Influence of Preplant Applications of 2,4-D, Dicamba, Tribenuron, and Tribenuron Plus Thifensulfuron on Peanut

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ABSTRACT

Field trials were conducted in Georgia, North Carolina, and Texas to evaluate the effects of preplant applications of 2,4-D, dicamba, tribenuron, and tribenuron plus thifensulfuron on peanut yield. Herbicides were applied 30, 15, 7, or 0 d before planting (DBP) in conventional production systems in Georgia and Texas, and 28, 21, 14, 7, and 0 DBP in no- and strip-tillage systems in North Carolina. Amine and ester formulations of 2,4-D did not affect peanut yield at any time of application in any state. Dicamba reduced peanut yield when applied at 0 DBP in two of seven trials. Tribenuron did not affect peanut yield regardless of preplant interval. However, tribenuron plus thifensulfuron reduced yields when applied at 7 DBP in one of five trials. These data suggest that 2,4-D, tribenuron, and tribenuron plus thifensulfuron can be safely used for preplant weed control in peanut when applied 7 DBP. Dicamba should be applied a minimum of 15 DBP.

Key Words: *Arachis hypogaea,* burndown weed control, crop tolerance, reduced tillage.

A renewed interest in conservation tillage for peanut (*Arachis hypogaea* L.) production has occurred over the past several years because of its potential benefits including reductions in soil erosion, decreases in soil compaction, improvements in timing of crop planting and establishment, and declines in machinery investment, and increasing labor costs (Bader *et al.*, 1995). However, herbicide inputs for conservation tillage systems are generally greater than for conventional tillage systems (Wilcut *et al.*, 1987). The primary herbicides used for preplant weed control in reduced tillage peanut systems are glyphosate [*N*-(phosphonomethyl)glycine] and paraquat (1,1'-dimethyl-4-4'-bypyridinium). Additionally, the premixed combination of tribenuron-methyl {2-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)methylamino]carbonyl]amino] sulfonyl]benzoate} plus thifensulfuron-methyl {3-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl) amino]carbonyl]amino] sulfonyl]-2-thiophenecarboxylate} has the potential to be utilized in peanut but is limited by label restrictions that only allow applications made at least 45 DBP (Anon., 2003c).

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The above-mentioned herbicides provide acceptable control of cover crops and numerous weed species, but do not consistently control cutleaf eveningprimrose (*Oenothera laciniata* Hill) (Guy and Ashcraft, 1996; Reynolds *et al.*, 2000). Consequently, cutleaf eveningprimrose is considered to be the most troublesome annual weed of reduced tillage peanut production systems in the southeast (J. A. Baldwin, pers. commun.). Cutleaf eveningprimrose also serves as an overwintering host for western flower thrips [*Frankliniella occidentalis* (Pergande)] which is a known vector of tomato spotted wilt tospovirus (Chamberlin *et al.*, 1992).

Cutleaf eveningprimrose can be controlled by 2,4-D [(2,4-dichlorophenoxy)acetic acid] or dicamba [3,6-dichloro-2-methoxybenzoic acid] (Guy and Ashcraft, 1996; Reynolds *et al.*, 2000; Culpepper, 2001). Both of these herbicides applied preplant control troublesome weeds in reduced tillage systems of other crops (Wilson and Worsham, 1988; Bruce and Kells, 1990; Moseley and Hagood, 1990; White and Worsham, 1990; Wicks *et al.*, 1996). Cutleaf eveningprimrose can also be controlled with spring applications of tribenuron-methyl (Johnson *et al.*, 2000). However, this herbicide is only registered for use in certain small grain crops and has a 45 d rotational crop restriction to peanut (Anon., 2003b).

The use of 2,4-D and dicamba preplant (PRE) in peanut has not been evaluated. Current registrations state that 2,4-D can be applied preplant in field corn (*Zea mays* L.), soybean [*Glycine max* (L.) Merr.], and rice (*Oryza sativa* L.). Additionally, 2,4-D can be applied to fallow land or crop stubble, but rotational crops can only be planted 3 mo after application or until the chemical disappears from the soil (Anon., 2003d). Dicamba is registered for preplant use in cotton (*Gossypium hirsutum* L.), field corn, grain sorghum [*Sorghum bicolor* (L.) Moench], and soybean with plant-back restrictions of 21, 0, 15, and 14 d, respectively (Anon., 2003a).

Because the tolerance of peanut to these herbicides has not been adequately documented, the objective of this research was to determine the yield response of peanuts to preplant applications of 2,4-D, dicamba, tribenuron-methyl, and tribenuron-methyl plus thifensulfuron-methyl in conventional and reduced tillage systems.

Materials and Methods

Field experiments were conducted in Georgia in 2000 and 2001; Texas in 2000; and North Carolina in 1999, 2000, and 2001. Experimental locations, soil series, organic matter, peanut cultivar, planting, digging, and harvesting dates are presented in (Table 1). Planting depth, cultural, and pest management practices were based on local Cooperative Extension Service recommendations. Plot size was two rows spaced 90 cm apart by 6 to 10 m long, depending on location. The plot areas were irrigated throughout the season as needed except at the North Carolina locations which only received rainfall.

For the Georgia and Texas experiments in 2000, treatments consisted of 2,4-D amine at 0.6 kg ai/ha, dicamba at 0.3 kg ai/ha, and tribenuron-methyl (0.011 kg ai/ha) plus thifensulfuron-methyl (0.021 kg ai/ha). For the Georgia experiments in 2000, 2,4-D ester at 0.6 kg ai/ha was also included. For Georgia experiments in 2001, tribenuron-methyl at 0.013 kg ai/ha replaced tribenuron-methyl plus thifensulfuron-methyl. For all Georgia and Texas experiments, treatments were applied either at 30, 15, 7, or 0 DBP. A randomized complete block design was used at all locations.

For the North Carolina experiments, 2,4-D amine at 0.75 kg ai/ha was applied in strip-tillage in 2000 and 2001 at the Upper Coastal Plain Experiment Station near Rocky Mount. In 2000, no-tillage was included. Treatments were applied either at 28, 21, 14, or 7 DBP. Applications were also made immediately prior to and following planting. The experimental design was a split-plot in 2000 and a randomized complete block in 2001. In 2000, tillage system served as whole plots and 2,4-D application served as subplots.

Three additional North Carolina experiments included a rate

Table 1. Experiments, locations, soil series, organic matter, cultivar, and dates for planting, digging, and harvest.

Experiment	Location	Year	Soil[a]	Organic matter	Cultivar	Dates		
						Planting	Digging	Harvest
				%				
1	Attapulgus, GA	2000	Lucy LS	0.5	GA Green	10 May	19 Sept.	28 Sept.
2	Attapulgus, GA	2001	Lucy LS	1.6	GA Green	14 May	1 Oct.	8 Oct.
3	Williamson, GA	2000	Cecil SCL	1.6	GA Green	17 May	9 Oct.	12 Oct.
4	Plains, GA	2000	Greenville SL	1.4	GA Green	5 May	14 Sept.	20 Sept.
5	Tifton, GA	2000	Tifton LS	0.5	GA Green	17 May	21 Sept.	2 Oct.
6	Tifton, GA	2001	Tifton LS	0.4	C-99R	11 May	11 Oct.	26 Oct.
7	Yoakum, TX	2000	Tremona LS	0.7	GA Green	8 June	25 Sept.	29 Sept.
8	Rocky Mount, NC	1999	Goldsboro LS	1.6	VA 98R	8 May	8 Oct.	15 Oct.
9, 10	Rocky Mount, NC	2000	Goldsboro LS	1.6	VA 98R	15 May	2 Oct.	9 Oct.
11	Rocky Mount, NC	2001	Goldsboro LS	1.6	VA 98R	10 May	28 Sept.	4 Oct.
12	Lewiston-Woodville, NC	2000	Norfolk SL	1.2	NC 12C	8 May	--	--

[a]Soil series and taxonomic class: LS, loamy sand; SL, sandy loam; SCL, sandy clay loam; Lucy, loamy, kaolinitic, thermic Arenic Kandiudults; Cecil, fine, kaolinitic, thermic Typic Kanhapludults; Greenville, fine, kaolinitic, thermic, Rhodic Kandiudults; Tifton, fine-loamy, siliceous, thermic, Plinthic Paleudults; Tremona, clayey, mixed, active, thermic Aquic Arenic Paleustalfs; Goldsboro, fine-loamy, siliceous, subactive, thermic Aquic Paleudalts; Norfolk, fine-loamy, siliceous, thermic Typic Kandiudults.

study for 2,4-D amine applied at 0.25, 0.5, 0.75, and 1.0 kg ai/ha. In 1999, treatments were applied PRE at Rocky Mount. In 2000, treatments were applied preplant incorporated (PPI) and the experiment was conducted at Rocky Mount and at the Peanut Belt Res. Sta. located near Lewiston-Woodville, NC.

For all experiments, treatments were applied using a CO_2-pressurized backpack sprayer calibrated to deliver 169 to 225 L/ha at 131 to 220 kPa using flat fan nozzles. Prior to herbicide application in Georgia, Texas, and for the North Carolina rate studies, seedbeds were prepared using conventional tillage methods in order to maximize injury potential. PPI herbicides were incorporated to a depth of 8 cm in North Carolina. No additional tillage operations were performed in order to minimize soil disturbance and herbicide dilution or movement. For the North Carolina strip trials in 2000 and 2001, a strip tillage implement consisting of an in-row sub-soiler, two sets of fluted coulters, and two crumbler baskets was used to prepare a 50 cm wide tilled zone immediately prior to planting. Peanut was seeded using an air-planter with a single fluted coulter. A sub-soiler was not included with the no-till planting

Plot areas were maintained weed-free throughout the growing season to avoid weed interference using a combination of standard herbicide programs and hand removal. Each treatment was replicated three to four times. Visual estimates of injury were made 2 wk after planting and again at mid season on a scale of 0 (no stunting) to 100% (complete death) as compared to the non-treated check. Yield data were obtained using commercial digging and harvesting equipment. All data were subjected to ANOVA and means separated using Duncan's Multiple Range Test (P = 0.05). Data from the Georgia, North Carolina, and Texas locations are presented separately due to treatment differences between states. The 2000 Georgia yield data revealed no treatment by location interaction so data was pooled. Treatment by location interactions were significant for the 2000 injury and all 2001 Georgia data and for the North Carolina experiments; thus, the means for these data are presented separately by location.

Table 2. Peanut injury and yield as influenced by 2,4-D amine rate when applied the day of planting in North Carolina.

	Peanut injury			Yield
	1999[a]	2000[b]	1999	1999
2,4-D amine rate	Rocky Mount	Rocky Mount	Lewiston-Woodville	Rocky Mount
kg ai/ha	-----------------	%	-----------------	kg/ha
0.00	0 ac	0 a	0 a	3420 a
0.25	0 a	3 a	0 a	3670 a
0.50	0 a	8 a	0 a	3960 a
0.75	0 a	4 a	0 a	3580 a
1.00	0 a	5 a	0 a	3550 a

[a]2,4-D was applied PRE in 1999 at Rocky Mount.

[b]2,4-D was applied PPI in 2000 at Rocky Mount and Lewiston-Woodville.

[c]Means in the same column with the same letter are not significantly different according to Duncan's Multiple Range Test (P = 0.05).

Results and Discussion

Peanut Injury. Peanut injury from experiments conducted in Georgia and Texas was variable ranging from 0 to 30% (data not presented). However, injury was transient and not observable by mid-season (data not presented). Notably, dicamba consistently injured peanut 10 to 30% when applied at 0 or 7 DBP for all Georgia and Texas experiments. Injury symptoms caused by dicamba included stunting, leaf strapping, and epinasty. In contrast, 2,4-D amine and ester, tribenuron plus thifensulfuron, and tribenuron alone did not consistently injure peanut. Peanut injury with 2,4-D amine was 8% or less for all DBP timings, no- or strip-tillage method, and rate experiments in North Carolina (Tables 2 and 3).

Peanut Yield. There were no significant peanut yield differences among any application timings for 2,4-D amine or ester for Georgia (2000 and 2001) or Texas as compared to the non-treated check (Table 4). North Carolina peanut yield with 2,4-D amine was not influenced by rate for conventionally prepared seedbeds (Table 2) or by timing of application in strip-tillage or no-tillage (Table 3). These results greatly improve the interpretation of the current product label which indicates that rotational crops can only be planted 3 mo after application or until the product disappears from the soil (Anon., 2003d). However, these data are contrary to current soybean recommendations that require longer planting intervals when ester or amine formulations of 2,4-D are used for preplant weed management (Owen, 1998).

Dicamba reduced peanut yield only when applied 0 DBP in Texas in 2000 and Attapulgus, GA in 2001 (Table 4). However, no yield differences were recorded for dicamba treated peanut

Table 3. Peanut injury and yield as influenced by 2,4-D amine[a] application timing in reduced tillage systems at Rocky Mount, NC.

	Peanut injury			Peanut yield		
	2000		2001	2000		2001
Days before planting	No tillage	Strip tillage	Strip tillage	No tillage	Strip tillage	Strip tillage
	----------	%	----------	------------	kg/ha	-----------
Nontreated	0 a[b]	0 a	0 a[d]	4570 a	4510 a	6170 a
0 PRE[c]	0 a	0 a	1 a	4390 a	4070 a	5790 a
0 preplant[d]	0 a	0 a	8 b	4390 a	4530 a	5970 a
7	0 a	0 a	3 a	4610 a	4460 a	6120 a
14	0 a	0 a	0 a	4560 a	4280 a	5700 a
21	0 a	0 a	0 a	4670 a	4520 a	5700 a
28	0 a	0 a	0 a	4570 a	4760 a	6100 a

[a]2,4-D amine applied at 0.75 kg ai/ha.

[b]Means in the same column with the same letter are not significantly different according to Duncan's Multiple Range Test (P = 0.05).

[c]0 PRE was applied after peanut planting.

[d]0 preplant was applied before peanut planting.

Table 4. Peanut yield response to preplant applications of 2,4-D, dicamba, tribenuron plus thifensulfuron, and tribenuron in Georgia and Texas, 2000-2001.

Herbicide	Herbicide rate	Application timing	2000		2001- Georgia	
			Georgia[a]	Texas	Attapulgus	Tifton
	kg ai/ha	Days before planting	---------kg/ha----------		------------kg/ha------------	
Nontreated	--	--	3590 ab	1870 a	6220 a	5145 a
2,4-D amine	0.60	30	3430 a	1760 a	6140 a	5410 a
	0.60	15	3670 a	1540 a	6405 a	5620 a
	0.60	7	3960 a	1530 a	5990 a	5830 a
	0.60	0	3720 a	1760 a	6120 a	5350 a
2,4-D ester	0.60	30	4360 a	--	6130 a	5730 a
	0.60	15	3560 a	--	5930 a	5600 a
	0.60	7	4040 a	--	6190 a	5640 a
	0.60	0	3840 a	--	6090 a	5320 a
Dicamba	0.30	30	3720 a	1660 a	5930 a	6160 a
	0.30	15	3640 a	1490 a	6020 a	5760 a
	0.30	7	3670 a	1360 a	6170 a	5210 a
	0.30	0	3480 a	440 b	4040 b	5300 a
Tribenuron plus thifensulfuronc	0.011 + 0.021	30	4050 a	1560 a	--	--
	0.011 + 0.021	15	4290 a	1910 a	--	--
	0.011 + 0.021	7	3740 a	270 b	--	--
	0.011 + 0.021	0	4180 a	1560 a	--	--
Tribenuron	0.013	30	--	--	6120 a	5440 a
	0.013	15	--	--	6330 a	5630 a
	0.013	7	--	--	5930 a	5630 a
	0.013	0	--	--	5830 a	5590 a

[a]Georgia data pooled over four locations (Attapulgus, Williamson, Plains, Tifton).

[b]Means followed in the same column with the same letter are not significantly different according to Duncan's Multiple Range Test (P = 0.05).

[c]Commercially available as Harmony Extra 75DF. A premix formulation of tribenuron-methyl (25%) plus thifensulfuron-methyl (50%) marketed by E.I. DuPont De Nemours and Company, Wilmington, DE.

at the four Georgia locations in 2000 and at the Tifton location in 2001. Dicamba is registered for preplant applications in cotton and soybean with a minimum planting interval of 21 and 14 d, respectively (Anon., 2003a). This, coupled with the lack of peanut injury when applied ≥ 7 DBP indicates that a 15 d planting interval for peanut will be adequate to prevent visual injury symptoms and yield losses from dicamba.

Tribenuron plus thifensulfuron did not affect yield in Georgia in 2000 (Table 4). However, tribenuron plus thifensulfuron reduced peanut yield when applied at 7 DBP in Texas (Table 4). Previous research has demonstrated that tribenuron plus thifensulfuron applied within the labeled 45 d planting interval did not injure cotton, soybean, or rice (Guy, 1995; Jordan *et al.*, 1997; Fairbanks *et al.*, 2001). For these studies, the peanut yield loss associated with 7 DBP in Texas is a data anomaly and cannot be explained. Tribenuron did not affect peanut yield when applied at any time (Table 4).

Conclusions

These data indicate that 2,4-D, dicamba, tribenuron plus thifensulfuron, and tribenuron can be applied preplant for weed control in peanut with minimal concern for crop injury and yield loss. 2,4-D, tribenuron, and tribenuron plus thifensulfuron should be applied a minimum of 7 d before planting. Dicamba requires a 15 d planting interval. These intervals will minimize the potential for peanut injury to occur and are consistent with current labels for other broadleaf crops such as soybean and cotton.

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