Peanut (*Arachis hypogaea* L.) Response to Imazethapyr as Affected by Timing of Application[1]

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ABSTRACT

Field studies were conducted in 1994 and 1995 to evaluate the effect of imazethapyr on peanut growth and yield under weed-free conditions as influenced by timing of application. Imazethapyr applied preemergence (PRE) and 7, 21, 35, 49, and 63 d after planting (DAP) had no effect on peanut pod weight. In 1 of 2 yr, imazethapyr applied PRE, 21 DAP, or 35 DAP increased yield over the untreated check. In 1 of 2 yr, peanut grade was reduced with imazethapyr applied 49 DAP.

Key Words: Groundnut, herbicides, peanut injury, preemergence, pod yield, postemergence, total sound mature kernels.

Imazethapyr, an imidazolinone herbicide, is registered for use in peanut (*Arachis hypogaea* L.) and can be applied preplant incorporated (PPI), preemergence (PRE), at peanut ground cracking (GC), or postemergence (POST) for weed control (Grichar *et al.*, 1990, 1992; Brecke, 1991; Wilcut, 1991a, b; Richburg and Wilcut, 1992). Imazethapyr also is applied as split applications of the aforementioned methods.

Imazethapyr applied PPI or PRE controls coffee senna (*Cassia occidentalis* L.), morningglory spp. (*Ipomoea* spp.), pigweed spp. (*Amaranthus* spp.), prickly sida (*Sida spinosa* L.), purple nutsedge (*Cyperus rotundus* L.), and yellow nutsedge (*Cyperus esculentus* L.) (Cole *et al.*, 1989; Walls *et al.*, 1989; Grichar *et al.*, 1990, 1992; Brecke, 1991; Wilcut, 1991b). Imazethapyr POST provides the broadest spectrum and most consistent control when applied within 10 d of weed emergence (Wilcut, 1991a,b; Wilcut *et al.*, 1991a,b), and imazethapyr is one of the few POST herbicides to control both yellow and purple nutsedge (Grichar *et al.*, 1992; Grichar and Colburn, 1992; Richburg *et al.*, 1993). Control is greatest when imazethapyr is applied to the soil or when yellow nutsedge is no more than 5 to 10 cm tall (Richburg *et al.*, 1993).

The increased duration of residual control by imazethapyr applied PRE in Virginia allows producers more flexibility in their weed management systems (Wilcut, 1991b). Residual control by imazethapyr may reduce the potential impact of adverse weather and other management problems. Many currently registered POST herbicides have a narrow period for effective application (Wilcut, 1991a).

Some peanut growers in Texas have expressed concern that imazethapyr POST has reduced peanut yield and quality. In our research, we have found nothing to support this theory nor could we find any literature on this subject. All research with imazethapyr on peanut has been under weedy conditions where in most instances imazethapyr controlled weeds and improved yields over the nontreated check. Therefore, the objectives of this research were to determine effects of imazethapyr on peanut growth, yield, and quality where applied to weed-free peanuts in various stages of development.

Materials and Methods

These studies were conducted in 1994 and 1995 at the Texas Agric. Exp. Stn. near Yoakum, TX. The soil at the test site was a Tremona loamy fine sand (thermic Aquic Arenic Paleustalfs) with less than 1% organic matter and a pH of 7.2.

Treatments were applied three times in a randomized complete block design. Each plot consisted of two rows spaced 97 cm apart and 7.6 m long. Pendimethalin [*N*-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine] was applied broadcast at 1.12 kg ai/ha and incorporated to a 5-cm depth prior to peanut planting to control annual grasses and small-seeded broadleaf weeds. Additional weeds which developed throughout the growing season were hand-pulled at weekly intervals to prevent interference with peanut growth. Sprinkler irrigation was applied on a 2-wk schedule throughout the growing season.

Seeds of cultivar Florunner were planted 25 April 1994 and 1 May 1995 at 100 kg/ha. The ammonium salt of imazethapyr at 70 gae/ha was applied as follows: PRE, immediately after peanuts were planted; 7 d after planting (DAP) at peanut emergence, or 21, 35, 49, and 63 DAP. All POST imazethapyr contained a nonionic surfactant (X-77, Valent USA Corp., Box 8025, Walnut Creek, CA). The dates of application were selected to expose peanut plants to the herbicide during all stages of development from prebloom through early pod development. Peanut flowering is initiated at approximately 40 to 45 DAP followed by initiation of pegging approximately 60 DAP.

Herbicide treatments were applied broadcast with a compressed-air bicycle sprayer equipped with Teejet 11002 flat fan nozzles (Spraying Systems, Co., Wheaton, IL) delivering a spray volume of 190 L/ha at 180 kPa. Data collected included measurements of peanut canopy height at eight random locations per plot 84 to 93 DAP. Peanut yield was determined by digging the pods when plants were 147 d old, air-drying in the field for 4 to 6 d, and harvesting individual plots with a small-plot thresher. Weights were recorded after trash and soil were removed from the samples.

One hundred mature pods were collected at random from each sample, weighed, and then shelled. Pod, shell, and peanut kernel weight were determined for each sample.

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Grades were determined for a 200-g pod sample from each plot following procedures described by the Federal State Inspection Service (Anonymous, 1995). Data were subjected to analysis of variance and means of imazethapyr treatments were compared with the nontreated check using Fishers' Protected LSD Test at P = 0.05 level. Data for pod, shell, and kernel weight were combined over years. Imazethapyr did not affect pod, kernel, or hull weight (data not shown). Since plant height, peanut yield, and peanut grade showed a year-by-year herbicide timing interaction, these data are presented by years.

Results and Discussion

Peanut Growth. Imazethapyr had an effect on peanut plant height in 1 yr (Table 1). In 1994, no differences were noted in peanut plant height between imazethapyr treatments and the untreated check. In 1995, imazethapyr applied 49 DAP resulted in smaller peanut plants than the untreated check. Under wet conditions, imazethapyr POST can cause peanut stunting (personal observation). Irrigation (5.1 cm) was applied 6 d after the 49 DAP imazethapyr treatment. This may have moved the imazethapyr into the peanut root zone and caused stunting (personal opinion). This stunting may last for 10 to 14 d, at which time the peanut plant recovers completely without an apparent reduction in yield.

Some herbicides have caused peanut injury when applied PPI or PRE. Wehtje *et al.* (1988) reported at least a twofold difference between maximum registered rates of alachlor [2-chloro-*N*-(2,6-diethylphenyl)-*N*-(methoxymethyl) acetamide] and metolachlor [2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl) acetamide] which injured peanuts. Cardina and Swann (1988) examined growth and yield of peanut as influenced by metolachlor applied PPI at 2.2 to 6.7 kg ai/ha. They found that all metolachlor rates delayed peanut emergence and reduced peanut size when irrigation followed planting.

Herbicides also have injured peanuts if applied too early in the growing season. Chlorimuron {2-[[[[(4-chloro-6-methoxy-2-pyrimidinyl)amino]carbonyl]-amino]sulfonyl] benzoic acid} should not be applied to peanuts less than 60 d old because of potential plant injury and yield reductions if applied earlier (Wilcut *et al.*, 1989; Johnson *et al.*, 1992). Littlefield *et al.* (1995) concluded that nicosulfuron {2-[[[[(4,6-dimethoxy-2-pyrimidinyl)amino]-carbonyl]amino]sulfonyl]-*N*,*N*-dimethyl-3-pyridinecarboxamide} applied to peanut 7 wk after planting or later did not damage foliage or reduce yield unless excessive rainfall occurred soon after application. They stated that earlier applications were feasible but only at rates less than 36 g ai/ha, but this rate may not provide adequate weed control.

Peanut Pod Development and Yield. Pod, kernel, or hull weight were not affected by imazethapyr (data not shown) (Table 1). Ketchersid *et al.* (1978) found that 2,4-DB [4-(2,4-dichlorophenoxy)butyric acid] at 0.9 kg ai/ha resulted in enlarged pods at harvest, lower percentages of sound mature kernels, and a higher percentage of hulls when applied at the post bloom stage 55 DAP.

Peanut yields were unaffected by imazethapyr in 1994 (Table 1). In 1995, imazethapyr applied PRE or POST 21 or 35 DAP increased yield over the nontreated check. There was a trend for all other imazethapyr treatments to increase yield also. Under weedy conditions in the Southeast, imazethapyr POST following pendimethalin PPI increased peanut yield compared with pendimethalin alone (Wilcut *et al.*, 1991a,b, 1994).

Late season imazethapyr applications are not feasible because weed control can be variable (Wilcut and Walls, 1990; Wilcut, 1991b; Richburg and Wilcut, 1992). Imazethapyr is most effective when applied to yellow nutsedge 5 to 10 cm tall (Wilcut and Walls, 1990; Wilcut, 1991b; Grichar *et al.*, 1992; Anonymous, 1995). Imazethapyr POST controls small prickly sida and spurred anoda [*Anoda cristata* (L.) Schlecht] (Wilcut, 1991b; Wilcut *et al.*, 1991a,b). Control of coffee senna, prickly sida, and spurred anoda will be unacceptable if imazethapyr is applied to weeds exceeding the two-leaf stage. Imazethapyr POST controls bristly starbur (*Acanthospermum hispidum* DC.) up to approximately 4 cm tall (Richburg and Wilcut, 1992).

Table 1. Effect of imazethapyr applications of 0.07 kg/ha on peanut plant growth, pod weight, yield, and total sound mature kernels[a].

Treatment	Appl. timing	Plant height		Yield		TSMK	
		1994	1995	1994	1995	1994	1995
		---- cm ----		---- kg/ha ----		----- % -----	
Check	-	24	22	2140	2440	56.5	65.5
Imazethapyr	PRE	23	21	2270	3250	58.9	68.0
Imazethapyr	7 DAP	23	22	2750	2910	60.1	66.3
Imazethapyr	21 DAP	24	21	2180	3020	52.6	66.3
Imazethapyr	35 DAP	23	22	2000	3030	53.8	66.7
Imazethapyr	49 DAP	26	19	2260	2910	58.5	64.4
Imazethapyr	63 DAP	23	24	2050	2550	60.1	66.2
LSD (0.05)		NS	3	NS	500	NS	NS

[a]PRE = preemergence, DAP = days after planting, TSMK = total sound mature kernels.

Peanut Grade. Peanut grades (total sound mature kernels) were extremely low in 1994, but were not affected by imazethapyr (Table 1). The low grade may be due in part to 28 cm of rainfall received in a 3-wk period soon after peanut planting and the resulting delay in plant development. In 1995, the grades improved considerably, but were not affected by imazethapyr. Littlefield *et al.* (1995) reported nicosulfuron at 54 g/ha reduce sound mature kernels.

In conclusion, these data indicate that imazethapyr applied POST will not adversely effect peanut yield and quality. Imazethapyr control of most weed species is better and more consistent with soil applications or with an application to very small weeds (Wilcut *et al.*, 1995); however, imazethapyr applications up until 49 DAP may cause some stunting of peanuts. Soil applications of imazethapyr have resulted in peanut stunting if rainfall and cool weather conditions are present soon after application (personal observation). Although peanut plant size may be reduced by imazethapyr application, this did not have an adverse effect on yield or grade. The 63 DAP application of imazethapyr resulted in a numerical yield decrease 1 yr and the smallest percentage yield increase the other year; however, no effect was seen on peanut grade, size, or pod weight by delaying imazethapyr application.

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Literature Cited

Anonymous. 1995. Farmerstock Peanuts Inspection Instructions. U.S. Dept. Agric., Washington, DC.

Brecke, B. J. 1991. Purple nutsedge (*Cyperus rotundus*) control in peanuts. Proc. South. Weed Sci. Soc. 44:139 (abstr.).

Cardina, J., and C. W. Swann. 1988. Metolachlor effects on peanut growth and development. Peanut Sci. 15:57-60.

Cole, T. A., G. R. Wehtje, J. W. Wilcut, and T. V. Hicks. 1989. Behavior of imazethapyr in soybeans (*Glycine max*), peanuts (*Arachis hypogaea*), and selected weeds. Weed Sci. 37:639-644.

Grichar, W. J., J. H. Blalock, and A. E. Colburn. 1990. Imazethapyr for weed control in Texas peanuts. Proc. Amer. Peanut Res. Educ. Soc. 22:59 (abstr.).

Grichar, W. J., and A. E. Colburn. 1992. Nutsedge control in peanuts with Pursuit. Texas Agric. Exp. Stn. Pub. MP-1741.

Grichar, W. J., P. R. Nester, and A. E. Colburn. 1992. Nutsedge (*Cyperus* spp.) control in peanuts (*Arachis hypogaea*) with imazethapyr. Weed Technol. 6:396-400.

Johnson, W. C., III, C. C. Holbrook, B. G. Mullinix, Jr., and J. Cardina. 1992. Response of eight genetically diverse peanut genotypes to chlorimuron. Peanut Sci. 19:111-115.

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.

Littlefield, T. A., D. L. Colvin, B. J. Brecke, and L. B. McCarty. 1995. Time and rate of nicosulfuron application in peanut (*Arachis hypogaea*). Weed Technol. 9:34-36.

Richburg, J. S., III, and J. W. Wilcut. 1992. Imazethapyr systems for weed management in Georgia peanut. Proc. South. Weed Sci. Soc. 45:106 (abstr.).

Richburg, J. S., III, J. W. Wilcut, and G. R. Wehtje. 1993. Toxicity of imazethapyr to purple (*Cyperus rotundus*) and yellow nutsedge (*Cyperus esculentus*). Weed Technol. 7:900-905.

Richburg, J. S., III, J. W. Wilcut, and G. R. Wiley. 1995. AC 263,222 and imazethapyr rates and mixtures for weed management in peanut (*Arachis hypogaea*). Weed Technol 9:801-806.

Walls, F. R., Jr, K. R. Muzyk, and G. Wiley. 1989. Influence of timing of imazethapyr applications in peanuts. Proc. Amer. Peanut Res. Educ. Soc. 21:55 (abstr.).

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.

Wilcut, J. W. 1991a. Economic yield response of peanut (*Arachis hypogaea*) to postemergence herbicides. Weed Technol. 5:416-420.

Wilcut, J. W. 1991b. Imazethapyr and AC 263,222 systems for Georgia peanuts. Proc. South. Weed Sci. Soc. 44:138 (abstr.).

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 peanuts (*Arachis hypogaea* L.). Peanut Sci. 21:23-28.

Wilcut, J. W., F. R. Walls, Jr., and D. N. Horton. 1991a. Imazethapyr for broadleaf weed control in peanuts (*Arachis hypogaea*). Peanut Sci. 18:26-30.

Wilcut, J. W., F. R. Walls, Jr., and D. N. Horton. 1991b. Weed control, yield, and net returns using imazethapyr in peanuts (*Arachis hypogaea*). Weed Sci. 39:238-242.

Wilcut, J. W., G. R. Wehtje, M. G. Patterson, T. A. Cole, and T. V. Hicks. 1989. Absorption, translocation, and metabolism of foliar-applied chlorimuron in soybeans (*Glycine max*), peanuts (*Arachis hypogaea*), and selected weeds. Weed Sci. 37:175-180.

Wilcut, J. W., A. C. York, W. J. Grichar, and G. R. Wehtje. 1995. The biology and management of weeds in peanut (*Arachis hypogaea*), pp. 207-244. *In* H. E. Pattee and H. T. Stalker (eds) Peanut Science and Technology. Amer. Peanut Res. Educ. Soc., Stillwater, OK.

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