Response of Virginia-Type Peanut to Norflurazon

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ABSTRACT

Four field experiments were conducted in North Carolina from 1994 to 1996 to determine the effect of norflurazon applied preemergence at 1.6 kg ai/ha to virginia-type peanut (*Arachis hypogaea* L.) cvs. NC 7, NC 9, NC 10C, NC-V 11, VA-C 92R, and AT VC-1. Injury 3 wk after planting was 7% or less in three experiments. Greater injury was noted on VA-C 92R relative to other cultivars in one of these experiments. Injury ranged from 25 to 41% in the fourth experiment, with greater injury noted on NC 9, NC-V 11, and VA-C 92R than on NC 7, NC 10C, or AT VC-1. Norflurazon did not affect peanut maturity, the percentage of extra large kernels, total sound mature kernels, or fancy pods. Norflurazon reduced peanut yield 6% irrespective of cultivars in two of four experiments.

Key Words: *Arachis hypogaea*, cultivar response, herbicide tolerance, yield, market quality.

Weed management programs in peanut consist of a variety of soil-applied and postemergence herbicides (Wilcut *et al.*, 1995). One weakness of herbicides currently registered for use in peanut is the relatively short residual activity on broadleaf weeds. Although AC 263,222 {(±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-5-methyl-3-pyridinecarboxylic acid} provides season-long control of weeds like Florida beggarweed [*Desmodium tortuosum* (Sw.) DC], sicklepod [*Senna obtusifolia* (L.) Irwin and Barneby], and purple nutsedge (*Cyperus rotundus* L.), it can carry over to cotton (*Gossypium hirsutum* L.) (Wilcut *et al.*, 1995; York and Wilcut, 1995; Webster *et al.*, 1997). This rotational restriction limits utility of AC 263,222 in North Carolina where cotton and peanut are commonly rotated. Imazethapyr {2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-5-ethyl-3-pyridinecarboxylic acid} provides residual weed control but can injure cotton the year following imazethapyr application to peanut (Wilcut *et al.*, 1995; York and Wilcut, 1995). A herbicide that provides residual control without risk of carryover to cotton would be advantageous.

Norflurazon [4-chloro-5-(methylamino)-2-(3-trifluoromethyl)phenyl-3-(2*H*)-pyridazinone] may be a viable alternative to currently used herbicides applied for residual broadleaf weed control in peanut (McLean *et al.*, 1995; Littlefield and Colvin, 1996). Norflurazon controls prickly sida (*Sida spinosa* L.), spurred anoda [*Anoda cristata* (L.) Schlecht.], tropic croton (*Croton glandulosus* var. *septentrionalis* Muell.-Arg.], common ragweed (*Ambrosia artemisiifolia* L.), and common lambsquarters (*Chenopodium album* L.), and it suppresses perennial nutsedges (*Cyperus* spp.) (Wilcut *et al.*, 1995). Norflurazon also controls some annual grasses (Wilcut *et al.*, 1995). AC 263,222 and imazethapyr do not control common ragweed (Wilcut *et al.*, 1995; York *et al.*, 1995; Gooden and Stabler, 1996; Richburg *et al.*, 1996). Imazethapyr does not control common lambsquarters, and control of this weed by AC 263,222 has been inconsistent (Choate *et al*, 1996; Jordan and York, 1997). Additionally, there are no concerns with norflurazon carryover to cotton. Although the manufacturer of norflurazon (Zorial Rapid 80 herbicide label, Novartis Co., Greensboro, NC) indicates that small grains and corn can be injured by residues of norflurazon applied to previous crops, cotton is the primary rotation crop following peanut in North Carolina.

Norflurazon is currently registered for preemergence applications only on the runner-type cultivar Florunner. Georgia researchers (McLean *et al.*, 1994) noted minor differences in tolerance of norflurazon among both runner- and virginia-type cultivars, but norflurazon did not adversely affect yield.

Understanding injury potential of norflurazon will be beneficial in determining the utility of norflurazon in weed management systems in virginia-type peanut production. Research was conducted to determine effects of norflurazon applied preemergence on yield and quality of six virginia-type peanut cultivars.

Materials and Methods

The experiments were conducted from 1994 through 1996 at the Peanut Belt Research Station near Lewiston, NC on a Goldsboro sandy loam (fine-loamy, silicious, thermic Aquic Paleudults) with 3.0% organic matter and pH 6.0 in 1994, and a Norfolk loamy sand (fine-loamy, silicious, thermic Typic Paleudults) with 1.5% organic matter and pH

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5.8 in 1995 and 1996. Separate fields were used in 1995 and 1996. The experiment also was conducted at the Upper Coastal Plain Research Station near Rocky Mount, NC in 1995 on a Norfolk loamy sand with 2.1% organic matter and pH 5.1. Plot size was four 91-cm rows by 15 m. Peanut was planted at 110 kg/ha in conventionally prepared seedbeds on 10 May 1994, 5 May 1995, and 14 May 1996 at Lewiston and 9 May 1995 at Rocky Mount. Fertilization and insect and disease management practices were standard for peanut production in North Carolina.

The experimental design was a split block with treatments replicated four times at Lewiston and three times at Rocky Mount. Whole plots were norflurazon applied preemergence at 0 and 1.6 kg ai/ha. Subplots were the cultivars NC 7, NC 9, NC 10C, NC-V 11, VA-C 92R, and AT VC-1. These cultivars represent 99% of the peanut produced in North Carolina (Jordan and Spears, 1997). Plots were maintained weed-free throughout the season with pendimethalin [*N*-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine] (0.84 kg ai/ha) applied preplant incorporated, paraquat (0.14 kg ai/ha) applied at emergence, and the sodium salt of acifluorfen {5-[2-chloro-4-(trifluoromethyl)phenoxy]2-nitrobenzoic acid} (0.28 kg ae/ha) plus the sodium salt of bentazon (0.56 kg ae/ha) plus the dimethylamine salt of 2,4-DB [(2,4-dichlorophenoxy) butanoic acid] (0.28 kg ae/ha) applied postemergence. Herbicides were applied with a CO_2-pressurized backpack sprayer calibrated to deliver 180 L/ha.

Visual estimates of percent injury were recorded 3 and 4 wk after planting (WAP) and biweekly thereafter using a scale of 0 to 100 where 0 = no injury and 100 = plant death. Norflurazon-treated peanut was compared to the same cultivar not treated with norflurazon. Peanut was harvested and dried to 7% moisture. A subsample of pods from each plot in 1994 and 1996 was shelled and graded according to industry standards to determine the percentage of extra large kernels (ELK), total sound mature kernels (TSMK), and fancy pods (FP) (Davidson *et al*., 1982). Peanut value/kg was calculated based upon the USDA Farm Services Administration (formerly Agricultural Stabilization and Conservation Service) loan schedule for the respective crop year.

At Lewiston in 1995 and 1996, pods from six randomly selected plants per plot were removed by hand within 2 hr after digging. Samples were then composited across replications. The exocarp of the pods was removed to reveal the color of the mesocarp which is an indication of peanut maturity (Sanders, 1995). Exocarp removal was accomplished as described previously (Mitchem *et al*., 1996).

Data were subjected to analysis of variance with partitioning appropriate for the split block design. Peanuts treated with norflurazon were compared to a nontreated control for each cultivar. Data were pooled over experiments when appropriate. Means of significant main effects and interactions were separated using Fisher's Protected LSD Test at P = 0.05.

Results and Discussion

Injury from norflurazon appeared as foliar chlorosis and bleaching. The cultivar VA-C 92R was injured 7% by norflurazon 3 WAP at Lewiston in 1994 (Table 1). Injury to other cultivars was less, and ranged from 2 to 4%. Injury was 3% or less at Rocky Mount and Lewiston in 1995, and no differences were noted among cultivars (data not shown). No injury was observed 4 WAP or later at Lewiston in 1994 or in either experiment in 1995. In other research (McLean *et al*., 1994), the cultivar AT VC-1 was injured less than cultivars NC 7 and NC-V 11. However, injury did not exceed 9% at 33 d after planting.

Table 1. Peanut injury 3 wk after preemergence application of norflurazon (Lewiston, 1994 and 1996).

Cultivar	1994	1996
	%	%
NC 7	4	28
NC 9	3	37
NC 10C	2	23
NC-V 11	3	41
VA-C 92R	7	39
AT VC-1	3	25
LSD (0.05)	3	8

Greater injury was observed with all cultivars at Lewiston in 1996 (Table 1). The cultivars NC 9, NC-V11, and VA-C 92R were injured 37 to 41% while injury to NC 7, NC 10C, and AT VC-1 was less, and ranged from 23 to 28%. The crop quickly recovered, and injury was 5% or less 4 WAP (data not shown). No injury was observed 6 WAP or later.

The greater injury at Lewiston in 1996 relative to other experiments did not appear to be related to climatic or edaphic conditions. One might expect a greater potential for injury under conditions of high rainfall, which would leach more of the herbicide into the crop's root zone, and at low temperatures, which would slow metabolism of the herbicide by the crop. The first 2 WAP at Lewiston in 1996 were generally drier and warmer than in the other experiments. Rainfall during the first 2 WAP totalled 3.8, 10.7, 2.6, and 2.8 cm at Lewiston in 1994, Lewiston in 1995, Rocky Mount, and Lewiston in 1996, respectively (data not shown). Maximum air temperatures during the same period averaged 25, 26, 28, and 27 C at Lewiston in 1994, Lewiston in 1995, Rocky Mount, and Lewiston in 1996, respectively. Minimum air temperatures averaged 11, 12, 14, and 16 C, respectively.

The soil at Lewiston in 1996 was somewhat coarser textured and lower in organic matter than at the other locations, but the differences likely were not great enough to explain the greater injury. The greater injury at Lewiston in 1996 may have been related to timing of the first evaluation. Injury was transient, and it is possible that greater injury than recorded also occurred in the other experiments but the crop had recovered when the initial evaluation was made.

No differences among treatments were noted for peanut yield at Rocky Mount. Pooled over treatments, peanut yielded 3020 kg/ha (data not shown). The main effect of norflurazon treatment and the cultivar-by-norflurazon interaction treatment for peanut yield were not significant at Lewiston in 1995. However, the main effect of cultivars was significant. Greatest yields were produced with NC-V 11, VA-C 92R, and AT VC-1 while lesser yields were produced by NC 7, NC 9 and NC 10C (Table 2). Peanut value and gross returns could not be determined as market quality factors were not measured in 1995.

Data from the 1994 and 1996 experiments at Lewiston were pooled. The cultivar-by-norflurazon interaction

Table 2. Peanut yield, percentage ELK, TSMK, FP, unit value, and gross return for each cultivar[a].

Cultivar	Peanut yield 1995	Peanut yield 1994 & 1996[b]	ELK	SMK	FP	Value	Gross returns
	---- kg/ha ----		%	%	%	$/kg	$/ha
NC 7	5420	3440	47	71	91	0.75	2560
NC 9	5080	4010	30	70	92	0.74	2940
NC 10C	5390	4130	16	69	85	0.71	2050
NC-V 11	5960	4220	36	72	84	0.75	3160
VA-C 92R	5720	3865	40	70	90	0.74	2830
AT VC-1	5630	3845	27	70	85	0.73	2810
LSD (0.05)	400	410	4	2	4	0.01	260

[a]Data pooled over norflurazon rates. Data for extra large kernels, sound mature kernels, fancy pods, value, and gross returns are pooled over 1994 and 1996 at Lewiston.

[b]Data pooled over years.

Table 3. Main effect of norflurazon on peanut yield and gross returns (Lewiston, 1994 and 1996)[a].

Norflurazon rate	Yield	Gross Returns
kg/ha	kg/ha	$/ha
0	4050	2970
1.6	3790	2770
LSD (0.05)	160	130

[a]Data pooled over cultivars and years.

was not significant for any variable recorded. Significant main effects of cultivars were noted for yield, market quality factors, value/kg, and gross returns. NC 9, NC 10C, NC-V 11, VA-C 92R, and AT VC-1 yielded similarly (Table 2). Yield of NC 7 was similar to that of AT VC-1 but less than that of NC 9, NC 10C, NC-V 11, and VA-C 92R. Large differences were noted among cultivars for percentage ELK while smaller differences were noted for TSMK and FP (Table 3). The results were similar to those observed in cultivar performance trials in North Carolina (Jordan and Spears, 1997). Differences in peanut value/kg primarily reflected the differences in percentage ELK.

Differences in visible injury among cultivars (Table 1) was not reflected in yields. Pooled over experiments and cultivars in 1994 and 1996, norflurazon reduced peanut yield 6% (Table 4). Norflurazon had no effect on ELK, TSMK, or FP (data not shown) and, hence, no effect on peanut value/kg. The reduction in gross returns of $200/ha was due to the reduction in yield.

Peanut maturity, measured as the percentage of pods with black or brown mesocarps, was unaffected by norflurazon in 1995 or 1996 at Lewiston. Pooled over cultivars, the percentage of pods with black or brown mesocarps was 66 and 65% with norflurazon at 0 and 1.6 kg/ha, respectively, in 1995; and 42 and 41%, respectively, in 1996 (data not shown). Hence, yield response to norflurazon cannot be explained by differential maturity and failure to dig norflurazon-treated peanut at the most opportune time.

Although visible injury to peanut varied by cultivar in some experiments, norflurazon reduced yield and gross returns in two of four experiments regardless of cultivar. These results suggest use of norflurazon on virginia-type peanut should be avoided except in situations where the herbicide is essential for control of specific problem weeds. More research in North Carolina is needed to determine if the value of weed control provided by norflurazon exceeds potential yield and value loss from norflurazon injury.

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