
200	1000	73	141	0.52	0.58	2	5	0.11	0.19	62	161	0.43	0.35	0	5
	LSD (0.05)	59	34	0.25	0.15	2	3	0.09	0.06	37	48	NS	0.12	1	2

[a] The ES isomer is considered to be the most active PGR isomer of the two isomers.
[b] R = diniconazole applied in the Hoagland's nutrient solution, and S = diniconazole sprayed on the shoot twice daily.
[c] All areas, weights, and numbers are on a per plant basis.
[d] Nodules were rated on a 10 = excellent nodulation to 0 = no nodules scale.

Table 2. The effect of diniconazole and daminozide on the germination of seeds coming from treated plants.

	1984				1985					
	Germination 150 DAH[c]						100 DAH			150 DAH
	Rate[a]				Rate					
	ES	ER	8 DAP[b]	12 DAP	ES	ER	0[d]	+ GA	+ C = C	0
Seed source	g ai ha^{-1}		%		g ai ha^{-1}		%			
Control	0	0	74	90	0	0	73	80	90	86
Diniconazole	90	420	72	92	80	520	71	75	92	88
Diniconazole	115	540	72	90	100	670	71	76	88	94
Diniconazole	180	840	62	89	150	970	73	74	90	92
Daminozide	1435		41	80	1435		53	61	89	90
	LSD (0.05)		11	9			11	14	NS	NS

[a] Rate given is the total ai applied during the season.
[b] Days after planting (DAP).
[c] Days after harvest of the crop (length of seed storage DAH). Germination percentages represent the combined data from Tifton and Plains seed sources. 1984 germination percentages are shown at both 8 and 12 DAP, and 1985 germinations at 12 DAP only.
[d] In 1985, seeds were untreated (0), treated with 1 mM GA mixture, or treated with ethylene gas.

plete block design containing 10 treatments (5 foliar and 5 root), 3 replications and 10 plants per replication–treatment combination, was used in this experiment. Each replication–treatment combination (experimental unit) was placed in a single 10-l aerated container filled with one-half-strength N-free Hoagland's solution, inoculated with 1 g of a multiple-strain *Bradyrhizobium* peanut inoculant (Nitragin Company, Milwaukee, WI). The containers were covered with a 2.5-cm-thick styrofoam board containing 10 predrilled holes. One pregerminated seed was placed through each hole. Foliar treatments consisted of 0, 0.2, 2, 20, and 200 ppb of diniconazole (without adjuvant) misted to cover all foliage completely (~1 ml plant^{-1}) twice daily at 9:00 and 16:00 hours for the entire experimental period. Diniconazole was added to Hoagland's solution to provide root treatments of 0, 0.2, 2, 20, and 200 ppb ES isomer in solution. All solutions (nutrients and PGR) were changed weekly. Temperatures were maintained at 25°C/19°C for the 14-h/10-h day/night periods, respectively.

Treatments were harvested 28 days after planting (DAP). Leaf and root areas were measured using a Li-Cor model LI-3000 leaf-area meter. Root measurements were multipled by 3.14 to better reflect root surface area. Anatomical differences in leaves were determined on the center third of mature terminal leaflets that were collected from each experimental unit and preserved in a formalin:70% ethanol:acidic acid (5:9:5) mixture. Leaf pieces were dehydrated in a graded ethanol/tertiary butanol series, infiltrated first with paraffin oil and then with melted paraplast. Mesophyll thickness measurements were made 0.5 cm from the midrib.

Table 3. The effect of application frequency on the effectiveness of diniconazole and daminozide in controlling plant growth, soil-borne diseases, and promoting peanut yield (1986).

Treatment	Formulation	Application interval and no.		Total ES	Plant heights Tifton	Plant heights Plains	Internode no. main stem^{-1}		Yield		White mold		*Rhizoctonia* limb rot	Two-spotted spider mite
		Days	No.	g ai ha^{-1}	120 DAP	133 DAP	Tifton	Plains	Tifton	Plains	Tifton	Plains		
					cm				kg ha^{-1}		hits 100 m^{-1}			
Control				0	53	41	24	20	3467	5694	64[c]	28[c]	2.4[d]	0.6[e]
Diniconazole	Granular	7	12[a]	168[b]	39	—	—	—	3953	—	22	—	1.8	1.8
Diniconazole	Granular	14	6	168	41	26	20	18	4446	5353	31	2	2.0	1.0
Diniconazole	Granular	21	4	168	40	—	—	—	4407	—	6	—	1.8	1.0
Diniconazole	Granular	28	3	168	41	23	24	18	4349	5378	19	2	1.8	2.0
Diniconazole	WP + oil[f]	7	12	168	50	—	—	—	4537	—	17	—	1.3	5.5
Diniconazole	WP + oil	14	6	168	53	36	22	20	4218	6051	19	2	1.0	5.8
Diniconazole	WP + oil	21	4	168	50	—	—	—	4328	—	23	—	1.0	4.5
Diniconazole	WP + oil	28	3	168	46	32	24	20	4600	5658	12	3	1.3	2.5
Diniconazole	WP + WK	14	6	168	50	32	23	20	4167	5997	14	0	1.0	4.5
Diniconazole	WP alone	14	6	168	49	30	22	20	4734	5679	17	2	1.0	5.0
Daminozide	WP	42	2	957	47	36	22	20	3814	5492	75	9	2.5	0.5
Daminozide	WP	—	1	957	53	40	24	20	3885	4904	67	39	2.8	0.3
Daminozide	WP	42	2	1435	42	38	23	20	4205	5231	62	34	2.3	0.3
			LSD (0.05)		9	7	3	NS	990	634	16	10	1.4	2.1

[a] Applications of granular formulations were started 16 DAP and WP at 30 DAP. Frequency is followed by the total number of applications. Each application was the same amount within a treatment.

[b] 828 g ai ha^{-1} of ER isomer was applied with the 168 g ai ha^{-1} of the ES isomer. Fungicidal activity mainly comes from the ER isomer.

[c] Each hit is a portion of the row 0.3 m or less that has been infected by *Sclerotium rolfsii*. If a row had an area of 0.6 m of continuous infection, that area would be counted as 2 hits. Ratings were made just after digging.

[d] *Rhizoctonia* ratings were made only at the Tifton location on a 1 = light, 2 = medium, and 3 = heavy damage to limbs (immediately after inverting) scale.

[e] Two-spotted mite infestations were observed and visually rated only at the Tifton location on a 0 = none to 8 = severe scale (1 day prior to inverting).

[f] Crop oil concentrate used was Crop Surf (Universal Cooperatives, Minneapolis, MN); Surfactant WK (Dupont).

Field Studies

Experiments were conducted in 1984, 1985, and 1986 at the University of Georgia's research stations near Plains [Greenville sandy clay loam (clayey, kaolinitic, thermic Rhodic Paleudult), OM < 1%, pH 6.2] and Tifton [Tifton loam sand (fine-loamy, siliceous, thermic Plinthic Paleudults), OM < 1%, pH 6.2], Georgia, USA. Treatments were arranged in a randomized complete block design replicated four (1986) or six (1984 and 1985) times. Plot size for each replicated treatment was 1.8 × 12.2 m (Tifton) or 1.6 × 12.2 m (Plains). All field trials were planted between May 1 and May 10. Two row plots were sprayed using a 6-nozzle (D2-13) shielded boom sprayer calibrated to deliver 234 l ha^{-1}.

All plots except the 1985 Tifton test were irrigated to maintain a soil moisture content at or above −50 kPa (15-cm depth) soil water pressure. Cultural practices were consistent with Georgia Cooperative Extension Service recommendations (Womack et al. 1981).

Plant heights (10 plants $replication^{-1}$) were measured as distance from the soil surface to the terminal bud on the main stem. Main stem internode number and length were determined on 10 plants $replication^{-1}$. Harvest date, leaf area index (LAI), and dry weight of fruit and shoot parts were determined on selected treatments by processing a subsample (41 × 91 cm) of each experimental unit taken 7–12 days prior to inverting. Optimum harvest date was determined using the Hull-Scrape method (Williams and Drexler 1981). After the plots were inverted and windrowed, numbers of disease loci caused by *Sclerotium rolfsii* were enumerated for each plot using the method of Rodriguez-Kabana et al. (1975). *Rhizoctonia* and two-spotted spider mite (*Tetranychus urticae*) visual ratings were made as described in Table 3.

From each end, 1 m of plot was trimmed 1 day prior to inverting. Hand-threshed peanut subsamples were taken from each plot for grade and germination determinations 3 days after inverting. Grade was determined, but will not be presented since no differences due to treatment were noted.

Specific materials and methods related to particular field studies follow.

Initial rate study. Twenty-five DAP diniconazole treatments of 0, 20, 40, 80, and 160 g ES isomer ha^{-1} (+1% v/v Dupont WK surfactant) were applied to Florunner peanut using the previously described plot sprayer. Plant height and width measurements (12 per replication) were taken 0, 14, 21, and 28 days after treatment.

Fungicide application schedule study. This test differed from other studies in that irrigation was excluded and diniconazole treatments were not oversprayed with chlorothalonil (Bravo 500) to control leafspot. Control plots were sprayed with chlorothalonil (1240 g ha^{-1} $spray^{-1}$) on the same schedule as diniconazole-treated plots (10-day interval beginning 40 DAP). Nine applications of 21.4 g ES + 140 g ER ha^{-1} were made prior to harvest. Growth analysis samples were taken 93 DAP after receiving 107 g ES ha^{-1} from 5 sprays.

Seed germination. Diniconazole treatments in 1984 (Table 2) were made in 3 equal split applications at 30, 40 and 78 DAP. Daminozide was applied at 30 DAP (957 g ha^{-1}) and 78 DAP (478 g ha^{-1}). Seeds from treated plants were

collected at harvest and stored at 22°C for 150 days before conducting germination studies.

Diniconazole treatments in 1985 were applied in 4 split applications at 49, 57, 85, and 100 DAP (Plains) or 40, 46, 72, and 105 DAP (Tifton). Daminozide applications were made at 49 and 85 DAP (Plains) or 40 and 72 DAP (Tifton). Seeds from treated plants were collected at harvest and stored at 22°C for 100 or 150 days before germination. Additional treatments of soaking in 1 mM gibberellic acid (GA) mixture (ProGibb, Abbot Labs, Chicago, IL) for 12 h prior to planting or treating with ethylene gas for 5 days at 8 μMl^{-1} (Ketring and Morgan 1972) were applied to 1985 seeds at 100 and 150 days after harvest (DAH). All germination studies were conducted in the greenhouse in flats (1 m $\times$ 60 cm, 10 cm deep) filled with a 1:1:1 mixture of peat:perlite:vermiculite. Temperatures were maintained at 25°C/19°C for the 14-h/10-h day/night periods, respectively. From each of 4 replications, 200 seeds were shelled, sized to fall through a 1.3-cm screen and ride a 1.1-cm screen, and treated with a fungicide (Botec) immediately before planting into flats. Germination was defined as emergence of the first true leaf. Percent germination was determined at 8 and 12 DAP in 1984 and at 12 DAP in 1985.

Application interval and method study. Chemicals and application dates and rates used in this 1986 experiment are listed in Table 3. Preliminary field research in 1985 indicated a 2-week greater lag time with granular diniconazole than with wettable powder (WP) formulations. For this reason, the first applications of the 1986 granular treatments were made at 14 DAP and first WP treatments at 30 DAP.

Data from all experiments were analyzed as randomized complete block designs using the PROC GLM procedure of SAS (1982). LSD values were calculated when the F test indicated significant differences among the treatment means. All tests were conducted at the $p = 0.05$ level unless otherwise stated.

Results

Greenhouse Study

Both foliar and root-absorbed diniconazole decreased leaf, stem, and root growth at the 200 ppb (ES isomer) solution concentration (Table 1). As compared with the control, diniconazole at 200 ppb decreased plant height by 85 and 62%, and stem dry weight by 72 and 51%, leaf area $plant^{-1}$ by 68 and 39%, leaf dry weight plant by 42 and 36%, root area $plant^{-1}$ by 73 and 31%, and root dry weight $plant^{-1}$ by 22 and 29%, for root- and foliar-applied material, respectively.

Root-applied diniconazole (200 ppb) increased specific leaf (mg cm^{-2} surface area) and specific root weights by 81 and 229%, respectively, when compared to the control. Leaf mesophyll cross sections measured 92 and 121 μm for control and 200-ppb (nutrient solution) treatments, respectively (Fig. 2). Observations made on the same cross sections using polarized light indicated an increase in starch accumulation of mesophyll-layer chloroplasts at the 200-ppb diniconazole concentration.

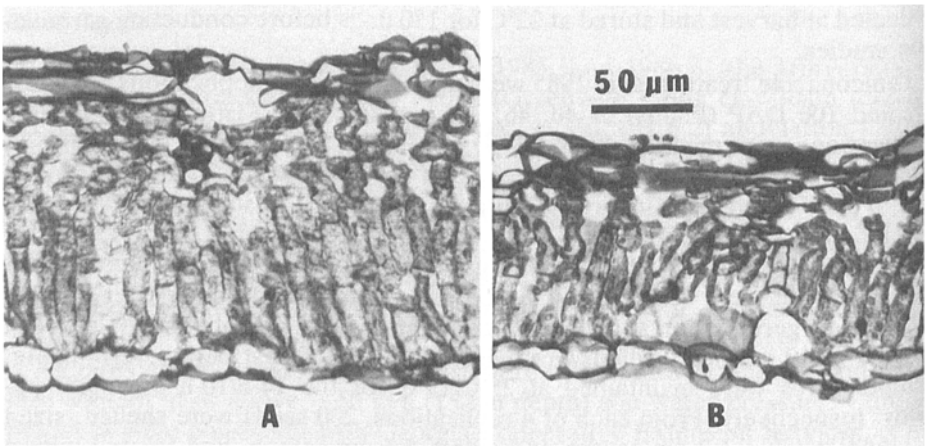

Fig. 2. Cross sections of mature terminal leaflets taken from the center third of the leaf, 0.5 cm from the midrib: (A) 200 ppb diniconazole applied to roots in nutrient solution, and (B) control.

Field Experiments

Initial rate study. This study was conducted to identify the amount of diniconazole needed for 50% reduction in both main stem and lateral stem growth rate for 28 days after treatment. Main stem growth rates during the period 0–28 days after treatment were 0.43, 0.39, 0.18, 0.11, and 0.07 cm day^{-1} for 0, 20, 40, 80, and 160 g ai ha^{-1} treatments, respectively. Lateral stem growth rates during this same period were 1.79, 1.79, 1.54., 1.18, and 0.79 cm day^{-1} for 0, 20, 40, 80, and 160 g ha^{-1} treatments, respectively. Calculations based on linear regression determined that 36 g ha^{-1} and 137 g ha^{-1} were needed to obtain 50% growth-rate reductions of main and lateral stems, respectively, during the period of 25–53 DAP.

Fungicide application schedule study. As compared to control plants, diniconazole (193 g ai ha^{-1}) reduced main stem height by 33%, LAI by 16%, and total vegetative dry weight by 19%, but had no effect on average leaf size. Yield was significantly increased from 3020 to 3730 kg ha^{-1} with diniconazole treatment. The yield increase is thought to be due to a significant reduction in white mold (*Sclerotium rolfsii*) infestation, which was controlled by the 1260 g ha^{-1} ER isomer applied along with the ES isomer. Significant decreases in both main stem and cotyledonary lateral stem internode lengths due to diniconazole treatment are shown in Fig. 3.

Seed germination. Germination studies conducted 150 DAH on seed collected from Plains and Tifton 1984 test plots revealed both the 180 g ai ha^{-1} diniconazole treatment and the 1435 g ai ha^{-1} daminozide treatment had significantly lower germination percentages 8 DAP when compared to the control (Table 2); 12 DAP only the daminozide treatment had a significantly lower germination percentage than the control.

Only the daminozide treatment significantly reduced germination (100 DAH) in 1985 seed source studies (Table 2). Ethylene significantly improved germination percentages in all treatments 100 DAH; 1 mM GA had no effect. Increased seed storage time (150 DAH) also significantly improved germination per-

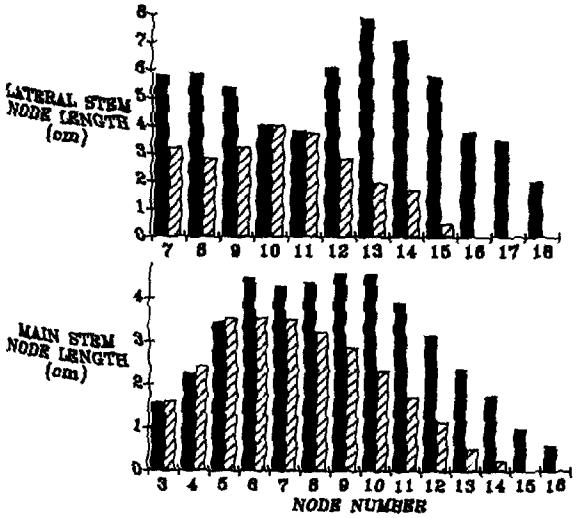

Fig. 3. Main and cotyledonary lateral stem internode lengths at 94 DAP. Solid bars represent control plants. Striped bars represent diniconazole-treated (107 g ES ha^{-1}) plants. Main stem internode length at node 3 represents the distance between node 3 and node 4. Node 0 for the main stem was at the cotyledonary lateral branch attachment point. Node 0 for the cotyledonary lateral branch was at the main stem attachment point. Cotyledonary lateral internode lengths at nodes 7, 8, and 12–18 and main stem internode lengths at nodes 9–16 were significantly ($p = 0.05$) affected by treatment.

centages. Neither ethylene, 1 mM GA, nor previous PGR treatment, had any effect on germination percentages at 150 DAH.

Application interval and method. Location had the greatest effect on plant height. Control plants in Tifton averaged 53 cm compared to 41 cm at Plains (Table 3). Similar WP and granular (G) diniconazole treatments reduced plant height more at Plains than at Tifton, when compared to the control. Most of the plant height reduction was due to reductions in internode length rather than in node number. Granular treatments were made 14 days earlier than like WP treatments, therefore direct comparisons between the two must be made with caution.

Adjuvants had no significant effect on PGR activity of diniconazole at either location (the no adjuvant treatment was significantly different than the crop oil treatment at Plains when $p = 0.1$). Application interval also had no significant effect on PGR activity at either location.

Daminozide gave rapid intitial vine control, acting faster than all diniconazole treatments. Plant height was signficantly reduced at Tifton (58 DAP) by an average of 34, 16, and 10% for all daminozide, G diniconazole and WP diniconazole treatments, respectively. No significant reductions were measured at Plains 65 DAP. The single application of 957 g ha^{-1} daminozide did not differ from the control in harvest plant height at either location. The 1435 g ha^{-1} split-application daminozide treatment significantly reduced harvest plant height at Tifton only (Table 3).

Three diniconazole treatments (7-day interval + oil, 28-day interval + oil, and 14-day interval alone) significantly increased pod yield (when compared to the control; Table 3) at Tifton. When compared to the Plains control, only the single 957 g ha^{-1} daminozide treatment significantly influenced (decreased) yield (Table 3).

Complicating our interpretations of diniconazole PGR effects was the presence of the ER (fungicide) isomer in the test material. Diniconazole reduced *S.*

rolfsii damage by 72 and 93% at Tifton and Plains, respectively (average over all treatments compared to the control; Table 3). *Rhizoctonia solani* damage at Tifton was also reduced 23 and 54% by the G and WP formulations, respectively (no *R. solani* ratings were made at Plains). Daminozide had no effect on severity of either diease (Table 3).

Further complicating interpretations was diniconazole's effect on two-spotted mite populations. A late-season drought combined with diniconazole resulted in treatment-specific "blooms" of the mite. The severity of the "bloom" was positively correlated with the last application of diniconazole (Table 3).

Discussion

Growth and development responses of peanut to diniconazole were similar to responses of a variety of plants to paclobutrazol (Steffens et al. 1983, Bausher and Yelenosky 1987). Rates as low as 2 ppb in the greenhouse or 40 g ha^{-1} in the field significantly reduced main stem heights by decreasing both internode numbers and internode lengths. Greenhouse and field data both indicate that PGR activity of diniconazole is greater when root absorbed than when shoot absorbed.

Numerous researchers have reported soil applications of paclobutrazol to be more effective in controlling stem growth than foliar applications (Wilfret 1981, Barret and Bartuska 1982, Wieland and Wample 1984). Williams et al. (1984) reported that narrow-band soil injections of paclobutrazol provided effective control of shoot growth of deciduous fruit trees with minimum amounts of chemical. Our 1986 results showed that surface application of granules reduced peanut main stem heights by 23 and 40% at Tifton and Plains, respectively. Since the soil surface of these plots (especially the sandier Tifton soil) frequently was dry, soil injections of diniconazole may improve its performance as a PGR and will be a subject of further experimentation.

Like paclobutrazol (Barrett and Bartuska 1982), diniconazole appears to be translocated in the xylem, but not in the phloem. In greenhouse studies, tap root lengths were signficantly reduced by root applications of diniconazole, but not by foliar aplications, and both specific root and specific leaf weights were increased by root, but not by shoot, applications. Daminozide PGR activity, however, depends on foliar absorption (soil-applied daminozide is rapidly bound to the soil and degraded), and translocation takes place in both the xylem and phloem (Moore 1968, Rothenberger 1964).

Greenhouse and field studies both indicated that the degree of PGR activity of diniconazole is dependent on the plant part. Stem growth was reduced more than leaf growth, and root growth (only measured in the greenhouse experiment) was least affected. These data are consistent with paclobutrazol studies conducted on apple by Steffens et al. (1983). Along with an incremental reduction in internode lengths and leaf expansion, Steffens et al. also noted an increase in specific leaf weight and carbohydrate levels which they speculated may be due to reductions in activity of invertase and amylase. Cross sections of greenhouse-grown, diniconazole-treated leaves (200 ppb in solution) in our

studies revealed significant increases (when compared to the control) in starch content of treated leaves along with increases in leaf thickness of ~1 mesophyll cell layer.

Bausher and Yelenosky (1987) described significant changes in the morphology, growth, and development of roots of Valencia sweet orange [*Citrus sinensis* (L.) Osbeck] seedlings when concentrations of 10^3–10^5 ppm of paclobutrazol were applied to 1-week-old seedlings. Diniconazole applied in much lower concentrations (200 ppb in nutrient solution) also decreased root elongation, decreased secondary root formation, and increased root thickness in our peanut studies.

Studies by Bausher and Yelenosky (1987) determined that germination of Valencia sweet orange [*Citrus sinensis* (L.) Osbeck] and rough lemon (*C. limon*) can be inhibited by soaking the seeds in solutions of paclobutrazol (10^3–10^5 ppm) for 30 min. Sponsel (1986) discovered that pea (*Pisum sativum*) germination will proceed in the presence of paclobutrazol, but epicotyl elongation and the maintenance of seedling growth are retarded by GA biosynthesis inhibitors. For this reason, we chose to conduct our germination studies in greenhouse flats and considered a seed to be germinated only when the first true leaves emerged from the cotyledons.

Our 1984 and 1985 data indicate to us that 1400 g ai ha^{-1} daminozide increased peanut seed dormancy. This increase in dormancy was counteracted by either ethylene or increased storage time. Time-course decreases in dormancy also are thought to be due to internal production of ethylene (Ketring and Morgan 1972).

One nontarget effect of diniconazole was observed late in the 1986 season during a very dry period. Populations of the two-spotted spider mite drastically increased in plots treated with diniconazole. Severity of the mite "bloom" was positively correlated with the last application of diniconazole. Similar outbreaks of mites in peanut have been associated with fentin hydroxide and ammoniacal copper (Campbell 1978). Presumably, diniconazole's broad-spectrum fungicidal activity decreased populations of an entomophagous fungus that parasitizes the mite and helps keep mite populations in check. Another possibility is that diniconazole directly or indirectly affects mite reproduction. This observation appears to be in conflict with the report by Raese and Burts (1983) of paclobutrazol treatments decreasing two-spotted spider mite populations. However, paclobutrazol is formulated primarily as a PGR with little fungicide isomer present. Diniconazole is formulated primarily as a fungicide (84% ER) with only 16% of the ai being the ES PGR isomer. In addition, the study by Raese and Burts was conducted in the state of Washington using pear (*Pyrus communis* L.) trees, and our study was conducted in Georgia using peanut.

Diniconazole (168 g ES ha^{-1}) provided vine control equal to that of daminozide (1435 g ai ha^{-1}). The control of soil-borne pathogens by the ER isomer was an additional benefit and the major reason for increased yields with diniconazole.

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