Weed Technology. 2002. Volume 16:29–36

Weed Management with Diclosulam in Strip-Tillage Peanut (*Arachis hypogaea*)[1]

ANDREW J. PRICE and JOHN W. WILCUT[2]

Abstract: Experiments were conducted at three locations in North Carolina in 1999 and 2000 to evaluate weed management systems in strip-tillage peanut. Diclosulam was evaluated with standard preemergence (PRE), early postemergence, and postemergence (POST) herbicide systems in a factorial treatment arrangement. Preemergence treatments that contained diclosulam controlled common lambsquarters, common ragweed, and eclipta by 100%. Diclosulam PRE controlled entireleaf morningglory by 88%, ivyleaf morningglory by ≥ 90%, pitted morningglory by ≥ 81%, and prickly sida by ≥ 94%. Yellow nutsedge control with diclosulam ranged from 65 to 100% depending on location, whereas POST systems containing imazapic controlled yellow nutsedge by at least 89%, regardless of PRE herbicides. Peanut yields and net returns were reflective of levels of weed management. Systems that included diclosulam PRE plus POST herbicides consistently provided high yields and net returns. Clethodim late POST was required for full-season control of annual grasses, including broadleaf signalgrass, goosegrass, large crabgrass, and Texas panicum.

Nomenclature: Clethodim; diclosulam; imazapic; broadleaf signalgrass, *Brachiaria platyphylla* (Griseb.) Nash #[3] BRAPP; common lambsquarters, *Chenopodium album* L. # CHEAL; common ragweed, *Ambrosia artemisiifolia* L. # AMBEL; eclipta, *Eclipta prostrata* L. # ECLAL; entireleaf morningglory, *Ipomoea hederacea* var. *integriuscula* Gray # IPOHG; goosegrass, *Eleusine indica* (L.) Gaertn. # ELEIN; ivyleaf morningglory, *Ipomoea hederacea* (L.) Jacq. # IPOHE; large crabgrass, *Digitaria sanguinalis* (L.) Scop. # DIGSA; pitted morningglory, *Ipomoea lacunosa* L. # IPOLA; prickly sida, *Sida spinosa* L. # SIDSP; Texas panicum, *Panicum texanum* Buckl. # PANTE; yellow nutsedge, *Cyperus esculentus* L. # CYPES; peanut, *Arachis hypogaea* L. 'NC 10C' and 'NC 12C'.

Additional index words: Economic analysis.

Abbreviations: EPOST, early postemergence; fb, followed by; POST, postemergence; PPI, preplant incorporated; PRE, preemergence.

INTRODUCTION

Peanut has typically been grown in ridged conventional-tillage seedbeds (Sholar et al. 1995; Wilcut et al. 1987, 1990, 1994, 1995) that receive soil-applied preplant incorporated (PPI) and preemergence (PRE) herbicide treatments (or both) followed by (fb) multiple applications of early postemergence (EPOST) and postemergence (POST) herbicide combinations (Wilcut et al. 1994). Concerns for declining soil organic matter, soil structure degeneration, increased subsoil compaction, and crop damage caused by water stress and sandblasting have caused growers to devise ways to reduce tillage operations (Troeh et al. 1991). Strip-tillage is a type of conservation tillage where the area within the crop row is tilled, whereas the inter-row areas are not disturbed. This practice reduces soil erosion and evaporative water loss by leaving ≥ 30% crop residues on the soil surface, decreasing soil compaction, and increasing water infiltration (Troeh et al. 1991).

In peanut, herbicide systems are usually more intensive in strip-tillage when compared with conventional tillage because PRE or PPI within-the-row treatments were expected to provide reduced efficacy compared with conventional PPI treatments (Wilcut et al. 1987). Adequate weed control in minimum tillage requires PRE, EPOST, and POST herbicides (Wilcut et al. 1990). Depending on the herbicide system, conventional-tillage peanut produced yields 800 to 1,900 kg/ha higher than minimum-tillage peanut and also provided greater net returns (Wilcut et al. 1990). This may be partly because of more effective digging of peanut in conventional systems, that are ridged, compared with nonridged minimum-tillage peanut (Grichar and Boswell 1987). Since

[1] Received for publication February 26, 2001, and in revised form August 22, 2001.

[2] Graduate Research Assistant and Professor, respectively, Crop Science Department, P.O. Box 7620, North Carolina State University, Raleigh, NC 27695-7620. Corresponding author's E-mail: john_wilcut@ncsu.edu.

[3] Letters following this symbol are a WSSA-approved computer code from *Composite List of Weeds*, Revised 1989. Available only on computer disk from WSSA, 810 East 10th Street, Lawrence, KS 66044-8897.

the late 1980s, registrations for dinoseb and naptalam in peanut have either been canceled or withdrawn. Additionally, concerns about alachlor-treated peanut have eliminated this herbicide from use in U.S. peanut production (Bridges et al. 1994; Wilcut et al. 1994, 1995). Herbicide registrations in peanut since 1990 include clethodim, diclosulam, dimethenamid, flumioxazin, imazapic, and pyridate. Thus, the herbicide options available for weed management in strip-tillage peanut production have changed appreciably since the late 1980s.

Soil-applied herbicides registered in peanut include dimethenamid, ethalfluralin, imazethapyr, *s*-metolachlor, norflurazon, and pendimethalin. Pendimethalin and ethalfluralin applied PPI and *s*-metolachlor applied PPI or PRE control annual grasses and small-seeded broadleaf weeds (Wilcut et al. 1994). However, they do not control broadleaf weeds that are commonly found in North Carolina and Virginia peanut fields, including common ragweed, eclipta, *Ipomoea* species, and prickly sida (Askew et al. 1999; Bridges et al. 1994; Wilcut and Swann 1990; Wilcut et al. 1990, 1994). These weeds often require multiple applications of POST herbicides for season-long control (Bailey et al. 1999a, 1999b; Wilcut and Swann 1990). Imazethapyr soil-applied does not control common ragweed or eclipta (Wilcut et al. 1991; York et al. 1995). Norflurazon is not used in North Carolina and Virginia peanut production because of crop tolerance concerns and potential for carryover to small grains, corn (*Zea mays* L.), and tobacco (*Nicotiana tobaccum* L.) (Anonymous 2000a; Jordan et al. 1998). A broad-spectrum soil-applied herbicide providing residual control may reduce inputs by reducing the types and number of herbicides applied and the number of trips through the field (Bailey et al. 1999a, 1999b).

Diclosulam is a triazolopyrimidine sulfonanilide soil-applied herbicide recently registered for PPI and PRE treatment in peanut (Anonymous 2000b). Ethalfluralin PPI plus diclosulam PPI or PRE controls a broad spectrum of annual broadleaf weeds and usually exhibits excellent crop tolerance in conventional-tillage peanut (Bailey et al. 1999a, 1999b, 2000; Baughman et al. 2000; Dotray et al. 2000; Main et al. 2000; Prostko et al. 1998). The recent increase in reduced-tillage peanut production in the mid-Atlantic and Southeastern coastal plain and the paucity of data concerning diclosulam performance in reduced-tillage systems necessitates additional research. Therefore, studies were conducted to evaluate weed control, crop response, peanut yield, and economic returns from herbicide systems containing diclosulam in reduced-tillage peanut production.

MATERIALS AND METHODS

Field experiments were conducted at the Peanut Belt Research Station located near Lewiston, NC in 1999 and in two nearby but separate fields in 2000 to evaluate weed management systems in strip-tillage peanut. Soils were a Norfolk loamy sand (fine-loamy, siliceous, Thermic Typic Paleudults) with organic matter content ranging between 1 and 1.1% and pH of 5.5 to 6.0. Peanut cultivars included NC 10C in 1999 and NC 12C in 2000. Peanut was planted 5-cm deep at 120 to 130 kg/ha in 91-cm rows into corn stubble in 1999 and into cotton (*Gossypium hirsutum* L.) and soybean [*Glycine max* (L.) Merr.] stubble in 2000 (Jordan 2000). Pest management programs other than herbicide programs were based on North Carolina Cooperative Extension Service recommendations (Bailey 2000; Brandenburg 2000).

Common lambsquarters, common ragweed, eclipta, entireleaf morningglory, ivyleaf morningglory, pitted morningglory, prickly sida, and yellow nutsedge were each evaluated at two or three sites. At the time of EPOST and POST applications, broadleaf weeds were in the one- to seven-leaf stage, yellow nutsedge was 15- to 25-cm tall, and weed densities ranged from 3 to 10 plants/m^2 depending on species. Early postemergence treatments were applied 7 to 10 d after peanut emergence, and POST treatments were applied approximately 2 wk after EPOST treatments. Paraquat at 0.7 kg ai/ha was applied to all plots 3 wk before planting to control existing vegetation. The PRE herbicide options included: (1) paraquat at 0.7 kg/ha plus dimethenamid at 1.4 kg ai/ha, (2) paraquat at 0.7 kg/ha plus diclosulam at 0.027 kg ai/ha, or (3) paraquat at 0.7 kg/ha plus dimethenamid at 1.4 kg/ha plus diclosulam at 0.027 kg/ha. Postemergence herbicides included: (1) untreated, (2) paraquat at 0.14 kg ai/ha plus bentazon at 0.28 kg ai/ha EPOST fb acifluorfen at 0.28 kg ai/ha plus bentazon at 0.56 kg ai/ha, or (3) paraquat at 0.14 kg/ha plus bentazon at 0.28 kg/ha EPOST fb imazapic at 0.07 kg ai/ha POST. A nonionic surfactant[4] at 0.25% (v/v) was included in all EPOST and POST herbicide treatments. The paraquat burndown treatment served as the comparison for visual evaluations of weed control and crop injury. Clethodim late POST at 0.14 kg ai/ha plus crop oil concentrate[5] at 1% (v/v) was applied to all plots except the untreated

[4] Induce® nonionic low foam wetter–spreader adjuvant containing 90% nonionic surfactant (alkylarylopolyoxyalkane ether and isopropanol), free fatty acids, and 10% water. Helena Chemical Company, Suite 500, 6075 Poplar Avenue, Memphis, TN 38137.

[5] Agri-dex®, 83% paraffin base petroleum oil and 17% surfactant blend. Helena Chemical Company, Suite 500, 6075 Poplar Avenue, Memphis, TN 38137.

checks to provide season-long control of annual grasses, including broadleaf signalgrass, goosegrass, large crabgrass, and Texas panicum. This treatment was needed to facilitate harvest as the fibrous root systems of annual grasses interfere with digging and harvesting operations (Wilcut et al. 1994). The experimental design was a randomized complete block with three replications. There were four 91-cm-wide and 6.1-m-long plots.

Visual estimates of weed control were recorded early (mid-June) and late in the season (late-August) just prior to harvest. Weed control and peanut injury, based on leaf discoloration and biomass reduction as compared with the nontreated control, was visually estimated on a scale of 0 (no injury symptoms) to 100 (complete death of all plants or no plants present) (Frans et al. 1986). As weed control at the end of the season influenced peanut yield and harvest efficiency, only late-season evaluations of weed control will be presented (Wilcut et al. 1994). Peanut injury in the form of discoloration, stunting, and stand reduction was evaluated 2 and 5 wk after planting. The center two rows of each plot were harvested in mid-October of each year using conventional harvesting equipment.

Net returns to land and management were determined by substituting the cost of each herbicide system for weed control and average yield into a North Carolina farm budget (Brown 2000). All costs with the exception of those used for weed control were based on this budget generator. The production costs included cultural and pest management procedures, equipment and labor, interest on operating equipment, harvest operations, including drying and hauling, and general overhead costs. Quotes of herbicide and adjuvant costs were obtained from two North Carolina agricultural suppliers and averaged. Cost of herbicide application was \$4.28/ha, based on estimates developed by the Department of Agriculture and Resource Economics at North Carolina State University. Herbicide system costs represent the sum of all applications, herbicide, and adjuvant costs. Net returns were calculated by multiplying yield per hectare by the price support (\$0.67/kg) and subtracting total production costs for each system.

Data from the control were deleted prior to analysis to stabilize variance as visually estimated weed control ratings were set to zero, and peanut yield could not be harvested because of weed biomass interference with machinery. To recognize structure in the treatment arrangement, analysis of variance was conducted using the general linear models procedure in SAS (SAS 1998) to evaluate the effect of various PRE herbicide treatment options (three levels) and POST herbicide treatment options (three levels) on crop injury, weed control, and crop yield. Sums of squares were partitioned to evaluate location and year effects which were considered a single random variable. Main effects and interactions were tested by the appropriate mean square associated with the random variable (McIntosh 1983). Mean separations were performed using Fisher's protected least significant difference test at $P = 0.05$.

RESULTS AND DISCUSSION

Peanut injury was 2% or less at the first evaluation with no differences between soil-applied treatments (data not shown) and was also typical for POST herbicide crop injury (< 5% at 5 wk after treatment) (data not shown).

Weed Control. *Yellow nutsedge.* Location interactions were significant; therefore, each location is discussed separately. Dimethenamid PRE alone controlled yellow nutsedge by 32 to 64% depending on location (Table 1). The addition of bentazon plus paraquat EPOST fb acifluorfen plus bentazon POST to dimethenamid PRE provided 55 to 97% control depending on location. Diclosulam PRE alone or dimethenamid plus diclosulam PRE controlled yellow nutsedge by 65 to 100% depending on location. Similar levels of yellow nutsedge control with *s*-metolachlor plus diclosulam PRE was shown in conventional-tillage peanut in Texas (Baughman et al. 2000). The addition of bentazon plus paraquat EPOST fb acifluorfen plus bentazon POST to diclosulam PRE or diclosulam plus dimethenamid PRE did not always increase control. Imazapic POST systems controlled yellow nutsedge by ≥ 89%. These data are in agreement with earlier research and illustrate that imazapic is the POST standard for control of perennial sedges in peanut (Richburg et al. 1993, 1994).

Common ragweed. As no herbicides by location interactions were evident for common ragweed, the data were combined over location. Dimethenamid PRE controlled common ragweed by 82%, whereas diclosulam PRE or dimethenamid plus diclosulam PRE controlled common ragweed by ≥ 99% (Table 1). Acifluorfen, bentazon, and paraquat control small common ragweed but do not provide residual control (Wilcut 1991; Wilcut and Swann 1990). Common ragweed control with dimethenamid plus EPOST and POST herbicides was ≥ 97%. Common ragweed infests 75% of North Carolina and Virginia peanut hectarage (Bridges et al. 1994).

Eclipta. As with common ragweed, no treatment by location interactions for eclipta control was present; there-

Table 1. Interaction of preemergence (PRE), early postemergence (EPOST), and postemergence (POST) herbicide systems on yellow nutsedge and broadleaf weed control at three North Carolina locations in 1999 and 2000.

Herbicides			Yellow nutsedge					
PRE[a]	EPOST[b]	POST[c]	Lewiston 1999[d]	Lewiston A 2000	Lewiston B 2000	Common ragweed	Eclipta	Prickly sida
			%					
Dimethenamid	None	None	32 c[e]	64 b	58 cd	82 b	31 c	0 d
Dimethenamid	Bentazon + paraquat	Acifluorfen + bentazon	67 b	97 a	55 d	97 a	78 b	87 c
Dimethenamid	Bentazon + paraquat	Imazapic	89 ab	100 a	99 a	100 a	97 a	100 a
Dimethenamid + diclosulam	None	None	83 ab	100 a	74 c	100 a	100 a	97 b
Dimethenamid + diclosulam	Bentazon + paraquat	Acifluorfen + bentazon	81 ab	100 a	88 b	100 a	100 a	100 a
Dimethenamid + diclosulam	Bentazon + paraquat	Imazapic	91 a	100 a	100 a	100 a	100 a	100 a
Diclosulam	None	None	77 ab	100 a	65 cd	99 a	100 a	94 b
Diclosulam	Bentazon + paraquat	Acifluorfen + bentazon	90 ab	100 a	63 cd	100 a	100 a	100 a
Diclosulam	Bentazon + paraquat	Imazapic	92 ab	100 a	100 a	100 a	100 a	100 a

[a] Paraquat was applied preplant to all plots at 0.70 kg ai/ha. Rates of PRE herbicides were: dimethenamid at 1.40 kg ai/ha and diclosulam at 0.027 kg ai/ha.

[b] Rates of EPOST herbicides were: bentazon at 0.28 kg ai/ha and paraquat at 0.14 kg ai/ha.

[c] Rates of POST herbicides were: bentazon at 0.56 kg/ha, acifluorfen at 0.28 kg ai/ha, and imazapic at 0.071 kg ai/ha. Clethodim was applied late POST at 0.14 kg ai/ha except the untreated check.

[d] All locations were near Lewiston, NC. One location was in 1999 and two locations were in 2000.

[e] Mean separations within a column followed by the same letter are not significantly different at 5% level of probability.

fore, data were combined over location. All treatments that included diclosulam controlled eclipta by 100% (Table 1). Prostko et al. (1998) reported a minimum of 95% eclipta control with diclosulam PRE in conventional-tillage peanut. Dimethenamid PRE alone controlled eclipta by 31%. The addition of bentazon plus paraquat EPOST fb acifluorfen plus bentazon POST to dimethenamid increased control by 47 percentage points over dimethenamid alone. Any POST systems containing imazapic controlled eclipta by $>$ 97%. There are no other registered soil-applied herbicides in peanut that control eclipta (Wilcut et al. 1991, 1994, 1995).

Prickly sida. As with common ragweed and eclipta, no treatment by location interactions was present for prickly sida control; therefore, the data were combined over location. Dimethenamid PRE did not control prickly sida (Table 1). Dimethenamid PRE fb paraquat plus bentazon EPOST fb acifluorfen plus bentazon POST controlled prickly sida by 87%, whereas imazapic POST systems controlled prickly sida by 100%. Diclosulam PRE and dimethenamid plus diclosulam PRE controlled prickly sida by 94 and 97%, respectively. The addition of EPOST plus POST herbicides to dimethenamid plus diclosulam increased control to 100%. Similar results with diclosulam PPI or PRE fb POST herbicides have been reported in conventional-tillage peanut (Bailey et al. 1999a, 1999b).

Entireleaf and pitted morningglories. As there were no herbicide by location interactions for entireleaf and pitted morningglories, data were combined over location. Dimethenamid PRE did not control entireleaf morningglory or pitted morningglory (Table 2). The acifluorfen plus bentazon POST system controlled entireleaf and pitted morningglories by $\geq$ 85%, whereas the imazapic POST system controlled 100% of these populations. Similar control levels were reported with imazapic in Georgia (Richburg et al. 1995, 1996). Diclosulam PRE with or without dimethenamid controlled entireleaf and pitted morningglories by at least 81% which is similar to control levels reported in Texas (Dotray et al. 2000). The additional inputs of EPOST and POST herbicides to dimethenamid plus diclosulam systems controlled $\geq$ 93% of the entireleaf and pitted morningglory populations. Scott et al. (2001) saw similar results with diclosulam PRE in conventional-tillage peanut.

Ivyleaf morningglory. Location interactions were significant; therefore, each location is discussed separately. As seen with entireleaf and pitted morningglories, dimethenamid PRE did not control ivyleaf morningglory at either location (Table 2). At Lewiston A, dimethenamid PRE fb bentazon plus paraquat EPOST fb acifluorfen plus bentazon POST controlled ivyleaf morningglory by 87%, whereas imazapic POST systems controlled 100%. Diclosulam PRE with or without dimethenamid PRE controlled ivyleaf morningglory by $\geq$ 94%. At Lewiston B, dimethenamid PRE fb bentazon plus paraquat EPOST fb acifluorfen plus bentazon POST controlled ivyleaf morningglory by 94%, whereas imazapic POST systems provided 100% control. Diclosulam PRE with or without dimethenamid PRE controlled entireleaf morningglory by $\geq$ 90%. As the level of ivyleaf morningglory control with diclosulam was high, control was not increased when diclosulam was fb EPOST plus POST herbicide treatments. Annual *Ipomoea* species infest at least 80% of the peanut hectares in North Carolina and Virginia (Bridges et al. 1994).

Peanut Yield. Location interactions were significant; therefore, each location is discussed separately. Peanut treated with dimethenamid alone yielded 1,390 to 2,450 kg/ha, depending on location. These yields were always increased by additional inputs of diclosulam PRE or by EPOST and POST herbicides (Table 3). The increased yields reflect the increased levels of weed control provided by the additional herbicide inputs (Tables 1 and 2). Peanut yields with the same PRE herbicide treatment were higher with imazapic POST treatment in two instances and equivalent in seven other instances when compared with acifluorfen plus bentazon POST treatment.

Economic Return. Net returns from each herbicide system followed the same general trend as peanut yield (Table 3). Dimethenamid-only systems netted \$308 to \$329/ha. Returns were increased by additional inputs of diclosulam PRE or by EPOST and POST herbicides (Table 3). Diclosulam-only systems resulted in net returns of \$705 to \$1,657/ha. Additional inputs of EPOST plus POST herbicides to diclosulam PRE alone increased net returns in four instances but provided equivalent net returns in two other instances when compared with net returns from diclosulam PRE alone. The highest and most consistent net returns each year were from peanut treated with diclosulam PRE (without or without dimethenamid) fb EPOST plus POST herbicides.

Early postemergence and POST herbicides used in this study usually increased weed control when used with dimethenamid PRE but were not always needed with diclosulam PRE. Our data indicate that diclosulam PRE in strip-tillage production controls common ragweed and

Table 2. Interaction of preemergence (PRE), early postemergence (EPOST), and postemergence (POST) herbicide systems on entireleaf morningglory, ivyleaf morningglory, and pitted morningglory control at three North Carolina locations in 1999 and 2000.

Herbicides				Ivyleaf morningglory		
PRE[a]	EPOST[b]	POST[c]	Entireleaf morningglory	Lewiston A[d] 2000	Lewiston B 2000	Pitted morningglory
			%			
Dimethenamid	None	None	0 d[e]	0 c	0 c	0 d
Dimethenamid	Bentazon + paraquat	Acifluorfen + bentazon	87 c	87 b	94 b	85 c
Dimethenamid	Bentazon + paraquat	Imazapic	100 a	100 a	100 a	100 a
Dimethenamid + diclosulam	None	None	88 c	98 ab	90 b	81 c
Dimethenamid + diclosulam	Bentazon + paraquat	Acifluorfen + bentazon	95 b	98 ab	99 a	93 b
Dimethenamid + diclosulam	Bentazon + paraquat	Imazapic	100 a	100 a	100 a	100 a
Diclosulam	None	None	88 bc	94 ab	100 a	84 c
Diclosulam	Bentazon + paraquat	Acifluorfen + bentazon	99 a	97 ab	100 a	98 a
Diclosulam	Bentazon + paraquat	Imazapic	100 a	100 a	100 a	100 a

[a] Paraquat was applied preplant to all plots at 0.70 kg ai/ha. Rates of PRE herbicides were: dimethenamid at 1.40 kg ai/ha and diclosulam at 0.027 kg ai/ha.

[b] Rates of EPOST herbicides were: bentazon at 0.28 kg ai/ha and paraquat at 0.14 kg ai/ha.

[c] Rates of POST herbicides were: bentazon at 0.56 kg/ha, acifluorfen at 0.28 kg ai/ha, and imazapic at 0.071 kg ai/ha. Clethodim was applied late POST at 0.14 kg ai/ha on all plots except the untreated check.

[d] All locations were near Lewiston, NC. One location was in 1999 and two locations were in 2000.

[e] Mean separations within a column followed by the same letter are not significantly different at 5% level of probability.

Table 3. Interaction of preemergence (PRE), early postemergence (EPOST), and postemergence (POST) herbicide systems on yield, herbicide application cost, and economic return at three North Carolina locations in 1999 and 2000.

Herbicides			Yield				Economic return[a]		
PRE[b]	EPOST[c]	POST[d]	Lewiston 1999[e]	Lewiston A 2000	Lewiston B 2000	Herbicide application cost[f]	Lewiston 1999[e]	Lewiston A 2000	Lewiston B 2000
			kg/ha			$/ha	$/ha		
Dimethenamid	None	None	1,390 d[g]	1,600 c	2,450 d	89.49	3 c	−308 c	329 d
Dimethenamid	Bentazon + paraquat	Acifluorfen + bentazon	3,180 c	3,360 b	5,290 a	138.98	818 b	955 b	2,408 a
Dimethenamid	Bentazon + paraquat	Imazapic	4,170 b	3,270 b	5,080 a	160.40	1,547 ab	865 b	2,229 ab
Dimethenamid + diclosulam	None	None	4,110 b	3,930 a	4,390 bc	143.82	1,526 ab	1,390 a	1,731 bc
Dimethenamid + diclosulam	Bentazon + paraquat	Acifluorfen + bentazon	3,810 b	4,210 a	5,230 a	193.32	1,241 ab	1,537 a	2,309 a
Dimethenamid + diclosulam	Bentazon + paraquat	Imazapic	4,210 ab	4,270 a	4,840 ab	214.74	1,515 ab	1,561 a	1,995 abc
Diclosulam	None	None	4,240 ab	2,970 b	4,020 c	103.98	1,657 a	705 b	1,499 c
Diclosulam	Bentazon + paraquat	Acifluorfen + bentazon	4,050 b	4,270 a	5,080 a	153.43	1,462 ab	1,622 a	2,236 a
Diclosulam	Bentazon + paraquat	Imazapic	4,780 a	4,040 a	5,050 a	174.85	1,987 a	1,431 a	2,192 ab

[a] Economic returns were calculated by substituting the cost and yield of each herbicide systems into a farm budget.

[b] Paraquat was applied preplant to all plots at 0.70 kg ai/ha. Rates of PRE herbicides were: dimethenamid at 1.40 kg ai/ha and diclosulam at 0.027 kg ai/ha.

[c] Rates of EPOST herbicides were: bentazon at 0.28 kg ai/ha and paraquat at 0.14 kg ai/ha.

[d] Rates of POST herbicides were: bentazon at 0.56 kg/ha, acifluorfen at 0.28 kg ai/ha, and imazapic at 0.071 kg ai/ha. Clethodim was applied late POST at 0.14 kg ai/ha on all plots except the untreated.

[e] All locations were near Lewiston, NC. One location was in 1999 and two locations were in 2000.

[f] Application costs included application, herbicide, and adjuvant cost.

[g] Mean separations within a column followed by the same letter are not significantly different at 5% level of probability.

eclipta by 100% without additional herbicide inputs. However, control of yellow nutsedge, entireleaf morningglory, prickly sida, and pitted morningglory frequently required additional EPOST plus POST herbicide treatments. Annual grass control required a POST grass herbicide such as clethodim for season-long control. These data show that weeds can be controlled in strip-tillage peanut production, and that diclosulam PRE would be of benefit.

ACKNOWLEDGMENTS

Statistical assistance was provided by Dr. Cavell Brownie. We wish to thank the station personnel at the Peanut Belt Research Station for their assistance.

LITERATURE CITED

Anonymous. 2000a. Zorial Rapid 80 product label. Novartis Crop Protection Division. P.O. Box 18300, Greensboro, NC 27419. 5 p.

Anonymous. 2000b. Strongarm product label. Dow AgroSciences LLC. 9330 Zionsville Road, Indianapolis, IN 46268. 5 p.

Askew, S. D., J. W. Wilcut, and J. R. Cranmer. 1999. Weed management in peanut (*Arachis hypogaea*) with flumioxazin preemergence. Weed Technol. 13:594–598.

Bailey, J. 2000. Peanut disease management. *In* D. L. Jordan, ed. 2000 Peanut Information. North Carolina Cooperative Extension Service Publication AG-331. pp. 71–86.

Bailey, W. A., J. W. Wilcut, D. L. Jordan, C. W. Swann, and V. B. Langston. 1999a. Weed management in peanut (*Arachis hypogaea*) with diclosulam preemergence. Weed Technol. 13:450–456.

Bailey, W. A., J. W. Wilcut, D. L. Jordan, C. W. Swann, and V. B. Langston. 1999b. Response of peanut (*Arachis hypogaea*) and selected weeds to diclosulam. Weed Technol. 13:771–776.

Bailey, W. A., J. W. Wilcut, J. F. Spears, T. G. Isleib, and V. B. Langston. 2000. Diclosulam does not influence yields in eight Virginia market-type peanut (*Arachis hypogaea*) cultivars. Weed Technol. 14:402–405.

Baughman, T. A., P. A. Dotray, W. J. Grichar, et al. 2000. Strongarm and Dual Magnum combinations for weed control in Texas peanut. Proc. South. Weed Sci. Soc. 53:36.

Brandenburg, R. L. 2000. Peanut insect management. *In* D. L. Jordan, ed. 2000 Peanut Information. North Carolina Cooperative Extension Service Publication AG-331. pp. 69–77.

Bridges, D. C., C. K. Kvien, J. E. Hook, and C. R. Stark, Jr. 1994. Analysis of the Use and Benefits of Pesticides in U.S.-grown Peanut: III Virginia–Carolina Production Region. Tifton, GA: National Environmentally Sound Production Agriculture Laboratory. Rep. 1994-002. 47 p.

Brown, A. B. 2000. 1999 Outlook and situation. *In* D. L. Jordan, ed. 2000 Peanut Information. North Carolina Cooperative Extension Service Publication pp. 1–4.

Dotray, P. A., B. L. Porter, J. W. Keeling, T. A. Baughman, W. J. Grichar, E. P. Prostko, and R. G. Lemon. 2000. Weed management in Texas peanut with diclosulam. Proc. South. Weed Sci. Soc. 53:35.

Frans, R., R. Talbert, D. Marx, and H. Crowley. 1986. Experimental design and techniques for measuring and analyzing plant response to weed control practices. *In* N. D. Camper, ed. Research Methods in Weed Science. 3rd ed. Champaign, IL: Southern Weed Science Society. pp. 37–38.

Grichar, W. J. and T. E. Boswell. 1987. Comparison of no-tillage, minimum, and full tillage cultural practices in peanuts. Peanut Sci. 14:101–103.

Jordan, D. L. 2000. Peanut production practices. *In* D. L. Jordan, ed. 2000 Peanut Information. North Carolina Cooperative Extension Publ. AG-331. pp. 8–18.

Jordan, D. L., A. S. Culpepper, R. B. Batts, and A. C. York. 1998. Response of Virginia-type peanut to norflurazon. Peanut Sci. 25:4–7.

Main, C. L., J. A. Tredaway, and G. E. MacDonald. 2000. Weed management systems for control of Florida beggarweed (*Desmodium tortuosum*) and sicklepod (*Senna obtusifolia*). Proc South. Weed Sci. Soc. 53:33.

McIntosh, M. S. 1983. Analysis of combined experiments. Agron. J. 75:153–155.

Prostko, E. P., R. G. Lemon, and R. A. Whitney. 1998. Weed control in peanut with diclosulam. Proc. South. Weed Sci. Soc. 51:59.

Richburg, J. S., III, J. W. Wilcut, D. L. Colvin, and G. R. Wiley. 1996. Weed management in southeastern peanut (*Arachis hypogaea*) with AC 263,222. Weed Technol. 10:145–152.

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

Richburg, J. S., III, J. W. Wilcut, and G. R. Wehtje. 1994. Toxicity of foliar and/or soil applied AC 263,222 to purple (*Cyperus rotundus*) and yellow nutsedge (*C. esculentus*). Weed Sci. 42:398–402.

Richburg, J. S., III, J. W. Wilcut, and G. L. Wiley. 1995. AC 263,622 and imazethapyr rates and mixtures for weed management in peanut (*Arachis hypogaea*). Weed Technol. 9:801–806.

[SAS] Statistical Analysis Systems. 1998. SAS/STAT User's Guide. Release 7.00. Cary, NC: Statistical Analysis Systems Institute. 1028 p.

Scott, G. H., S. D. Askew, and J. W. Wilcut. 2001. Economic evaluation of diclosulam and flumioxazin systems in peanut (*Arachis hypogaea*). Weed Technol. 15:360–364.

Sholar, J. R., R. W. Mozingo, and J. P. Beasley, Jr. 1995. Peanut cultural practices. *In* H. E. Pattee and H. T. Stalker, eds. Advances in Peanut Science. Stillwater, OK: American Peanut Research and Education Society. pp. 354–382.

Troeh, F. R., J. A. Hobbs, and R. L. Donahue. 1991. Soil and water conservation. New Jersey: Prentice Hall. 232 p.

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

Wilcut, J. W. and C. W. Swann. 1990. Timing of paraquat applications for weed control in Virginia-type peanuts (*Arachis hypogaea*). Weed Sci. 38:558–562.

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

Wilcut, J. W., G. R. Wehtje, D. L. Colvin, and M. G. Patterson. 1987. Economic assessment of herbicide systems for minimum-tillage peanut and conventional tillage peanut. Peanut Sci. 14:83–86.

Wilcut, J. W., G. R. Wehtje, and T. V. Hicks. 1990. Evaluation of herbicide systems in minimum and conventional tillage peanut (*Arachis hypogaea*). Weed Sci. 38:243–248.

Wilcut, J. W., A. C. York, W. J. Grichar, and G. R. Wehtje. 1995. The biology and management of weeds in peanut (*Arachis hypogaea*). *In* H. E. Pattee and H. T. Stalker, eds. Advances in Peanut Science. Stillwater, OK: American Peanut Research and Education Society. pp. 207–244.

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.

York, A. C., J. W. Wilcut, C. W. Swann, D. L. Jordan, and F. R. Walls, Jr. 1995. Efficacy of imazethapyr in peanut (*Arachis hypogaea*) as affected by timing of application. Weed Sci. 43:107–116.