Response of Eight Peanut (*Arachis hypogaea* L.) Cultivars to the Herbicide AC 263,222

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ABSTRACT

Field experiments conducted in 1992 and 1993 in Georgia evaluated the response of the peanut cultivars Florunner, Georgia Runner, Goldkist GK 7, NC 7, NC-V11, Southern Runner, Sunrunner, and AgraTech VC-1 to AC 263,222 applied early-postemergence (EPOST) at 71 g ha^{-1}. Visual injury, which was less than 13%, was independent of cultivar, and injury was not evident on any cultivar midseason. AC 263,222 slightly reduced canopy width consistently on all cultivars. The only significant effect on percentage fancy pods, medium, No. 1, sound splits, damaged, and other kernels was the main effect of cultivar. There was a significant cultivar, AC 263,222, and cultivar-by-AC 263,222 effect on extra large kernels (ELK) and jumbo kernel percentages. Southern Runner and NC-V11 had significantly lower percentage jumbo and ELK, respectively when treated with AC 263,222. In addition, Florunner and Sunrunner also had numerically less percentage jumbo kernels. Reductions in percentages of ELK and jumbo were probably the result of AC 263,222-induced maturity delays. However, these reductions were not reflected in peanut yields. The occurence of late and early leaf spot, tomato spotted wilt virus (TSWV), and southern stem rot was independent of both cultivar and AC 263,222.

Key Words: Peanut, *Arachis hypogaea*, canopy width, cultivar, grade analysis, regression, yield, Florunner, Georgia Runner, Goldkist GK 7, Southern Runner, Sunrunner, NC 7, NC-V11, AgraTech VC-1, disease interaction, early leaf spot, *Cercospora arachidicola*, late leaf spot, *Cercosporidium personatum*, tomato spotted wilt virus, southern stem rot, *Sclerotium rolfsii*.

Crop cultivars may exhibit a differential response to herbicides (2, 4, 6, 9, 10, 12, 14). Soybean [*Glycine max* (L.) Merr.] cultivars have shown a differential response to the herbicide metribuzin [4-amino-6(1,1-

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dimethylethyl)-3-(methylthio)-1,2,4-triazin-5(4*H*)-one] (4, 14). Sweet corn, *Zea mays* L., cultivars have exhibited differential response to chloroacetamide and thiocarbamate herbicides (1).

Hauser *et al.* (5) reported that peanut cultivar Goldkist GK-3 was sensitive to multiple applications of dinoseb [2-(1-methylpropyl)-4,6-dinitrophenol] in two of eight trials. However, in later research with six peanut cultivars, no negative effects were observed, and the previously observed sensitivity of Goldkist GK-3 was attributed to weed competition (6). Recent studies have evaluated response of peanut cultivars to herbicides (2, 9, 10, 15). Brecke reported greater sensitivity of Early Bunch and Southern Runner to paraquat (1,1'-dimethyl-4,4'-bipyridinium ion) compared to Florunner (2). However, research by Wehtje *et al.* (16) reported that cultivars Florunner, NC 7, Southern Runner, and Sunrunner did not exhibit differential sensitivity to a single paraquat application at 0.14 kg ai ha^{-1}. Later research by Knauft *et al.* (12) reported that two paraquat applications at 0.14 kg ha^{-1} reduced yields of Florunner, Southern Runner, and Sunrunner. Differential response of peanut cultivars also has been reported with chlorimuron [2-[[[[(4-chloro-6-methoxy-2-pyrimidinyl)amino]carbonyl]-amino]sulfonyl]benzoic acid] as well (2). Johnson *et al.* (10) reported no differential yield responses of Florunner, NC 7, or Southern Runner to multiple herbicide applications, but canopy widths were affected.

AC 263,222, (±)-2[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-5-methyl-3-pyridinecarboxylic acid, is an experimental herbicide currently under development for use in peanut as an early-postemergence (EPOST) treatment. AC 263,222 provides soil residual control of numerous broadleaf and grass weeds and perennial sedges (18). Development of new peanut herbicides necessitates the need to determine if differential tolerance among peanut cultivars exists. Since the 1970s, Florunner has been the predominant cultivar. However, recent hectarage increases in other runner cultivars, and production of virginia-type cultivars in regions previously dominated by runners has occurred (7, 12). Therefore, the objective of this research was to evaluate the response of five runner and three virginia peanut cultivars to AC 263,222.

Materials and Methods

Experiments were conducted in 1992 and 1993 at the Coastal Plain Experiment Station near Tifton, GA. The soil type was a Tifton loamy sand (fine-loamy, siliceous, thermic Kandiudults) with 0.5% organic matter and pH of 6.2. Pendimethalin [*N*-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine] was applied at 1.1 kg ai ha^{-1} preplant incorporated (PPI) for annual grass control. The experimental area was maintained weed-free by hand on a weekly basis.

Peanut were planted 5 cm deep and were spaced 5 and 8 cm apart for runner and virginia cultivars, respectively. Planting dates were 11 May 1992 and 19 April 1993. The experimental design was a randomized complete block with a two by eight factorial arrangement of treatments with four replications in 1992 and three replications in 1993. Individual plots consisted of two 90-cm rows and were 6.1 m in length. The eight peanut cultivars consisted of five runner and three virginia types. The runner types were Florunner, Georgia Runner, Goldkist GK 7, Southern Runner, and Sunrunner and the virginia types were NC 7, NC-V11, and AgraTech VC 1.

The two herbicide treatments were either none or AC 263,222 applied EPOST at 71 g ha^{-1}. AC 263,222 was applied at 187 L ha^{-1} with a CO_2 backpack sprayer and X-77 [a nonionic surfactant containing alkylarylpolyoxyethylene glycols, free fatty acids, and isopropanol (Valent U.S.A. Corp., P.O. Box 8025, Walnut Creek, CA 94596-8025)] was included at 0.25% v/v of spray volume. Chlorothalonil (tetrachloroisophthalonitrile) was applied every 10 to 14 d at 1.25 kg ai ha^{-1} for leaf spot control beginning 30 d after planting (DAP) until harvest.

Nontreated peanut of each cultivar were used for maturity assessment using the Hull Scrape method (8). These peanut were used from an extra replication. All cultivars were dug approximately 140 DAP, except Southern Runner which was dug approximately 150 DAP. Southern Runner cultivar requires approximately 10 to 20 additional days to mature compared to most other runner cultivars evaluated (J. Baldwin, Univ. of Georgia, pers. commun., 1992).

Canopy width measurements were taken in 1992 at 4 and 6 wk after treatment (WAT) and 2, 4, 6, 8, and 10 WAT in 1993. Peanut yield and grade analysis were taken for all cultivars evaluated. A random 500-g sample, free of foreign matter and splits due to harvesting, was taken for grade analysis. Grade analysis included percentage total sound mature kernels (TSMK) (sound mature kernels plus sound splits), extra large kernels (ELK) for virginia peanut or jumbo for runner peanut (seed that rode a 8.33- by 25.40-mm slotted screen), medium kernels (seed that rode a 7.14-by 25.40-mm slotted screen for virginia types and 7.14- by 19.05-mm for runner types), and number 1 (No. 1) kernels (seed that rode a 5.95- by 25.40-mm for virginia types and 6.35- by 19.05-mm for runner types), other kernels (seed that passed through screens that retained No. 1 seed), and damaged kernels (visually damaged seed that passed through screens that retained No. 1 seed). Percentage fancy pods (unshelled peanut that rode a 13.5-mm roller spacing on the presizer) for virginia types also was taken.

Evaluations for possible disease interactions with AC 263,222 were also taken prior to harvest. Diseases intensity of early leaf spot (*Cercospora arachidicola* Hori) and late leaf spot [*Cercosporidium personatum* (Berk. & Curt. Deighton] were rated immediately prior to harvest. The Florida 1-10 rating scale was used where 1 = no spots and 10 = complete defoliation by leaf spot, resulting in death (3). A visual estimate of plants with symptoms of tomato spotted wilt virus (TSWV) also was taken at this time. Number of southern stem rot (*Sclerotium rolfsii* Sacc.) loci was determined for each plot immediately after inversion, where a locus represented 31 cm or less of linear row with one or more plants diseased (13). These ratings were subsequently converted to a percentage of 31-cm sections of linear row with at least one diseased plant.

All data were subjected to analysis of variance. No significant treatment-by-year interactions were detected. Consequently, data were pooled across years. Canopy width measurements in 1993 were subjected to regression analysis. In addition, analysis of variance was performed on regression coefficients of each regression equation using individual replication data. Means were separated with

appropriate Fisher's Protected Least Significant Difference (LSD) Test at the 5% level of probability.

Results and Discussion

Disease Interactions. The occurrence of early and late leaf spot, TSWV, and southern stem rot was independent of cultivar, AC 263,222 and the interactions thereof (data not shown).

Peanut Injury. Early season peanut injury in the form of minor stunting and chlorosis was evident. This injury did not exceed 13% and was independent of cultivar. By midseason, visual injury was not apparent (data not shown).

Peanut Canopy Width. The main effects of cultivar and AC 263,222 on canopy width were significant in 1992 (Table 1). Canopy width differences between cultivars were expected since Florunner, Georgia Runner, Southern Runner, Goldkist GK 7, and Sunrunner have a runner growth habit, while NC 7, NC-V11, and AgraTech VC 1 have a decumbent growth habit. The main effect of AC 263,222 on canopy width in 1992 at 4 and 6 WAT also was significant. Although the interaction of cultivar by AC 263,222 was not significant, AC 263,222 tended to reduce canopy widths in all cultivars in 1992.

Reduced canopy development from herbicides has been previously reported. One paraquat application at 0.14 kg ha^{-1} reduced canopy width of Florunner, Sunrunner, Georgia Runner, and NC 7 (12). Johnson *et al.* (9) reported two applications of paraquat plus bentazon [3-(1-methylethyl)-(1*H*)-2,1,3-benzothiadiazin-4(3*H*)-one 2,2-dioxide] reduced canopy width of Florunner, Southern Runner, and NC 7. Canopy width reductions by AC 263,222 may delay canopy closure and lead to increased late season weed problems (18).

Regression analysis of canopy width measurements in 1993 revealed a linear canopy width response on all cultivars (Table 1). Analysis of regression coefficients revealed significant cultivar and AC 263,222 main effects. However, the interaction was nonsignificant. Averaged over cultivars, the main effect regression equation for AC 263,222 was $Y = 1.46 + 9.29X$ ($r^2 = 0.94$), while the reqression equation averaged over cultivars without an AC 263,222 treatment was $Y = 2.70 + 8.86X$ ($r^2 = 0.94$). For all cultivars, regression coefficients were less with AC 263,222 compared to each respective nontreated cultivar. It was evident that AC 263,222 delayed canopy closure both years. All regression equations had correlation coefficients (r^2) from 0.87 to 0.95.

Peanut Yield and Grade. Yield was influenced only by cultivar (Table 2). The main effects of cultivar on grade categories was significant (Table 2). The main effect of AC 263,222 and the interaction of cultivar and AC 263,222 were not significant. Inspection of data revealed that NC 7 had the highest fancy pod percentage followed by AgraTech VC 1 and NC-V11. In general, virginia-type peanut had smaller percentages of medium and No. 1 kernels than runner-types.

A cultivar, AC 263,222, and cultivar-by-AC 263,222 effect on percentage ELK and jumbo kernels was detected (Table 2). As expected, cultivars NC 7, NC-V11,

Table 1. Canopy width response of eight peanut cultivars to AC 263,222 applied early-postemergence in Georgia, 1992-1993.

Peanut cultivar	Early-postemergence herbicide AC 263,222 at 71 g ai ha^{-1}	Canopy width 1992 4 wk after treatment	Canopy width 1992 6 wk after treatment	Canopy width 1993 Regression equation	Canopy width 1993 Regression coefficient	r^2
		cm				
Florunner	No	37	65	Y = -1.82 + 9.72X	9.72	0.94
Florunner	Yes	30	58	Y = -0.92 + 9.46X	9.46	0.95
Georgia Runner	No	42	72	Y = 1.27 + 9.25X	9.25	0.91
Georgia Runner	Yes	35	63	Y = 4.85 + 8.62X	8.62	0.91
Goldkist GK 7	No	36	63	Y = 1.06 + 9.87X	9.87	0.93
Goldkist GK 7	Yes	28	54	Y = 0.45 + 9.72X	9.72	0.95
Southern Runner	No	38	66	Y = 4.93 + 8.94X	8.94	0.91
Southern Runner	Yes	28	56	Y = 6.84 + 8.12X	8.12	0.87
Sunrunner	No	39	65	Y = 2.22 + 9.56X	9.56	0.92
Sunrunner	Yes	29	56	Y = 3.21 + 9.21X	9.21	0.93
NC 7	No	34	62	Y = 0.03 + 8.57X	8.57	0.91
NC 7	Yes	30	58	Y = 0.29 + 8.36X	8.36	0.89
NC-V11	No	43	65	Y = 3.79 + 8.99X	8.99	0.93
NC-V11	Yes	32	56	Y = 4.67 + 8.53X	8.53	0.89
AgraTech VC 1	No	43	67	Y = 3.08 + 9.18X	9.18	0.91
AgraTech VC 1	Yes	35	61	Y = 2.73 + 8.85X	8.85	0.92
LSD (0.05):						
Cultivar [a]		15	18		.20	
AC 263,222[b]		8	9		.41	
Cultivar x AC 263,222		NS	NS		NS	

[a]LSD for comparison of cultivar means averaged over AC 263,222 treatment.

[b]LSD for comparison of AC 263,222 means averaged over cultivars.

and AgraTech VC 1 had larger percentages of ELK than jumbo for Florunner, Georgia Runner, Goldkist GK 7, Southern Runner, and Sunrunner. Southern Runner and NC-V11 had a smaller percentage of jumbo and ELK kernels, respectively, when treated with AC 263,222. Although not significant, Florunner and Sunrunner also had lower jumbo percentages when treated with AC 263,222. As stated earlier, ELK or jumbo, medium, No. 1, and sound split kernels make up TSMK, but these reductions were not evident in these other grade components (medium, No. 1, or sound splits). Previous research has shown that paraquat reduced ELK of NC 7 and Florigiant, both virginia market types (12).

TSMK was influenced only by cultivar (Table 2). Overall, TSMK values were low for these experiments due to droughty conditions during 1992 and 1993 growing seasons. In general, runner types had higher TSMK percentages than virginia-type cultivars. Higher TSMK percentages for runner type may be attributed to the greater adaptation of this type than the virginia type to the southeastern region. A nonsignificant trend for AC 263,222 to lower TSMK percentages for Florunner, Southern Runner, Sunrunner, and NC-V11 was evident. These cultivars are the same cultivars that had lower ELK or jumbo percentages. These data show that nonsignificant reductions in ELK or jumbo kernel percentages resulted in redistribution and increased percentages in several other grade components.

Reductions in percentage of either ELK or jumbos and TSMK were not reflected in yields. Grade reductions may simply reflect delayed maturity. As previously mentioned, maturity assessment and the resulting harvest date were based on nontreated peanuts. AC 263,222 may slow the maturation process, consequently smaller ELK or jumbo kernel percentages and distribution of smaller peanut into other grade components. Because herbicide-induced yield differences were not observed, given additional time for maturity, AC 263,222-treated peanut may grade similar to nontreated peanut. Knauft *et al.* (12) noted similar results from paraquat application and attributed grade differences to method of maturity sampling from nontreated border peanut. Other herbicides have been shown to effect peanut yield and pod development (11).

Previous research has shown that registration of AC 263,222 would provide growers with an effective broadleaf and perennial nutsedge herbicide (17). Based on these results, a differential peanut cultivar yield response to AC 263,222 should not be a problem. However, slower canopy width closure could result in increased late-season weed problems and/or delayed maturity may occur for Florunner, Southern Runner, Sunrunner, and NC-V11.

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Table 2. Peanut grade analysis and yield of eight peanut cultivars treated with AC 263,222 applied early-postemergence in Georgia, 1992-1993.

Peanut cultivar	Early-postemergence herbicide AC 263,222 at 71 g ai ha^{-1}	Peanut grade and yield 1992-1993 Fancy pods	ELK/ Jumbo	Medium	No. 1	Sound splits	Damage	Other	Peanut TSMK	Yield
		%								kg ha^{-1}
Florunner	No	—	11.7	37.7	10.2	7.5	.7	7.1	67.1	3830
Florunner	Yes	—	9.7	37.1	10.9	7.7	.8	8.1	65.5	4070
Georgia Runner	No	—	10.6	33.7	10.8	8.3	1.0	9.0	63.5	2940
Georgia Runner	Yes	—	10.5	32.7	11.5	8.4	1.4	8.9	63.2	3330
Goldkist GK 7	No	—	10.8	33.1	11.5	9.4	1.4	7.9	64.8	4140
Goldkist GK 7	Yes	—	10.9	33.2	11.2	11.7	.8	7.1	67.0	4400
Southern Runner	No	—	18.5	37.1	7.7	4.4	.6	5.7	67.9	3570
Southern Runner	Yes	—	13.3	38.3	9.4	4.7	.7	6.7	65.8	3460
Sunrunner	No	—	12.3	35.2	10.8	6.5	1.3	7.7	64.9	3210
Sunrunner	Yes	—	10.0	34.0	12.6	6.3	1.0	8.4	62.9	2990
NC 7	No	86.0	38.1	14.2	4.1	5.7	4.0	2.3	62.1	3770
NC 7	Yes	88.0	39.4	13.9	3.1	7.2	5.7	2.5	63.6	3690
NC-V11	No	75.2	31.7	21.0	5.6	7.2	2.2	2.8	65.5	4350
NC-V11	Yes	78.3	26.4	21.6	6.3	8.3	3.8	3.0	62.6	4260
AgraTech VC 1	No	81.3	31.0	21.9	5.3	5.4	4.3	2.4	63.6	3840
AgraTech VC 1	Yes	80.2	31.7	23.2	5.3	4.7	2.9	2.3	63.9	4150
LSD (0.05):										
Cultivar[a]		4.3	2.3	2.6	2.0	2.4	1.0	1.1	2.0	540
AC 263,222[b]		NS	1.6	NS	NS	NS	NS	NS	NS	NS
Cultivar x AC 263,222		NS	3.2	NS	NS	NS	NS	NS	NS	NS

[a]LSD for comparison of cultivar means averaged over AC 263,222 treatment.
[b]LSD for comparison of AC 263,222 means averaged over cultivars.

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Literature Cited

1. Bennett, M. A., and S. F. Gorski. 1989. Response of sweet corn (*Zea mays*) endosperm mutants to chloroacetamide and thiocarbamate herbicides. Weed Technol. 3:475-478.
2. Brecke, B. J. 1989. Response of peanut cultivars to selected herbicide treatments. Proc. South. Weed Sci. Soc. 42:28 (abstr.).
3. Chiteka, Z. A., D. W. Gorbet, F. M. Stokes, T. A. Kucharek, and D. A. Knauft. 1988. Components of resistance to late leaf spot in peanut. I. Levels of variability-implications for selection. Peanut Sci. 15:25-30.
4. Hardcastle, W. S. 1974. Differences in the tolerance of metribuzin by varieties in soybeans. Weed Res. 14:181-184.
5. Hauser, E. W., G. A. Buchanan, W. J. Ethredge, M. D. Jellum, and S. R. Ceil. 1976. Interactions among peanut cultivars, herbicide sequences, and a systemic insecticide. Peanut Sci. 3:56-62.
6. Hauser, E. W, G. A. Buchanan, J. E. Harvey, W. L. Currey, D. W. Gorbet, and N. A. Minton. 1981. Pesticide interactions with peanut cultivars. Peanut Sci. 8:142-144.
7. Holbrook, C. C., and C. K. Kvien. 1989. 1988 cultivar census. Peanut Res. 27(1):4.
8. Johnson, W. C., III. 1987. The hull scrape method to assess peanut maturity. Georgia Coop. Ext. Serv. Bull. 958.
9. Johnson, W. C., III, D. L. Colvin, and B. G. Mullinix, Jr. 1993. Comparative response of three peanut cultivars to multiple herbicide applications. Peanut Sci. 20:17-20.
10. Johnson, W. C., III, C. C. Holbrook, B. G. Mullinix, Jr., and J. Cardinia. 1992. Response of eight genetically diverse peanut genotypes to chlorimuron. Peanut Sci. 19:111-115.
11. Ketchersid, M. L., T. E. Boswell, and M. G. Merkle. 1978. Effects of 2,4-DB on yield and pod development in peanuts. Peanut Sci. 5:35-39.
12. Knauft, D. A., D. L. Colvin, and D. W. Gorbet. 1990. Effect of paraquat on yield and market grade of peanut (*Arachis hypogaea*) genotypes. Weed Technol. 4:866-870.
13. 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.
14. Smith, A. E., and R. E. Wilkinson. 1974. Differential absorption, translocation, and metabolism of metribuzin by soybean cultivars. Plant Physiol. 32:253-257.
15. Wehtje, G, J. W. Wilcut, T. V. Hicks, and J. McGuire. 1988. Relative tolerance of peanuts to alachlor and metolachlor. Peanut Sci. 15:53-56.
16. Wehtje, G., J. W. Wilcut, J. A. McGuire, and T. V. Hicks. 1991. Foliar penetration and phytotoxicity of paraquat as influenced by peanut cultivar. Peanut Sci. 18:67-71.
17. Wilcut, J. W., J. S. Richburg, III, G. Wiley, F. R. Walls, Jr., S. R. Jones, and M. J. Iverson. 1994. Imidazolinone herbicide systems for peanut (*Arachis hypogaea* L.). Peanut Sci. 21:23-28.
18. Wilcut, J. W., A. C. York, and G. R. Wehtje. 1994. The control and interaction of weeds in peanut. Rev. Weed Sci. 177-205.

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