Purple Nutsedge Control in Peanut as Affected by Imazameth and Imazethapyr Application Timing[1]

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ABSTRACT

Field experiments in 1994 and 1995 compared control by imazameth at 53 and 71 g ai/ha and imazethapyr at 71 g ai/ha applied to purple nutsedge (*Cyperus rotundus* L.) 5, 10, 20, or 30 cm tall. Peanut (*Arachis hypogaea* L.) injury was not observed with either herbicide. Imazameth and imazethapyr were similarly effective on purple nutsedge for the first 1 to 2 mo after planting. Regardless of application timing, imazameth was more effective than imazethapyr at approximately 3 mo or more after planting. Timing of application affected late-season control by imazameth only in 1995 where greater control was obtained when applied to 10- or 20-cm purple nutsedge. Peanut yields were variable in 1994 and were not related to the imidazolinone herbicide used, the herbicide rate, or the level of purple nutsedge control. In 1995, yield from plots treated with imazameth at 53 g/ha was greater than yield from plots treated with imazameth or imazethapyr at 71 g/ha. Timing of herbicide application did not affect yield.

Key Words: *Arachis hypogaea*, *Cyperus rotundus*, weed size.

Peanut (*Arachis hypogaea* L.) acreage has expanded greatly on the Texas High Plains over the last 15 yr due to availability of productive, irrigated sandy soils that possess little disease incidence (Anon., 1991, 1994). Purple nutsedge (*Cyperus rotundus* L.), a common and troublesome weed in peanut in the southeastern United States (Dowler, 1995) and in other crops around the world (Holm *et al.*, 1977), is becoming a major problem in Texas peanut production. Purple nutsedge reduces peanut yield and quality through competition and interference with foliar pesticide applications and harvesting (Holm *et al.*, 1977; Young *et al.*, 1982; Wilcut *et al.*, 1994b). Hauser (1962) reported that purple nutsedge can produce greater than 5000 kg/ha of underground plant material consisting primarily of tubers. Allelopathic substances exuded by purple nutsedge also suppress crop growth (Singh *et al.*, 1970; Horowitz and Friedman, 1971).

Purple nutsedge is controlled by a limited number of herbicides. Vernolate (*S*-propyl dipropylcarbamothioate) applied preplant incorporated (PPI) controls purple nutsedge for only 4 to 5 wk after application (Wilcut *et al.*, 1994b). Alachlor [2-chloro-*N*-(2,6-diethylphenyl)-*N*-(methoxymethyl)acetamide] at 3.4 kg ai/ha applied PPI and at-cracking (AC) controlled purple nutsedge similarly to vernolate at 2.2 kg ai/ha applied PPI plus alachlor at 3.4 kg ai/ha applied AC (Brecke, 1991). Late season control by metolachlor [2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide] at 2.8 kg ai/ha applied PPI and AC was 15 to 40% greater than control by vernolate plus alachlor (Brecke, 1991). In greenhouse studies, imazaquin {2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-3-quinolinecarboxylic acid} placed above purple nutsedge tubers reduced shoot emergence and shoot and root dry weights more than imazaquin placed below the tubers (Richburg *et al.*, 1993).

Herbicides applied postemergence (POST) may control purple nutsedge early in the season, but late season control has been unacceptable. Wilcut *et al.* (1994b) reported that bentazon [3-(1-methylethyl)-(1*H*)-2,1,3-benzothiadiazin-4(3*H*)-one 2,2-dioxide] applied POST did not effectively control purple nutsedge. Paraquat (1,1'-dimethyl-4,4'-bipyridinium ion) suppresses purple nutsedge, but sequential applications are necessary because of lack of residual activity (Wilcut *et al.*, 1994a,b).

Imazethapyr {2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-5-ethyl-3-pyridinecarboxylic acid} can be applied PPI, preemergence (PRE), AC, or POST in peanut to control many annual broadleaf weeds and perennial sedges (Brown, 1992; Grichar, 1992; Grichar *et al.*, 1992; Wilcut and Richburg, 1992; Richburg *et al.*, 1993; Wilcut *et al.*, 1991a,b, 1994a,b; York *et al.*, 1995). Imazethapyr controlled purple nutsedge at least 85% when applied PPI and 94% when applied POST (Grichar *et al.*, 1992). Adding metolachlor did not improve control. Imazethapyr at 70 g/ha applied PPI or PRE controlled purple nutsedge less effectively than vernolate (Brecke, 1991).

Imazameth {(±)-2[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-5-methyl-3-pyridinecarboxylic acid}, recently registered for early POST use in peanut, controls many annual broadleaf and grass weeds and perennial sedges (Wilcut *et al.*, 1991a,b; Wilcut and Richburg, 1992). Imazameth was more effective on purple nutsedge when applied AC than PPI (Brecke, 1991). Imazameth at 71 g/ha applied POST controlled bristly starbur (*Acanthospermum hispidum* DC.), coffee senna (*Cassia occidentalis* L.), common lambsquarters (*Chenopodium album* L.), morningglory species (*Ipomoea* sp.), prickly sida (*Sida spinosa* L.), sicklepod [*Senna obtusifolia* (L.) Irwin and Barneby], smallflower morningglory [*Jacquemontia tamnifolia* (L.) Griseb], and yellow nutsedge (*Cyperus esculentus* L.) at least 91%; common cocklebur (*Xanthium strumarium* L.) 77%; and Florida beggarweed [*Desmodium tortuosum* (Sw.) DC.] 47 to 100% (Wilcut *et al.*, 1996). Imazameth at 36 to 71 g/ha controlled purple nutsedge 87 to 100%

[1] Contribution of the Dept. of Plant and Soil Sci., College of Agric. Sci. and Nat. Resources, Texas Tech Univ. Publ. No. T-4-414 and approved for publication by the Director of the Texas Agric. Exp. Stn., Lubbock.

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in Georgia (Richburg *et al.*, 1996). No information is available on purple nutsedge control by imazameth on the Texas Southern High Plains. The objective of this research was to evaluate purple nutsedge control and peanut response to imazameth and imazethapyr as affected by time of application.

Materials and Methods

Experiments were conducted near Seminole, TX on an Amarillo fine sandy loam soil (fine-loamy, mixed, thermic Aridic Paleustalf) in 1994 and near Loop, TX on an Amarillo loamy fine sand soil in 1995. Purple nutsedge populations were approximately 1600 plants/m^2 in 1994 and 1250 plants/m^2 in 1995. Each soil had a pH of 7.8 and less than 1.0% organic matter. The cultivar Tamrun 88 was planted on 102-cm rows on 5 May 1994 and on 81-cm rows on 9 May 1995. Individual plots were 2 by 8 m in 1994 and 3 by 9 m in 1995.

Imazameth at 53 or 71 g/ha and imazethapyr at 71 g/ha were applied POST to purple nutsedge at the four heights listed in Table 1 using a tractor-mounted compressed-air sprayer delivering 140 L/ha at a pressure of 207 kPa. The nonionic surfactant X-77 (a mixture of alkylaryl polyoxyethylene glycols, free fatty acids, and isopropanol) (Valent U.S.A. Corp., Walnut Creek, CA) at 0.5% (v/v) was added to all treatments. Overhead sprinkler irrigation was used at both locations to supplement natural rainfall. Irrigation plus rainfall exceeded 64 cm at both locations during the growing season.

Purple nutsedge control and peanut injury were estimated visually at 31, 63, 118, and 167 d after planting (DAP) in 1994 and 28, 83, and 166 DAP in 1995 using a scale of 0% (no purple nutsedge control or peanut injury) to 100% (complete purple nutsedge control or peanut death). Peanut yield was determined by harvesting the whole plot in 1994 and by harvesting the center two rows of each plot in 1995. Peanut pods were dried, screened for foreign matter, and adjusted to 10% moisture for yield comparisons.

The experimental design was a randomized complete block with treatments replicated three times. Data were subjected to an analysis of variance with partitioning appropriate for the factorial treatment arrangement. Treatment means were separated using Fisher's Protected LSD Test at P = 0.05 (Steele and Torrie, 1980).

Table 1. Date and height of purple nutsedge and peanut at each application.

	1994			1995		
Event	Date	Purple nutsedge ht.	Peanut ht.	Date	Purple nutsedge ht.	Peanut ht.
		---cm---			---cm---	
Peanut planting	5 May	0	--	9 May	2	--
First appl.	30 May	5	0[a]	18 May	5	0[b]
Second appl.	6 June	10	6	6 June	10	12
Third appl.	26 June	20	12	19 June	20	15
Fourth appl.	20 July	30	24	10 July	30	18
Harvest	27 Oct.	--	--	2 Nov.	--	--

[a]Cracking.
[b]Preemergence.

Results and Discussion

Neither herbicide caused visible injury to peanut at any application timing in 1994 and 1995 (data not shown). Peanut has been reported to have excellent tolerance to imazethapyr (Richburg *et al.*, 1994; Wilcut *et al.*, 1994). Imazameth, however, has caused visible injury up to 13% in some cultivars (Richburg *et al.*, 1995).

A herbicide treatment by application time interaction was observed at the 118 DAP rating in 1994. Therefore, purple nutsedge control was examined within herbicide treatments over application timings and within application timings over herbicide treatments. At the 167 DAP rating in 1994 and at both late-season ratings in 1995, no herbicide treatment by application timing interaction was observed. Therefore, purple nutsedge control was examined within herbicide treatments and within application timings.

In 1994, purple nutsedge control by imazameth and imazethapyr was similar at 31 and 63 DAP (data not shown). Imazameth at 53 or 71 g/ha and imazethapyr at 71 g/ha controlled purple nutsedge at least 65% at 31 DAP and at least 70% at 63 DAP. At 118 and 167 DAP, imazameth controlled purple nutsedge more effectively than imazethapyr (Table 2). At 118 DAP, control by imazethapyr, imazameth at 53 g/ha, and imazameth at 71 g/ha ranged from 37 to 52%, 58 to 88%, and 70 to 92%, respectively. Control by imazameth at 53 and 71 g/ha was similar when applied to 10-cm purple nutsedge. However, control was 12 to 24% greater with the higher rate of imazameth applied to 5-, 20-, or 30-cm purple nutsedge. Both herbicides controlled purple nutsedge more effectively when applied to weeds 5 to 20 cm tall compared with weeds 30 cm tall. At 167 DAP in 1994, imazameth controlled purple nutsedge at least 81%, whereas control by imazethapyr was only 62% (Table 2). Application timing did not affect control.

In 1995, purple nutsedge control by imazameth and imazethapyr was similar at 28 DAP and ranged from 55 to 60% (data not shown). By 83 DAP, control by imazameth at either rate exceeded control by imazethapyr. Control by imazameth at 53 g/ha, imazameth at 71 g/ha, and imazethapyr averaged 62, 70, and 55%, respectively (Table 3). Control was most effective when the herbicides were applied to 10- and 30-cm purple nutsedge.

At 166 DAP in 1995, purple nutsedge control by imazameth exceeded control by imazethapyr (Table 3). Imazameth at 53 and 71 g/ha controlled purple nutsedge 55 to 57% compared with 29% control by imazethapyr. Control was most effective if applications were made to 10- or 20-cm purple nutsedge. When applications were made to 10- or 20-cm purple nutsedge, control by imazameth was 63 to 78% compared with 23 to 27% control by imazethapyr. Poor late season control by imazethapyr [less than that reported by Grichar *et al.* (1992) and Wilcut *et al.* (1994a)] may be due to the less humid climate of the Texas Southern High Plains which typically will decrease the activity of herbicides applied POST because of reduced leaf uptake.

In general, purple nutsedge was controlled more

Table 2. Purple nutsedge control by imazameth and imazethapyr in 1994.

Herbicide	Rate	118 DAP					167 DAP				
		Purple nutsedge height at application (cm)									
		5	10	20	30	Avg	5	10	20	30	Avg
	g/ha	%					%				
Imazameth	53	76 b[a]y[b]	88 ax	68 by	58 cy	73	88	85	82	90	86 X[c]
Imazameth	71	88 ax	92 ax	92 ax	70 bx	86	63	90	83	88	81 X
Imazethapyr	71	47 az	52 ay	52 az	37 bz	47	65	62	53	67	62 Y
Avg		70	77	71	55		72A[d]	79A	73A	82A	

[a]Height means within herbicides and rates for each observation date followed by the same lower case letter (a,b,c) are not significantly different at $P \leq 0.05$.

[b]Herbicide and rate means within heights for each observation date followed by the same lower case letter (x,y,z) are not significantly different at $P \leq 0.05$.

[c]Herbicide and rate means for each observation date followed by the same upper case letter (X,Y,Z) are not significantly different at $P \leq 0.05$.

[d]Height means for each observation date followed by the same upper case letter (A,B,C) are not significantly different at $P \leq 0.05$.

Table 3. Purple nutsedge control by imazameth and imazethapyr in 1995.

Herbicide	Rate	83 DAP					166 DAP				
		Purple nutsedge height at application (cm)									
		5	10	20	30	Avg	5	10	20	30	Avg
	g/ha	%					%				
Imazameth	53	37	72	68	70	62 Y[a]	32	78	63	53	57 X
Imazameth	71	68	77	68	67	70 X	48	65	63	43	55 X
Imazethapyr	71	65	48	53	52	55 Z	37	23	27	28	29 Y
Avg		57 B[b]	66 A	63 AB	63 AB		39 B	55 A	51 A	41 B	

[a]Herbicide and rate means for each observation date followed by the same letter (X,Y,Z) are not significantly different at $P \leq 0.05$.

[b]Height means for each observation date followed by the same letter (A,B,C) are not significantly different at $P \leq 0.05$.

effectively by imazameth applied to purple nutsedge 10 to 20 cm tall. York *et al.* (1995) reported that the most effective imazethapyr application timings varied by weed species and location. Richburg *et al.* (1996) reported imazameth at 36 to 71 g/ha applied within 1 wk of peanut emergence or 3 wk after peanut emergence controlled purple nutsedge at least 87%. No other information regarding application timings of imazameth has been reported.

No herbicide treatment by application timing interaction was observed for peanut yield. Therefore, yield by year was examined within herbicide treatments and within application timings. Yields from imidazolinone-treated plots were equal to or greater than nontreated plots in 1994 and 1995 (Table 4). In 1994, peanut yield was similar regardless of herbicide treatment or application timing. However, a general trend of greater yield at the 5- and 10-cm application timing was apparent. In 1995, yields from plots treated with imazameth at 53 g/ha were greater than yields from plots treated with imazethapyr at 71 g/ha. Peanut yield was not affected by herbicide application timing.

In this study, peanut yield could not be explained by weed control although previous research has shown peanut yield to increase with improved weed control (Wilcut *et al.*, 1994a; Richburg *et al.*, 1996). Peanut stand was 16 to 17 plants/m row in both years while purple nutsedge populations ranged from 1250 to 1600 plants/m^2. These dense purple nutsedge populations made it difficult to dig and invert peanuts which may have masked yield differences due to the herbicide treatments. In 1995, peanuts were planted later and purple nutsedge emerged earlier as compared with 1994 (Table 1). This increased interference time likely attributed to the lower yields in 1995.

Conclusions

Purple nutsedge is among the top five most troublesome weeds in Texas peanut production because it is extremely difficult to control and can substantially reduce yield and quality. Imazameth controlled purple nutsedge as well as or better than imazethapyr at all application timings. Trends for greater peanut yield were apparent when imazameth applications were made to 5- to 10-cm purple nutsedge. The results reported herein suggest imazameth is better than imazethapyr at

Table 4. Peanut yield following imazameth and imazethapyr applications throughout the growing season.[a]

Herbicide	Rate	1994					1995				
		Purple nutsedge height at application (cm)									
		5	10	20	30	Avg	5	10	20	30	Avg
	g/ha	kg/ha					kg/ha				
Imazameth	53	3850	3050	1780	1740	2605 X[b]	2010	2090	1880	1940	1980 X
Imazameth	71	2890	3440	1850	2660	2710 X	1580	1610	1380	1200	1440 Y
Imazethapyr	71	2950	2300	2020	2080	2340 X	1090	810	1220	1300	1105 Y
Avg		3230 A[c]	2930 A	1883 A	2160 A		1560 A	1505 A	1495 A	1480 A	

[a]Peanut yield from nontreated plots was 800 kg/ha in 1994 and 870 kg/ha in 1995.

[b]Herbicide and rate means for each observation date followed by the same letter (X,Y,Z) are not significantly different at $P \leq 0.05$.

[c]Height means for each observation date followed by the same letter (A,B,C) are not significantly different at $P \leq 0.05$.

controlling purple nutsedge but, like imazethapyr, rotational restrictions for cotton (*Gossypium hirsutum* L.) may limit its usefulness on the Texas Southern High Plains.

Acknowledgments

The authors are grateful to Dr. D. B. Wester, Res. Scientist, for statistical expertise in data analysis and to American Cyanamid Company for partial funding for this study.

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Accepted 7 July 1997