Weed Management and Net Returns Using Soil-Applied and Postemergence Herbicide Programs in Peanut (*Arachis hypogaea* L.)

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ABSTRACT

Field studies were conducted during the 1997 and 1998 growing seasons to compare Palmer amaranth and Texas panicum control and peanut pod yield and net returns by dimethenamid, ethalfluralin, or S-metolachlor applied alone or with sequential postemergence (POST) applications of acifluorfen, acifluorfen plus bentazon, bentazon, imazapic, imazethapyr, or pyridate. The addition of a POST herbicide to ethalfluralin did not improve Texas panicum control over ethalfluralin alone. Dimethenamid followed by imazapic POST or S-metolachlor followed by imazapic or imazethapyr POST improved Texas panicum control over those two soil-applied herbicides used alone. Palmer amaranth control was acceptable with imazapic or imazethapyr alone (82 to 93%). Only imazapic applied POST following ethalfluralin improved Palmer amaranth control over ethalfluralin alone. The addition of any POST herbicide to dimethenamid improved Palmer amaranth control over dimethenamid alone while only the addition of bentazon or pyridate to S-metolachlor did not improve Palmer amaranth control over S-metolachlor alone. Peanut yield increased as herbicide inputs increased. Herbicide systems which include imazapic applied POST following ethalfluralin, dimethenamid, or S-metolachlor soil-applied provided the highest peanut yield and net return.

Key Words: Acifluorfen, bentazon, dimethenamid, ethalfluralin, imazapic, imazethapyr, pyridate, S-metolachlor, preplant incorporated, postemergence.

Peanut has several unique features that contribute to challenging weed management. First, most peanut cultivars grown in the U.S. require a fairly long growing season of 140 to 160 d depending on cultivar and geographical region (Henning *et al.*, 1982; Wilcut *et al.*, 1995). Because of this long growing season, soil-applied herbicides may not provide season-long control, resulting in mid to late season weed problems. Secondly, peanut has a prostrate growth habit, a relatively shallow canopy, and is slow to shade row middles allowing weeds to be more competitive (Walker *et al.*, 1989; Wilcut *et al.*, 1995). Additionally, peanut fruit develops underground on pegs which originate from stems that grow along the soil surface. The prostrate growth habit and pattern of fruit development limits cultivation to an early season control option (Brecke and Colvin, 1991; Wilcut *et al.*, 1995).

Pigweed (*Amaranthus* spp.) is listed as one of the 10 most common weeds in most peanut-growing states in the United States, with Palmer amaranth (*Amaranthus palmeri* S. Wats.) ranked as the fourth most common weed in South Carolina (Dowler, 1998). Palmer amaranth is not generally ranked as a troublesome weed in most crops in the U.S., however, it is a common weed in many crops produced around the world. Palmer amaranth is currently found in the southern half of the United States (Anonymous, 1990). In Texas, Palmer amaranth can be found in all areas of the state (Correll and Johnston, 1979), and is a severe problem in many peanut fields, when not properly controlled (P. Dotray personal observation).

Texas panicum (*Panicum texanum* Buckl.), a large seeded, vigorous, fast growing annual grass is commonly found in peanut fields in parts of Florida, South Carolina, Oklahoma, and Texas (Dowler, 1998). It is listed as one of the most troublesome weeds in all peanut growing states except Alabama and Georgia (Dowler, 1998). During the digging operation, the peanut plant is lifted out of the ground and inverted. A heavy stand of Texas panicum can reduce the effectiveness of the process. The tight fibrous root system becomes intertwined with the peanut plant, causing peanut pods to be stripped from the vine during digging. Peanuts that become detached from the plant remain unharvested in or on the soil (Buchanan *et al.*, 1982).

Weed problems may reduce producer income in several different ways. Herbicide costs range from \$37 to \$124/ha with a net cost to U.S. peanut producers in excess of \$70 million annually (Wilcut *et al.*, 1995). Weeds also increase the need for additional tillage operations with a net loss to producers of \$7 to \$20/ha (Wilcut *et al.*, 1995).

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Weeds that escape control then cost producers another $49 to $124/ha due to yield reductions and $7 to $62/ha due to quality reductions (Bryson, 1989; Bridges, 1992). Reductions in harvesting efficiency associated with pod loss is estimated to range from $7/ha in Alabama to $17/ha in Oklahoma and South Carolina (Bridges, 1992). Estimated total income losses from poor weed control, yield and quality reductions, increased cultural inputs, and reduced harvesting efficiency range from $132/ha in Texas to $391/ha in Florida (Bridges, 1992).

This study was conducted to evaluate weed control options for Texas panicum and Palmer amaranth using various soil-applied and POST herbicide combinations. In addition, the profitability of the herbicide combinations was compared to determine the most cost effective herbicide treatment.

Materials and Methods

Field studies were conducted in 1997 and 1998 in a producer's field near Pearsall, TX on a Duval fine sandy loam (fine-loamy, mixed, hyperthermic Aridic Haplustalfs) with less than 1% organic matter and pH 7.2. The producer rotated peanut crops between two fields that were approximately 0.8 km apart. Each year the test area was infested with a natural population of Texas panicum and Palmer amaranth. Texas panicum densities were 10 to 15 plants/m^2 and densities for Palmer amaranth were 20 to 30 plants/m^2. The experimental design was a randomized complete block with four replications and a four (soil applied herbicides) by eight (POST herbicides) factorial arrangement of treatments. Each plot was two rows 7.6 m long spaced 97 cm apart.

Herbicide treatments at planting included no soil-applied herbicides, preplant incorporation applications of ethalfluralin [N-ethyl-N-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluoromethyl) benzenamine] at 0.84 kg ai/ha, dimethenamid [2-chloro-*N*-[(1-methyl-2-methoxy)ethyl]-*N*-(2,4-dimethyl-thien-3-yl)-acetamide at 1.4 kg ai/ha and S-metolachlor [S-2-chloro-*N*-(2-ethyl-6-methyphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide at 1.12 kg ai/ha. POST herbicides included no POST herbicides, acifluorfen {5-[2-chloro-4-(trifluormethyl)phenoxy]-2-nitrobenzoic acid} at 0.56 kg ai/ha, aciflurofen at 0.28 kg ai/ha plus bentazon [3-(1-methylethyl)-(1H)-2,1,3-benzothiadiazin-4(3H)-one,2,2-dioxide] at 0.56 kg ai/ha, bentazon at 1.12 kg ai/ha, imazapic {(±)-2-[4,5-dihydro-4-methyl-4-4(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-5-methyl-3-pyridinecarboxylic acid} at 0.07 kg ai/ha, imazethapyr {2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-5-ethyl-3-pyridinecarboxylic acid} at 0.07 kg ai/ha, pyridate [O-(6-chloro-3-phenyl-4-pyridazinyl) S-octylcarbonothioate] at 1.0 kg ai/ha, and 2,4-DB [4-(2,4-dichlorophenoxy) butanoic acid] at 0.28 kg/ha. Acifluorfen, bentazon, acifluorfen plus bentazon, and 2,4-DB, were applied with a petroleum oil adjuvant[3] at 2.3 L/ha. Imazapic and imazethapyr were applied with a nonionic surfactant[4] at 0.25% (v/v) of the spray volume. Ethalfluralin, dimethenamid, and S-metolachlor were incorporated immediately after application with a power-driven rotary tiller that had an incorporation depth of 6 cm. A nontreated check was included for comparison. Herbicides were applied with a compressed-air bicycle sprayer using Teejet[5] 11002 flat-fan nozzles that delivered a spray volume of 190 L/ha at 180 kPa. POST herbicides were applied 3 to 4 wk after planting (WAP) when peanut was 10 to 15 cm tall. "AT-108" and "Virugard" were planted on May 1, 1997 and May 20, 1998, respectively, at the rate of 100 kg/ha immediately after preplant incorporated (PPI) herbicides were applied.

Weed control and crop injury were visually estimated 2, 4, 8 and 14 wk after planting. Visual estimates were based on a scale of 0 (no weed control or peanut injury) to 100% (complete weed control as peanut death) relative to the nontreated control. Stand reduction, stunting, and foliar necrosis and chlorosis were used when making the visual estimates. The full impact of herbicide programs were reflected best in the 14-wk evaluations of weed control. Therefore, the 14-wk evaluations are the only evaluation presented.

Peanut yield was obtained by digging each plot separately, air drying in the field for 6 to 16 d, and harvesting peanut pods from each plot with a PTO-driven peanut combine. In 1997, peanuts were left in the field for 16 d before they were combined due to heavy rainfall which prevented access to the field and prevented adequate drying. In 1998, peanuts were harvested 6 d after digging. Weights were recorded after soil and foreign material were removed from the plot samples. Data were analyzed by a four by eight factorial analysis (soil-applied herbicide by POST herbicide). Signifi-

[3]Agridex (a mixture of paraffin base petroleum oil, polyoxyethylate polyol fatty acid ester, and polyol fatty ester). Helena Chemical Co., 5100 Poplar Street, Memphis, TN 38137.

[4]X-77 (a mixture of alkylaryl-polyoxyethylene glycols free fatty acids, and isopropanol). Valent USA Corp., Box 8025, Walnut Creek, CA 94596.

[5]Spraying Systems, Co., North Avenue and Schmale Road, Wheaton, IL 60188.

Table 1. Late season Palmer amaranth control using soil-applied and POST herbicides[a].

POST herbicide	Soil-applied herbicides			
	None	Ethalfluralin	Dimethenamid	S-metolachlor
	%			
Acifluorfen	77	99	98	96
Acifluorfen + bentazon	75	93	98	96
Bentazon	37	91	93	88
Imazapic	93	100	99	100
Imazethapyr	82	98	97	97
Pyridate	40	95	94	84
2,4-DB	61	91	95	90
None	0	79	59	69
LSD (0.05)	19			

[a]Herbicide treatments at planting included no soil-applied herbicides, preplant incorporation applications of ethalfluralin at 0.84 kg ai/ha, dimethenamid at 1.4 kg ai/ha and S-metolachlor at 1.12 kg ai/ha. POST herbicides included no POST herbicides, acifluorfen at 0.56 kg ai/ha, aciflurofen at 0.28 kg ai/ha plus bentazon at 0.56 kg ai/ha (A premix marketed as Storm), bentazon at 1.12 kg ai/ha, imazapic at 0.07 kg ai/ha, imazethapyr at 0.07 kg ai/ha, pyridate at 1.0 kg ai/ha, and 2,4-DB at 0.28 kg/ha. Acifluorfen, bentazon, acifluorfen + bentazon, and 2,4-DB, were applied with a Agridex at 2.3 L/ha. Imazapic and imazethapyr were applied with X-77 at 0.25% (v/v) of the spray volume.

cant differences among treatments were determined using analysis of variance and means were separated by Fisher's Protected least significant difference at $P \leq 0.05$. Transformation of treatment means for Palmer amaranth and Texas panicum control did not change the statistical analysis. Therefore, nontransformed data are presented.

Gross value ($/ha) was determined as a product of pod yield (kg/ha) and market value ($/kg). Net return ($/ha) was determined by subtracting herbicide costs from gross value. Costs other than those for herbicides were held constant over the entire experiment. Prices for each herbicide are the average of quotes provided by three major agricultural suppliers in south Texas.

Results and Discussion

There was a soil-applied by POST herbicide interaction for weed control, peanut yield, and net returns. Lack of year by treatment interactions allowed pooling of data over years for Texas panicum and Palmer amaranth control. A treatment by year interaction was significant for peanut yield and net return. Therefore, data are presented separately by year for these parameters.

Palmer Amaranth Control. Acifluorfen alone or acifluorfen plus bentazon controlled Palmer amaranth at least 70% while imazapic or imazethapyr alone controlled at least 80% (Table 1). Grichar (1997) reported imazapic POST provided greater than 95% Palmer amaranth control in 3 years when used alone while acifluorfen, acifluorfen plus bentazon, or imazethapyr provided greater than 90% control in 2 out of 3 years.

Bentazon, pyridate, or 2,4-DB POST without a soil-applied herbicide failed to control Palmer amaranth (Table 1). Bentazon does not control pigweed species (Buchanan *et al*., 1982; Grichar, 1994; Wilcut *et al*. 1994, 1995). Pyridate is active against yellow nutsedge *Cyperus esculentus* L., Florida beggarweed [*Desmodium tortuosum* (Sw.) DC.], and tall morningglory [*Ipomoea purpurea* (L.) Roth] (Grichar, 1992; Hicks *et al*., 1990; Jordan *et al*., 1993; MacDonald *et al*., 1988). Birschbach et al. (1993) reported that pyridate in combination with atrazine [6-chloro-N-ethyl-N-(1-methylethyl)-1,3,5-triazine-2,4-diamine] controlled an average of 98% triazine-resistant smooth pigweed (*Amaranthus hybridus* L.). In Europe, pyridate has been used extensively to control triazine-resistant weed biotypes (Birschbach *et al*., 1993).

When these POST herbicides were applied following PPI applications of ethalfluralin, dimethenamid, or S-metolachlor, Palmer amaranth control was at least 84% (Table 1). Ethalfluralin alone controlled 79% Palmer amaranth while dimethenamid and S-metolachlor alone controlled 59 and 69%, respectively. Pigweed spp. can be controlled with ethalfluralin (Wilcut *et al*., 1994). Metolachlor applied PPI or PRE controls pigweed less consistently than dinitroaniline herbicides (Wilcut, 1991; Wilcut *et al*., 1994).

Dimethenamid is used in corn (*Zea mays* L.), soybean (*Glycine max* L.), grain sorghum [*Sorghum bicolor* (L.) Moench], and peanut (Anonymous, 1998). Several broadleaf weeds are controlled or suppressed by dimethenamid including nightshade species (*Solanum* spp), pigweed species, and common lambsquarters (*Chenopodium album* L.)

Table 2. Late season Texas panicum control using soil-applied and POST herbicides[a].

POST herbicide	Soil-applied herbicides			
	None	Ethalfluralin	Dimethenamid	S-metolachlor
	%			
Acifluorfen	10	89	91	58
Acifluorfen + bentazon	0	88	87	64
Bentazon	7	96	88	45
Imazapic	80	97	97	94
Imazethapyr	67	97	90	84
Pyridate	13	90	91	51
2,4-DB	0	90	86	69
None	0	94	67	54
LSD (0.05)	25			

[a]Herbicide treatments at planting included no soil-applied herbicides, preplant incorporation applications of ethalfluralin at 0.84 kg ai/ha, dimethenamid at 1.4 kg ai/ha and S-metolachlor at 1.12 kg ai/ha. POST herbicides included no POST herbicides, acifluorfen at 0.56 kg ai/ha, aciflurofen at 0.28 kg ai/ha plus bentazon at 0.56 kg ai/ha (A premix marketed as Storm), bentazon at 1.12 kg ai/ha, imazapic at 0.07 kg ai/ha, imazethapyr at 0.07 kg ai/ha, pyridate at 1.0 kg ai/ha, and 2,4-DB at 0.28 kg/ha. Acifluorfen, bentazon, acifluorfen + bentazon, and 2,4-DB, were applied with a Agridex at 2.3 L/ha. Imazapic and imazethapyr were applied with X-77 at 0.25% (v/v) of the spray volume.

(Gaeddert *et al.*, 1997; Owen *et al.*, 1998; Tonks *et al.*, 1999). In field potato (*Solanum tuberosum* L.) studies, dimethenamid effectively controlled annual grasses but provided less consistent annual broadleaf weed control (Arnold and Gregory, 1994; Arnold *et al.*, 1998; Sarpe *et al.*, 1994). Other potato studies have shown that dimethenamid controlled common lambsquarters, redroot pigweed (*Amaranthus retroflexus* L.), and hairy nightshade (*Solanum sarrachoidas* Sendtner) better than metolachlor [2-chloro-N-(2-ethyl-6-methylpheny)-N-(2-methoxy-1-methylethyl)acetamide] or pendimethalin [N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine] (Tonks *et al.*, 1999).

Texas Panicum Control. Imazapic applied POST controlled Texas panicum 80% when used without a soil-applied herbicide (Table 2). Imazapic will control Texas panicum control when applied to Texas panicum less than 2.5 cm tall, while imazethapyr alone provides inconsistent control when applied to small Texas panicum (authors personal observation). Imazapic will control rhizome and seedling johnsongrass [*Sorghum halepense* (L.) Pers.], Texas panicum, large crabgrass, southern crabgrass, [*Digitaria ciliaris* (Retz.) Koel.], and broadleaf signalgrass (Wilcut *et al.*, 1993; 1995).

Ethalfluralin alone controlled 94% Texas panicum while dimethenamid and S-metolachlor controlled this weed less than 70% (Table 2). The dinitroaniline herbicides provide excellent control of annual grasses (Buchanan *et al.*, 1982; Chamblee *et al.*, 1982; Wilcut *et al.*, 1994) and are the only soil-applied herbicides registered for use in peanut that will provide full-season control of Texas panicum (Wilcut *et al.*, 1987a,b, Wilcut *et al.*, 1995).

Ethalfluralin in combination with POST herbicides controlled 88 to 97% Texas panicum which was not better than ethalfluralin alone (Table 2). Only dimethenamid in combination with imazapic provided better Texas panicum control than dimethenamid alone (Table 2). S-metolachlor in combination with imazapic or imazethapyr controlled at least 84% Texas panicum which was better than S-metolachlor alone. Dimethenamid controls many annual grasses, such as foxtails (*Setaria* spp.), barnyardgrass [*Echinochloacrus galli* (L.) Beauv.], and large crabgrass [*Digitaria sanguinalis* (L.) Scop.] but control of woolly cupgrass [*Eriochloa villosa* (Thunb.)Kunth], wild-proso millet (*Panicum miliaceum* L.), broadleaf signalgrass [*Brachiaria paltyphylla* (Griseb.) Nash], and Texas panicum is inconsistent (Grichar *et al.*, 1996; Mueller and Hayes, 1997; Rabaey and Harvey, 1997). Metolachlor provides little or no Texas panicum control (Wilcut *et al.*, 1995).

Peanut Yields. Peanut yields were lower in 1997 because peanuts were not harvested for 3 wk after digging due to extremely wet conditions. Peanut yields from plots without any herbicide were less than 700 kg/ha in both years (Table 3). In 1997, when comparing POST herbicides only, imazethapyr increased yield over the untreated check. When soil-applied herbicides alone were compared, ethalfluralin increased peanut yield. Dimethenamid or S-metolachlor alone did not result in a yield increase over the untreated check in 1997 but did increase yield over the untreated check in 1998 (Table 3). All ethalfluralin and dimethenamid herbicide combinations resulted in a yield increase over the untreated check (Table 3). Only S-metolachlor

Table 3. Peanut yields from herbicide treatments[a].

	Soil-applied herbicides							
	None		Ethalfluralin		Dimethenamid		S-metolachlor	
POST herbicide	1997	1998	1997	1998	1997	1998	1997	1998
	kg/ha							
Acifluorfen	960	2360	1930	4380	1970	3830	1440	4770
Acifluorfen + bentazon	660	1540	1740	2640	1900	3910	2190	2690
Bentazon	1270	1770	1760	3750	2110	2970	1770	2990
Imazapic	1230	3090	2430	4490	2280	3510	2570	4400
Imazethapyr	1700	1570	2060	3400	2210	2730	2340	3640
Pyridate	1200	1570	2060	3550	2200	2730	2050	2870
2,4-DB	1230	1160	1690	3020	2280	3550	2000	2500
None	540	680	1630	3950	1470	2080	1330	2250
LSD (0.05) 1997	1030							
LSD (0.05) 1998	1230							

[a]Herbicide treatments at planting included no soil-applied herbicides, preplant incorporation applications of ethalfluralin at 0.84 kg ai/ha, dimethenamid at 1.4 kg ai/ha and S-metolachlor at 1.12 kg ai/ha. POST herbicides included no POST herbicides, acifluorfen at 0.56 kg ai/ha, aciflurofen at 0.28 kg ai/ha plus bentazon at 0.56 kg ai/ha (A premix marketed as Storm), bentazon at 1.12 kg ai/ha, imazapic at 0.07 kg ai/ha, imazethapyr at 0.07 kg ai/ha, pyridate at 1.0 kg ai/ha, and 2,4-DB at 0.28 kg/ha. Acifluorfen, bentazon, acifluorfen + bentazon, and 2,4-DB, were applied with a Agridex at 2.3 L/ha. Imazapic and imazethapyr were applied with X-77 at 0.25% (v/v) of the spray volume.

followed by acifluorfen POST did not result in a yield increase over the untreated check.

In 1998, when used alone, acifluorfen and imazapic applied POST increased peanut yield over the untreated check (Table 3). Ethalfluralin, dimethenamid, and S-metolachlor and all POST herbicide combinations increased yield over the untreated check. Competition from Texas panicum and Palmer amaranth can severely reduce peanut yield (Grichar, 1997; Wilcut, *et al.* 1987a). Not only does the competition from these weeds reduce peanut yield but their extensive root system interferes with harvesting efficiency (Buchanan *et al.*, 1982).

Net Returns. Imazapic and imazethapyr were the most expensive herbicides used, while 2,4-DB was the least expensive (Table 4). Returns closely followed trends in yield. Although imazapic and imazethapyr were the most expensive herbicides to use they provided the greatest return (Table 5). Only in 1997, when imazapic was used without a soil-applied herbicide, was the net return for imazapic lower then with several other herbicides. In soybean, economic returns were found to be less with an extensive weed control system compared to a less extensive system (Bridges and Walker, 1987).

In 1997, when comparing POST herbicides applied alone, only imazethapyr increased return

Table 4. Herbicide costs for 1997 and 1998 averaged over three distributors[a].

	Soil-applied herbicides			
POST herbicide	None	Ethalfluralin	Dimethenamid	S-metolachlor
	$/ha			
Acifluorfen	24.50	43.77	71.65	56.54
Acifluorfen + bentazon	39.92	74.00	87.06	71.95
Bentazon	49.99	69.26	97.15	83.68
Imazapic	81.31	100.58	128.46	113.35
Imazethapyr	58.37	77.63	105.52	90.40
Pyridate	17.07	51.75	79.64	64.52
2,4-DB	15.26	34.53	62.42	63.16
None	0	19.27	47.15	32.04

[a]Herbicide treatments at planting included no soil-applied herbicides, preplant incorporation applications of ethalfluralin at 0.84 kg ai/ha, dimethenamid at 1.4 kg ai/ha and S-metolachlor at 1.12 kg ai/ha. POST herbicides included no POST herbicides, acifluorfen at 0.56 kg ai/ha, aciflurofen at 0.28 kg ai/ha plus bentazon at 0.56 kg ai/ha (A premix marketed as Storm), bentazon at 1.12 kg ai/ha, imazapic at 0.07 kg ai/ha, imazethapyr at 0.07 kg ai/ha, pyridate at 1.0 kg ai/ha, and 2,4-DB at 0.28 kg/ha. Acifluorfen, bentazon, acifluorfen + bentazon, and 2,4-DB, were applied with a Agridex at 2.3 L/ha. Imazapic and imazethapyr were applied with X-77 at 0.25% (v/v) of the spray volume.

Table 5. Net returns per hectare for each herbicide treatment[a,b].

	Soil-applied herbicides							
	None		Ethalfluralin		Dimethenamid		S-metolachlor	
POST herbicide	1997	1998	1997	1998	1997	1998	1997	1998
	$/ha							
Acifluorfen	699	1753	1410	3255	1412	2813	1028	3537
Acifluorfen + bentazon	457	1120	1237	1915	1344	2858	1578	1955
Bentazon	907	1283	1257	2756	1492	2140	1250	2169
Imazapic	845	2729	1753	3282	1589	2915	1823	3201
Imazethapyr	1222	2269	1753	2484	1559	2539	1672	2452
Pyridate	887	1166	1500	2623	1578	1977	1480	2098
2,4-DB	911	859	1239	2241	1045	2612	1444	1820
None	407	512	1209	2956	1060	1520	970	1663
LSD (0.05) 1997	692							
LSD (0.05) 1998	822							

[a]Net returns per hectare was determined by subtracting herbicide costs from gross $ value/ha.

[b]Herbicide treatments at planting included no soil-applied herbicides, preplant incorporation applications of ethalfluralin at 0.84 kg ai/ha, dimethenamid at 1.4 kg ai/ha and S-metolachlor at 1.12 kg ai/ha. POST herbicides included no POST herbicides, acifluorfen at 0.56 kg ai/ha, aciflurofen at 0.28 kg ai/ha plus bentazon at 0.56 kg ai/ha (A premix marketed as Storm), bentazon at 1.12 kg ai/ha, imazapic at 0.07 kg ai/ha, imazethapyr at 0.07 kg ai/ha, pyridate at 1.0 kg ai/ha, and 2,4-DB at 0.28 kg/ha. Acifluorfen, bentazon, acifluorfen + bentazon, and 2,4-DB, were applied with a Agridex at 2.3 L/ha. Imazapic and imazethapyr were applied with X-77 at 0.25% (v/v) of the spray volume.

over the untreated check (Table 5). Ethalfluralin alone increased return, while dimethenamid and S-metolachlor alone did not. Herbicide combinations which included soil-applied herbicides, with the exception of dimethenamid fb 2,4-DB POST and S-metolachlor fb acifluorfen POST, increased returns over the untreated check.

In 1998, acifluorfen, imazapic, and imazethapyr POST alone increased returns over the untreated check (Table 5). Ethalfluralin, dimethenamid, and S-metolachlor alone or in combination with a POST herbicide increased returns over the untreated check.

Results from this research demonstrate that although imazethapyr and imazapic are the most expensive herbicides, they provide the greatest net returns. Lesser inputs resulted in reduced weed control and lower net returns. Based on this data, the added cost of a soil- applied herbicide resulted in improved weed control and increased net returns over POST herbicides alone. Although many growers in the southwest feel that a total POST program using imazapic or imazethapyr is sufficient, this research shows that a soil-applied herbicide is important in order to maintain season-long weed control and increase net returns.

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Literature Cited

Anonymous. 1990. Weed Identification Guide. Champaign, IL: Southern Weed Science Society.

Anonymous. 1998. Crop Protection Chemicals Reference. 14th ed. Chem. Pharmaceutical Publ. Co. And John Wiley & Sons, Inc., New York. 2431 pp.

Arnold, R.N., and E.J. Gregory. 1994. Broadleaf weed control in field potatoes. Proc. West. Soc. Weed Sci. 47:17.

Arnold, R.N., E.J. Gregory, and D. Smeal. 1998. Broadleaf weed control in field potato. West Soc. Weed Sci. Res. Prog. Rep. pp. 117.

Birschbach, E.D., M.G. Myers, and R.G. Harvey. 1993. Triazine-resistant smooth pigweed (*Amaranthus hybridus*) control in field corn (*Zea mays* L.). Weed Technol. 7:431-436.

Brecke, B.J., and D.L. Colvin. 1991. Weed management in peanuts, pp. 239-251. *In* D. Pimentel (ed.). CRC Handbook of Pest Management in Agriculture, Vol. 3, 2nd ed. CRC Press, Boca Raton, FL.

Bridges, D.C. and R.H. Walker. 1987. Economics of sicklepod (*Cassia obtusifolia*) management. Weed Sci. 35:584-591.

Bridges, D.C. 1992. Crop Losses Due to Weeds in Canada and the United States. Weed Sci. Soc. Amer., Champaign, IL.

Bryson, C.T. 1989. Economic losses due to weeds in the southern states. Proc. South. Weed Sci. Soc. 42:385-392.

Buchanan, G.A., D.S. Murray, and E.W. Hauser. 1982. Weeds and their control in peanuts, pp. 206-249. *In* H.E. Pattee and C.T. Young (eds.). Peanut Science and Technology. Amer. Peanut Res. Educ. Soc. Inc., Yoakum, TX.

Chamblee, R.W., L. Thompson, Jr. and T.M. Bunn. 1982. Management of broadleaf signalgrass (*Brachiaria platyphylla*) in peanuts (*Arachis hypogaea*). Weed Sci. 30:40-44.

Correll, D.S., and M.C. Johnston. 1979. Manual of Vascular Plants of Texas. Univ. of Texas at Dallas, Richardson, TX.

Dowler, C.C. 1998. Weed survey–Southern states. Proc. South. Weed Sci. Soc. 51:299-313.

Gaeddert, J.W., D.E. Peterson, and M.J. Horak. 1997. Control and cross-resistance of an acetelactate synthase inhibitor-resistant Palmer amaranth (*Amaranthus palmeri*) biotype. Weed Technol. 11:132-137.

Grichar, W.J. 1992. Yellow nutsedge (*Cyperus esculentus*) control in peanuts (*Arachis hypogaea*). Weed Technol. 6:108-112.

Grichar, W.J. 1994. Spiny amaranth (*Amaranthus spinosus* L.) control in peanut (*Arachis hypogaea*). Weed Technol. 8:199-202.

Grichar, W.J., R.G. Lemon, and K.L. Smith. 1996. Use of SAN 582 in a weed control program for Texas peanut. Proc. South Weed Sci. Soc. 49:10.

Grichar, W.J. 1997. Control of Palmer amaranth (*Amaranthus palmeri*) in peanut (*Arachis hypogaea*) with postemergence herbicides. Weed Technol. 11:739-743.

Henning, R.J., A.H. Allison, and L.D. Tripp. 1982. Cultural practices, pp. 123-138. *In* H.E. Pattee and C.T. Young (eds.). Peanut Science and Technology, Amer. Peanut Res. Educ. Soc., Inc., Yoakum, TX.

Hicks, T.V., G.R. Wehtje, and J.W. Wilcut. 1990. Weed control in peanuts (*Arachis hypogaea*) with pyridate. Weed Technol. 4:493-495.

Jordan, D.L., J.W. Wilcut, and C.W. Swann. 1993. Application timing of lactofen for broadleaf weed control in peanut (*Arachis hypogaea*). Peanut Sci. 20:129-131.

MacDonald, G.E., B.J. Brecke, and D.L. Colvin. 1988. Evaluation of pyridate for postemergence weed control in peanuts. Proc. South Weed Sci. Soc. 41:64.

Mueller, T.C., and R.M. Hayes. 1997. Effect of tillage and soil-applied herbicides on broadleaf signalgrass (*Brachiaria platyphylla*) control in corn (*Zea mays*). Weed Technol. 11:698-703.

Owen, C.K., R.N. Arnold, and E.J. Gregory. 1998. Annual grass and broadleaf weed control in dry beans with dimethenamid. Proc. West. Soc. Weed Sci. 51:20-21.

Rabaey, T.L., and G. Harvey. 1997. Sequential applications control woolly cupgrass (*Eriochloa villosa*) and wild-proso millet (*Panicum miliaceum*) in corn (*Zea mays*). Weed Technol. 11:537-542.

Sarpe, N., N. Chirita, G. Budoi, and C. Hogea. 1994. Research works on both selectivity and efficacy of the herbicides dimethenamid, alachlor and pendimethalin (mixed with metribuzin or linuron) for potato crop. Proc. 46th Int. Symp. Crop Prot.: Part IV. 59: 1361-1365.

Tonks, D.J., C.V. Eberlein, M.J. Guttieri and B.A. Brinkman. 1999. SAN 582 efficacy and tolerance in potato (*Solanum tubersum*). Weed Technol. 13:71-76.

Walker, R.H., L.W. Wells, and J.A. McGuire. 1989. Bristly starbur (*Acanthospermum hispidum*) interference in peanuts (*Arachis* hypogaea). Weed Sci. 37:196-200.

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

Wilcut, J.W., G.R. Wehtje, and R.H. Walker. 1987a. Economics of weed control in peanuts (*Arachis hypogaea*) with herbicides and cultivations. Weed Sci. 35:711-715.

Wilcut, J.W., G.R. Wehtje, and M.G. Patterson. 1987b. Economic assessment of weed control systems for peanuts (*Arachis hypogaea*). Weed Sci. 35:433-437.

Wilcut, J.W., E.F. Eastin, J.S. Richburg, III., W.K. Vencill, F.R. Walls, and G. Wiley. 1993. Imidazolinone systems for southern weed management in resistant corn. Weed Science Soc. Amer. 33:5.

Wilcut, J.W., A.C. York, and G.R. Wehtje. 1994. The control and interaction of weeds in peanut (*Arachis hypogaea*). Rev. Weed Sci. 6:177-205.

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.). Advances in Peanut Science. Amer. Peanut Res. Educ. Soc., Stillwater, OK.