Sicklepod Control in Peanut Seeded in Single and Twin Row Planting Patterns

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ABSTRACT

Sicklepod [*Senna obtusifolia* (L.) Irwin & Barneby] control and peanut pod yield with preemergence applications of dimethenamid and dimethenamid plus diclosulam alone or followed by postemergence application of imazapic were compared when peanut was seeded in single and twin row planting patterns. Sicklepod control was 9% higher when peanut was seeded in the twin row planting pattern (rows spaced 18 cm apart on 91-cm centers) compared with peanut planted in the single row planting pattern (single rows on 91-cm centers) regardless of preemergence or postemergence herbicide treatment. Sicklepod control by dimethenamid plus diclosulam exceeded control by dimethenamid alone in 1 of 2 yr. Imazapic applied postemergence consistently increased sicklepod control over dimethenamid or dimethenamid plus diclosulam alone. Pod yield generally reflected differences noted for sicklepod control when comparing planting patterns and treatments.

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Altering plant population and row pattern can affect crop yield, quality, and pest development in peanut (*Arachis hypogaea* L.). Pod yield of bunch-type peanut was 16% higher when peanut was seeded in rows spaced 46 cm apart compared with yields in rows spaced 91cm apart (Norden and Lipscomb, 1974). Duke and Alexander (1964) reported pod yield that was 14% higher in narrow row plantings compared with traditional wider row patterns using large-seeded virginia bunch-type peanut. Spanish market-type peanut planted in 46-cm rows yielded higher than peanut planted in rows spaced 61, 76, 91, or 107 cm apart with the same in-row plant population (Parham, 1942). Cox and Reid (1965) reported that increasing plant populations by increasing in-row seeding rate or by decreasing row width increased pod yield.

Although less than 10% of peanut in North Carolina is seeded in twin row planting patterns (rows spaced approximately 18 cm apart with centers of these rows spaced 91 to 102 cm apart), research suggests that seeding peanut in twin row planting patterns can increase yield, improve market grade characteristics, and decrease incidence of tomato spotted wilt tospovirus (TSWV) when compared with single rows spaced 91 to 102 cm apart (Baldwin and Williams, 2002; Hurt *et al.*, 2003; Jordan, 2003; Lanier *et al.*, 2004). However, row visibility during the digging and inversion process in narrow row planting patterns or in twin row planting patterns may be lower compared with planting peanut in single row planting patterns (Beasley, 1970; Henning *et al.*, 1982). In virginia market-type production, pod yield increases have been reported when peanut was seeded in twin row planting patterns compared with single row planting patterns when weeds were controlled throughout the season (Sullivan, 1991; Mozingo and Swann, 2000; Lanier *et al.*, 2004).

Planting soybean [*Glycine max* (L.) Merr.] in narrow rows has been shown to improve weed control and reduce herbicide inputs, relative to planting in wide-row spacings (Wells *et al.*, 1993; Weber *et al.*, 1996). Hauser and Buchanan (1981) reported improved weed control when peanut was seeded in narrow rows compared with single row planting patterns. Colvin *et al.* (1985) reported more effective control of sicklepod, Florida beggarweed [*Desmodium tortuosum* (Sw.) DC], and bristly starbur (*Acanthospermum hispidum* DC) in both twin row and narrow row planting patterns compared with single row planting patterns. However, enhanced weed control in peanut seeded in twin row planting patterns did not reduce herbicide usage when compared with control in single row planting patterns (Colvin *et al.*, 1985).

Determining interactions of planting patterns with herbicide programs will assist growers and their advisors in developing efficient production and pest management systems for peanut. Therefore, research was conducted to evaluate sicklepod control and pod yield when peanut was planted in single and twin row planting patterns with herbicide programs containing combinations of preemergence and postemergence herbicides.

Materials and Methods

The experiment was conducted in North Carolina during 2001 and 2002 at the Cherry Farm Unit located near Goldsboro on a Wickham sandy loam (fine-loamy, mixed, semi active, thermic Typic Hapludults) with 1.8% organic matter and pH 6.2. Plot size was 3.6 by 12 m. The cultivar NC-V 11 was seeded in flat ground in single rows spaced 91 cm apart or in twin rows spaced 18 cm apart on 91-cm centers. Final in-row plant density for these respective row patterns was 13 and 15 plants/m-row. Tillage consisted of disking three times followed by two passes with a field cultivator at a depth of 8 cm prior to planting.

Herbicide treatments consisted of dimethenamid {(*S*)-2-chloro-*N*-[(1-methyl-2-methoxy)ethyl]-*N*-(2,4-dimethyl-thien-3yl)-acetamide} at 1.1 kg ai/ha applied preemergence and dimethenamid (1.1 kg/ha) plus diclosulam [*N*-(2,6-dichloropheny)-5-ethoxy-7-fluoro(1,2,4)triazolo-(1,5-c)pyrimidine-2-sulfonamide] at 0.027 kg ai/ha applied preemergence followed by no postemergence herbicide or postemergence herbicide treatments based on the primary economical recommendation provided by HADSS (Herbicide Application Decision Support System, Ag Renaissance Software LLC, www.hadss.com) (Wilkerson *et al.*, 2002). Imazapic {2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-5-methyl-3-pyridinecarboxylic acid} at 70 g ai/ha was recommended by the HADSS program. The mixture of acifluorfen {sodium 5-[2-chloro-4-(trifluoromehtyl)phenoxy]-2-nitrobenzoate} plus bentazon [3-(1-methylethyl)-*1H*-2,3-benzothiadiazin-4(3*H*)-one 2,2-dioxide] plus paraquat (1,1'-dimethyl-4,4'-bipyridinium dichloride) (0.28 + 0.56 + 0.14 kg ai/ha, respectively) was applied each year over the entire test area when peanut initially cracked through soil. Nonionic surfactant at 0.125% (v/v) was applied with the mixture of acifluorfen plus bentazon plus paraquat and at 0.25% (v/v) with imazapic. Weed densities were determined in each plot designated to receive herbicides based on the HADSS recommendation 4 wk after planting (3 wk after application of acifluorfen plus bentazon plus paraquat). Sicklepod density in plots receiving dimethenamid alone was 2 and 40 plants/m^2 in 2001 and 2002, respectively. Herbicides were applied with a CO_2-pressurized backpack sprayer calibrated to deliver 140 L/ha at 140 kPa. All herbicide combinations were applied in both the single and twin row planting patterns described previously.

Aldicarb [2-methyl-2-(methylthio)propionaldehyde] was applied at 7.8 kg ai/ha in-furrow. The in-furrow inoculant Rhizo-Flo® (Urbana Laboratories, St. Joseph, MO) was applied at 7.8 kg/ha in the seed furrow as a split hopper box treatment with aldicarb. Propiconazole {1-[[2-(dichlorophenyl)-4-propyl-1,3-dioxolan-2-yl]methyl]-1*H*-1,2,4-triazole} plus trifloxystrobin {benzene acetic acid (*E*,*E*)-alpha-(methoxyimino)-4-[[[[1-3-(trifluoromethyl)phenyl]ethyldiene]amino]oxy]methyl ester} were applied biweekly over the entire test area from early July through early Sept. to control early leaf spot (*Cercospora arachidicola* Hori).

The experimental design was a randomized complete block with four replications. Visual estimates of percent sicklepod control were recorded in late Aug. using a scale of 0 to 100% where 0 = no control and 100 = complete control. Foliar chlorosis, necrosis, plant stunting, and stand reduction were used when making the visual estimates. Within each replication, the plot with the poorest sicklepod control was assigned a value of zero, and sicklepod control for all other plots was compared with control in this plot. Peanut pods were dug and harvested based on pod mesocarp color (Williams and Drexler, 1981).

Data for percent sicklepod control and pod yield were subjected to analysis of variance appropriate for a two (year) by two (planting pattern) by two (preemergence herbicide) by two (postemergence herbicide) factorial treatment arrangement. Means of significant main effects and interactions were separated using Fisher's Protected LSD test at $P \leq 0.05$ (McIntosh, 1982).

Results and Discussion

The interaction of year by planting pattern by preemergence herbicide by postemergence herbicide was not significant for sicklepod control (P = 0.2660) or pod yield (P = 0.2993) (Table 1). However, the year by preemergence herbicide by postemergence herbicide interaction was significant for sicklepod control (P = 0.0068) and pod yield (P = 0.0001). Although not significant for sicklepod control (P = 0.3266), the interaction of planting pattern by preemergence herbicide by postemergence herbicide was significant for pod yield (P = 0.0321). Although the main effect of planting pattern was significant for sicklepod control (P = 0.0210), other interactions of planting pattern with other treatment factors were not significant.

When pooled over years and herbicide factors, sicklepod control was 9% higher when peanut was seeded in the twin row planting pattern compared with control in the single row pattern (55% versus 47%, data not presented). Hauser and Buchanan (1981) reported better sicklepod control when peanut was seeded in twin row planting patterns compared with single row planting patterns. Recently, Yoder *et al.* (2003) reported that Florida beggarweed control was higher in the twin row planting pattern compared with control in the single row planting pattern regardless of herbicide treatment.

Sicklepod control during 2001 was better when dimethenamid was applied with diclosulam (35%) than when dimethenamid was applied alone (5%) (Table 2). Control did not differ among these respective herbicide treatments in 2002 (10 and 12%). Previous research (Grey *et al.*, 2003) indicated that preemergence applications of diclosulam suppressed, but did not control sicklepod. Applying imazapic postemergence increased sicklepod control to 91% in 2001 regardless of preemergence herbicide treatment. In 2002, control was 77 to 86% when imazapic was applied. Previous research (Grey *et al.*, 2003) indicated that imazapic controlled sicklepod effectively.

In 2001, pod yield was lower when dimethenamid was applied alone compared with all other herbicide treatments (Table 2). There was no difference in pod yield when comparing treatments that included imazapic applied postemergence. In 2002, pod yield was greatest when dimethenamid plus diclosulam applied preemergence was followed by imazapic postemergence. Peanut following dimethenamid alone, or with diclosulam, yielded less than dimethenamid followed by imazapic postemergence. Diclosulam plus dimethenamid did not increase pod yield over dimethenamid alone when imazapic was included.

When comparing the interaction of planting pattern

Table 1. Analysis of variance (P-values) for sicklepod control in late August and pod yield as influenced by year, planting pattern, and herbicide treatment.

Source	Sicklepod control	Pod yield
	------ P-value ------	
Year	0.0150	0.0001
Planting pattern	0.0210	0.0002
Preemergence herbicide (PRE)	0.0120	0.0001
Postemergence herbicide (POST)	0.0001	0.0001
Year by planting pattern	0.6389	0.0180
Year by PRE	0.1314	0.0001
Year by POST	0.9659	0.0021
Planting pattern by PRE	0.8309	0.3308
Planting pattern by POST	0.7912	0.9732
PRE by POST	0.2196	0.0001
Year by planting pattern by PRE	0.7263	0.5571
Year by planting pattern by POST	0.5794	0.8061
Year by PRE by POST	0.0068	0.0001
Planting pattern by PRE by POST	0.3266	0.0321
Year by planting pattern by PRE by POST	0.2666	0.2993
Coefficient of variation	28.5	19.5

Table 2. Influence of preemergence and postemergence herbicides on sicklepod control and pod yield.

Herbicide[a]	AM[b]	Sicklepod control[c] 2001	Sicklepod control[c] 2002	Pod yield[c] 2001	Pod yield[c] 2002
		---- % ----		----- kg/ha -----	
Dimethenamid	PRE[d]	5 c	12 b	50 c	900 c
Dimethenamid followed by imazapic	PRE POST	91 a	77 a	5100 ab	2480 b
Dimethenamid plus diclosulam	PRE PRE	35 b	10 b	4750 b	1110 c
Dimethenamid plus diclosulam followed by imazapic	PRE PRE POST	91 a	86 a	5390 a	3370 a

[a]Dimethenamid, imazapic, and diclosulam applied at 1.1, 0.07, and 0.027 kg/ha, respectively. Acifluorfen (0.28 kg/ha) plus bentazon (0.56 kg/ha) plus paraquat (0.14 kg/ha) applied over the entire test area at the cracking stage of peanut.

[b]AM = Application method.

[c]Means within a year for sicklepod and pod yield followed by the same letter are not significantly different according to Fisher's Protected LSD test at $P \leq 0.05$. Data are pooled over planting patterns.

[d]PRE = Preemergence; POST = Postemergence.

and herbicide treatments, pod yield did not differ between single and twin row planting patterns when dimethenamid was the herbicide applied (Table 3). In the single row planting pattern, the greatest yield was noted when dimethenamid plus diclosulam was followed by imazapic. Dimethenamid followed by imazapic improved pod yield over dimethenamid plus diclosulam applied alone. In the twin row planting pattern, imazapic-treated peanut yielded more than peanut treated with dimethenamid alone or with diclosulam preemergence. When comparing herbicide treatments across planting patterns, pod yield with dimethenamid followed by imazapic and dimethenamid plus dicosulam alone increased in the twin row planting pattern compared with yield following these herbicides in the single row planting pattern (Table 3).

Results from this research indicated that late-season sicklepod control was higher in twin row planting patterns, regardless of preemergence or postemergence herbicide treatments. A positive response to the twin row planting pattern for sicklepod control compared to the single row planting pattern was noted under two contrasting densities of sicklepod. Density in 2001 was 2 plants/m^2 following dimethenamid alone, while density following this herbicide treatment in 2002 was 40 plants/m^2. In 2001, the decision was made not to attempt harvest of the dimethenamid-alone treatment in both planting patterns to reduce potential damage to harvesting equipment. Therefore, pod yield from this treatment, which was assigned a zero in most plots, is reflected in low yields during this year (50 kg/ha). In 2002, when all plots were harvested, a yield reduction of 73% was noted for dimethenamid alone compared to dimethenamid plus diclosulam followed by imazapic postemergence. A yield reduction of 78% was estimated by HADSS for the density of 40 plants/m^2 (data not presented).

Table 3. Influence of planting pattern, preemergence herbicide treatment, and postemergence herbicide treatment on sicklepod control.

Herbicide[a]	Application method	Pod yield[b] Single rows	Twin rows
		------- kg/ha -------	
Dimethenamid	PRE[c]	410 d	550 d
Dimethenamid followed by imazapic	PRE POST	3410 b	4170 a
Dimethenamid plus diclosulam	PRE PRE	2410 c	3450 b
Dimethenamid plus diclosulam followed by imazapic	PRE PRE POST	4180 a	4590 a

[a]Dimethenamid, imazapic, and diclosulam applied at 1.1, 0.07, and 0.027 kg/ha, respectively. Acifluorfen (0.28 kg/ha) plus bentazon (0.56 kg/ha) plus paraquat (0.14 kg/ha) applied over the entire test area at the cracking stage of peanut.

[b]Means within and across planting patterns followed by the same letter are not significantly different according to Fisher's Protected LSD test at $P \leq 0.05$. Data are pooled over years.

[c]PRE = Preemergence; POST = Postemergence.

Current integrated pest management strategies for peanut include seeding in twin row planting patterns to reduce incidence of TSWV (Baldwin and Williams, 2002; Hurt *et al.*, 2003). Consistent with other research (Hauser and Buchanan, 1981; Colvin *et al.*, 1985; Yoder *et al.*, 2003), results from these trials indicate that, in addition to decreased incidence of TSWV, growers will most likely improve weed control when adopting twin row planting patterns compared to single row plantings. However, these results also suggest that use of twin row planting patterns will not eliminate the need for herbicides in peanut.

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