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Row Pattern and Weed Management Effects on Peanut Production[1]

Daniel L. Colvin, Robert H. Walker*, Michael G. Patterson, Glenn Wehtje and John A. McGuire[2]

ABSTRACT

Field experiments were conducted from 1981 through 1983 on a Dothan sandy loam (Plinthic Paleudults) at Headland, Alabama, to investigate the effects of row patterns and weed management systems on weed control, peanut yield, and net returns to land and management. Treatments consisted of three row patterns, a) conventional 91-cm rows, b) dual twin 18-cm rows, and c) triple twin 18-cm rows, and six weed management systems ranging from none to various combinations of herbicide and mechanical inputs. The experimental area was naturally infested with bristly starbur (*Acanthospermum hispidum* DC.), sicklepod (*Cassia obtusifolia* L.), Florida beggarweed [*Desmodium tortuosum* (Sw.) DC.], large crabgrass [*Digitaria sanguinalis* (L.) Scop.], and Texas panicum (*Panicum texanum* Buckl.). Results showed that weed control was affected somewhat by row patterns with broadleaf weeds being more responsive to row pattern manipulation than grass weeds. Weed fresh weights were generally lower as row patterns narrowed from conventional 91-cm spacing, however exceptions did occur. Highest yields and net returns were obtained when peanuts were planted in the dual twin 18-cm rows and weed management included benefin applied preplant incorporated, plus alachlor applied preemergence, and two timely cultivations.

Key Words: Row spacings, herbicides, cultivations, weed weights, net returns.

The effect of row spacing on peanuts (*Arachis hypogaea* L.) has been studied since the early 1890's (2). Beattie in 1927 (1) noted that peanut row spacings varied from a width sufficient for the passage of a mule up to four feet (1.2 m). Parham (15) reported that spanish peanut yields were higher in 46-cm rows than in 61-, 76-, 91-, or 107-cm rows. Due to cultivation requirements he suggested a spacing of 67 to 76 cm as the most practical.

In more current studies, Duke and Alexander (7) found that yields of large-seeded virginia bunch-type peanuts were often higher in close rows than in standard row widths. Norden and Lipscomb (14) reported a 16% yield increase when bunch lines of peanuts were planted in 46-cm as compared to 91-cm rows. Cox and Reid (6) found that decreasing row width was generally an effective means of increasing yields.

Not until recently has the effects of row spacing been evaluated for the Florunner variety. Buchanan and Hauser (4) reported that Florunner peanut yields generally increased with decreasing row widths from 80 to 40 to 20 cm, in either the presence or absence of weeds. In addition, percent sound mature kernels were sometimes increased as row width decreased. Weed competition was much less in 40- and 20-cm rows than with the wider 80-cm row pattern. Later, Hauser *et al.* (10) reported an overall 15% yield advantage attributed to close row spacings as compared to conventional wider spacings. They further stated that even without a yield advantage, close rows could be justified simply due to increased weed suppression. Decreasing row width from 80 to 20 cm reduced the green weight of weeds from 21 to 54%. Therefore, close row configurations may permit a reduction in herbicide use (9). However, they also suggested that Florunner peanuts growing in close rows probably have a shortened fruiting period and therefore could possibly be more sensitive to periodic droughts (8).

Peanut weed control in earlier years relied heavily on cultivation, hand-hoeing or pulling. Selective herbicides began to be used in the 1950's (5, 18, 19, 20). Dinoseb [2-(1-methylpropyl)-4,6-dinitrophenol] alone or in com-

[1]Alabama Agricultural Experiment Station Journal Series No. 3-84676.

[2]Former Grad. Res. Asst., Assoc. Prof., Asst. Prof., Asst. Prof., Dept. of Agron. and Soils, Prof., Res. Data Analysis, respectively, Alabama Agric. Exp. Stn., Auburn Univ., AL 36849.

bination with naptalam {2-[(1-naphthalenylamino)carbonyl] benzoic acid} was among the first herbicides used. Dinitroaniline herbicides such as trifluralin [2,6-dinitro-*N*, *N*-dipropyl-4-(trifluoromethyl)benzenamine] and benefin [*N*-butyl-*N*-ethyl-2,6-dinitro-4-(trifluoromethyl)benzenamine] were introduced in the 1960's (13,16,17). More recently the amide herbicides, alachlor [2-chloro-*N*-2, 6-diethylphenyl)-*N*-*methoxymethyl) acetamide] and metolachlor [2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy -1- methylethyl) acetamide] have been added to the herbicides registered for peanut weed control.

As new compounds were introduced, peanut producers began to rely more heavily on herbicides. Increased reliance upon chemical weed control has led many weed scientists to question how much is sufficient and if mechanical weed control programs are profitable or necessary any longer (3). Hauser *et al.* (11) and Hauser and Parham (12) attempted to evaluate the relative merits of chemical and mechanical inputs. Their systems consisted of (a) cultivation alone, (b) herbicides alone, and (c) various combinations of cultivations and herbicides. They concluded that the best approach was a system involving both judicious applications of herbicides and limited, but timely and precise, "non-dirting" cultivations. Bridges *et al.* (3) in a similar experiment dealing with heavy populations of sicklepod (*Cassia obtusifolia* L.), Florida beggarweed [*Desmodium tortuosum* (Sw.) DC.], morning-glories (*Ipomoea* spp.) and large crabgrass [*Digitaria sanguinalis* (L.) Scop.] determined that peanut yields and average net returns were best with a combination of herbicides and two cultivations.

The objectives of this research were to determine the infuence of three row patterns and six weed management systems on weed control, peanut yield, and net returns to land and management.

Materials and Methods

Experiments were conducted from 1981 through 1983 at Headland, Alabama, on a Dothan sandy loam soil. The experiment was conducted on different but adjacent sites each year. Plot size was 3.1 m by 6.2 m with Florunner peanuts seeded to a rate of 128 kg/ha and approximately 5 cm deep regardless of row spacing. Planting dates were April 24, May 5, and May 11 in 1981, 1982 and 1983, respectively. Peanuts were planted into a well-prepared seedbed using both conventional and twin-row planting equipment. Peanut row patterns (Fig. 1) consisted of (a) conventional 91-cm rows, (b) dual twin 18-cm rows situated on either side of a 183 cm bed and , (c) triple twin 18-cm rows which consist of twin 18-cm rows down each side of a 183-cm bed, with another set of 18-cm rows positioned at the bed center.

Weed control inputs consisted of combinations of preplant herbicides, preemergence herbicides, mechanical cultivation, hand hoeing, and postemergence herbicides (Table 1). Predominat species of the sites included sicklepod, Florida beggarweed, bristly starbur (*Acanthospermum hispidum* DC.) and large crabgrass. A light infestation of Texas panicum (*Panicum texanum* Buckl.) was also present.

All preplant incorporated treatments were applied 1 to 3 days prior to planting and incorporated to a depth of 13 cm by one pass with a power driven vertical action tiller. Preemergence treatments were made within 1 day after planting; postemergence treatments were applied 39 to 45 days after planting. Peanut plants were 10 to 20 cm in width when the postemergence treatments were applied and weeds did not exceed 8 cm in height. All herbicides were applied with a tractor mounted conventional boom using compressed air as the propellant and in a volume of 140 L/ha.

Weed control ratings, hoeing times, weed fresh weights (harvested last week in August) and peanut yields were obtained each year. Costs of herbicides, cultivations and hoeings ($3.35/h) were used in preparing enterprise budgets for each treatment, using the Oklahama State University crop budget generator (21) as modified by the Auburn University Agricultural Economics and Rural Sociology Department for Alabama conditions. Net returns were calculated assuming sale of a maximum of 2245 kg/ha at 100% of price support ($605.00/1000kg). Value of yields in excess of 2245 kg/ha was set as $385.00/1000kg.

The experiment was conducted in a randomized complete block design with row patterns and weed management systems completely randomized in each block. The experiment was conducted for 3 years. In the statistical analysis, years were treated as a whole plot in time with row patterns and weed management systems treated as subplots in a factorial arrangement within whole plots. Most of the variables measured and presented showed interactions of row patterns and/or weed management systems with years, consequently each year was analyzed separately.

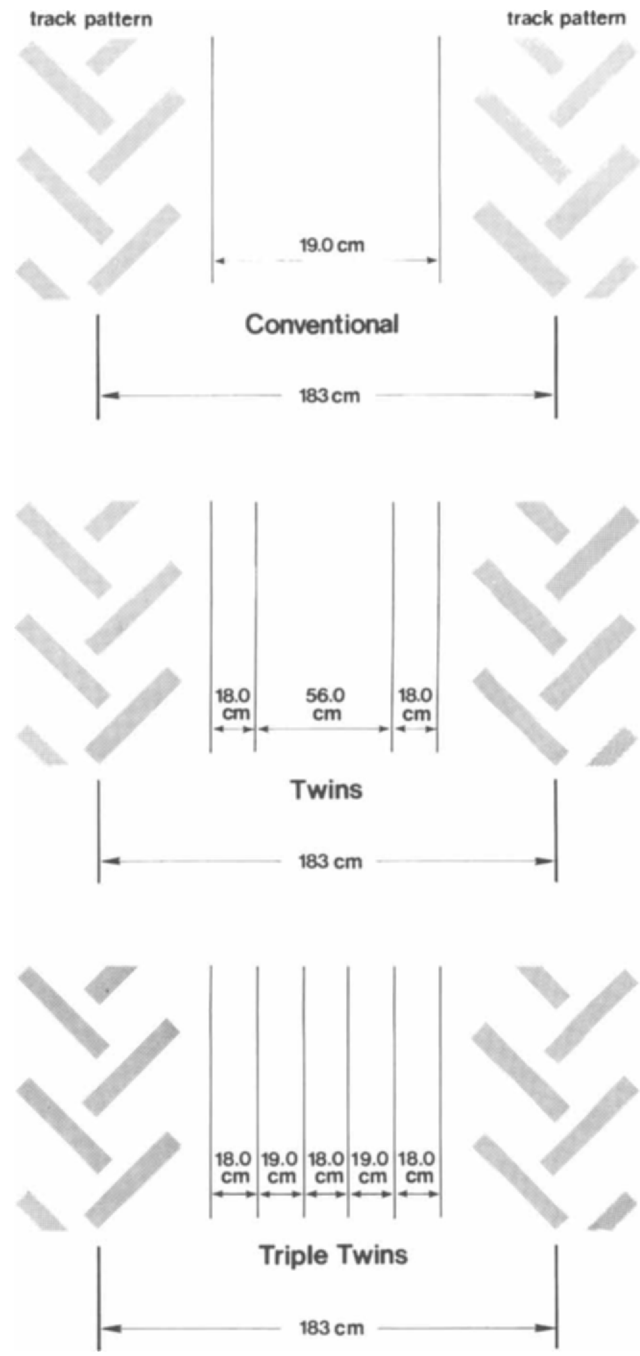

Fig. 1. Diagrams of conventional 91-cm row pattern (top), dual twin 18-cm row pattern (middle), and triple twin 18-cm pattern (bottom), all on a 183-cm bed.

Table 1. Weed management systems/treatments implemented over conventional 91-cm rows, dual twin 18-cm rows, and triple twin 18-cm rows.

Weed management systems	PPI[1]	Preemergence[2]	Postemergence[3]	Cultivation[4]	Hoeing[5]
1 (weed free)	none	none	none	none	yes
2 (weed check)	none	none	none	none	none
3	benefin	none	none	none	none
4	benefin	none	none	(2)	none
5	benefin	alachlor	none	(2)	none
6	benefin	alachlor	dinoseb + bentazon	(2)	none

[1]PPI designates herbicide applied to the soil surface before planting and mechanically mixed with the upper 13 cm of soil. Benefin applied at 1.68 kg ai/ha.

[2]Preemergence designates herbicide applied to soil surface immediately after planting. Alachlor applied at 4.48 kg ai/ha.

[3]Postemergence designates herbicides applied over the top of crop and weeds 39 to 45 days after crop emergence. Dinoseb and bentazon both applied at 0.84 kg ai/ha.

4Cultivation performed twice during the season with flat, non-dirting sweeps.

[5]Hand hoeing done as dictated by weed pressure on an as-needed basis.

In the individual year analyses row patterns and weed management systems were handled as a factorial arrangement in a randomized complete block design. Since there were no interactions in 1981 and only a few in 1982 and 1983, main effects data were chosen to present in tabular form. However, when row patterns by weed management systems interactions existed, the means of each factor were examined on a within level of the other factor basis for interpretation. These data are discussed but not presented. Duncan's multiple range tests were used at alpha =0.1 to make all comparisons.

Results and Discussion

Row patterns effects. When averaged across all weed control systems, row patterns did not affect control of bristly starbur or sicklepod any year, while Florida beggarweed control was generally lower for the triple pattern 2 or 3 years (Table 2). Large crabgrass and Texas panicum control was unaffected by row patterns in 1981 and 1982. However, less control of these grass species was evident in the conventional row pattern during 1983.

Row pattern affected weed fresh weights in only two incidences (Table 3). Broadleaf fresh weight was lower for the dual pattern in 1981, and grass fresh weight was lower for the dual and triple patterns during 1983.

Row patterns affected peanut yields each year but the effect was not consistent (Table 4). The dual pattern produced significantly higher yields than the conventional pattern during 1981 and 1983, while yields were equal for 1982. Peanut stand was variable for the dual pattern in 1982, which may account for its failure to outyield the conventional pattern during this year. Yield from the triple pattern was equal to the conventional pattern in 1981 and 1983, but lower during 1982. Again this may be attributable to the variable stand. The dual pattern produced significantly higher peanut yields than the triple pattern only during 1981.

Where only hand hoeing was used for weed control, row patterns affected the time required to remove all weeds (data not shown). On the average, the conventional pattern required 832 man hours/ha, while the dual and triple patterns required 1000 and 1136 man hours/ha, respectively. Also, we observed that cultivation was more difficult with the dual and particularly the triple pattern. However, the dual pattern has been successfully planted, cultivated, and dug/inverted at the Wiregrass Substation for 8 years with standard machinery.

Weed control systems effects. Control of bristly starbur, Florida beggarweed, and sicklepod generally required inputs of at least benefin plus alachlor plus two cultivations (system 5) to attain control equal to the hoed check (Table 5). Less intensive systems did not provide acceptable broadleaf weed control. However, no significant advantages could be detected for the more intensive program (system 6). A minimum input of benefin (system 3) gave acceptable control of Texas panicum and large crabgrass all 3 years. More intensive programs also controlled these species.

Table 2. Influence of row patterns on control of broadleaf and grass weeds averaged across weed management systems.

Weed species	Weed control[1] 1981 Row patterns Conv.[2]	Dual	Triple	1982 Row patterns Conv.	Dual	Triple	1983 Row patterns Conv.	Dual	Triple
	(%)								
Bristly starbur	81 a	83 a	79 a	76 a	75 a	71 a	96 b	99 a	99 a
Florida beggarweed	65 ab	72 a	64 b	68 a	62 ab	59 b	85 a	84 a	93 a
Sicklepod	79 a	84 a	77 a	79 a	75 a	70 a	---	---	---
Large crabgrass	80 a	84 a	82 a	91 a	88 a	88 a	88 b	98 a	94 ab
Texas panicum	79 a	83 a	83 a	85 a	84 a	83 a	85 b	98 a	95 a

[1]Means within a year and weed species followed by the same letter are not significantly different at the 10% level according to DMRT.

[2]Conv.= 91-cm rows; dual= dual twin 18-cm rows; triple= triple twin 18-cm rows.

Table 3. Influence of row patterns on weed fresh weight averaged across weed management systems.

Row patterns[4]	Weed fresh weight[1] Broadleaf species[2] 1981	1982	1983	Grass species[3] 1981	1982	1983
	(kg/ha)					
Conv.	17260 a	5480 a	830 a	1610 a	1470 a	740 a
Dual	9140 b	6360 a	910 a	1760 a	1320 a	170 b
Triple	14330 ab	5800 a	300 a	2270 a	1210 a	170 b

[1]Means followed by the same letter within a column are not significantly different at the 10% level according to DMRT.

[2]Broadleaf species consisted of sicklepod, Florida beggarweed and bristly starbur.

[3]Grass species consisted of Texas panicum and large crabgrass.

[4]Conv.= 91-cm rows; dual= dual twin 18-cm rows; triple= triple twin 18-cm rows.

Table 4. Influence of row patterns on peanut yield averaged across weed management systems.

Row patterns[2]	Peanut yield[1] 1981	1982	1983	3-yr avg.
	(kg/ha)			
Conv.	3310 b	3800 a	3230 b	3450 b
Dual	4110 a	3650 ab	3500 a	3750 a
Triple	3670 b	3350 b	3450 ab	3490 b

[1]Means followed by the same letter within a column are not significantly different at the 10% level according to DMRT.

[2]Conv.= 91-cm rows; dual= dual twin 18-cm rows; triple= triple twin 18-cm rows.

Broadleaf weed fresh weights reflect the same general trends as control ratings (Table 6). These weights were significantly reduced in 1981 and 1982 when inputs of benefin plus alachlor plus two cultivations (system 5) were used. Only benefin plus two cultivations were required in 1983 (system 4). Grass weed fresh weights were significantly reduced with the minimum input of benefin alone (system 3).

Highest peanut yields were concomitant with adequate broadleaf control (system 5). More intensive inputs did not provide significantly higher yields, while lesser input treatments produced lower yields 2 of 3 years (Table 7). No difference in yield among treatments in 1983 was directly related to the low weed pressure in the test area.

Interactions. Data for Florida beggarweed control, broadleaf weed weights, and peanut yield showed a row patterns by weed management systems interaction for 1982 (data not shown). Control of this species was less for the dual and triple patterns when used with system 4 (benefin plus two cultivations). We believe this response to be twofold. One was inability to cultivate between the paired rows. The other was due to higher soil temperatures at and a few weeks after planting in 1982 when compared to 1981 and 1983. Consequently Florida beggarweed was established before a competitive peanut canopy was produced by these two row patterns. This may indicate a need for earlier planting of the dual rows to allow for maximum peanut canopy development before the onset of weed growth.

Data for large crabgrass and Texas panicum control showed a row patterns by weed management systems interaction for 1983 (data not shown). Control of both species was higher with the dual and triple patterns

Table 5. Influence of weed management systems on control of broadleaf species averaged across all row patterns.

Weed control systems[2]	Weed control[1]															
	Bristly starbur			Florida beggarweed			Sicklepod		Large crabgrass			Texas panicum		
	1981	1982	1983	1981	1982	1983	1981	1982	1981	1982	1983	1981	1982	1983
	(%)													
1	99 a	99 a	100 a	98 a	99 a	100 a	99 a	99 a	98 a	99 a	100a	98 a	98 a	100 a
2	73 b	64 b	98 ab	20 e	24 c	56 c	63 bc	44 c	7 c	40 b	59b	8 c	13 b	58 b
3	55 c	19 c	97 b	44 d	18 c	81 b	57 c	47 c	90 b	99 a	100 a	88 b	97 a	99 a
4	65 bc	66 b	98 ab	69 c	49 b	93 ab	74 b	69 b	99 a	99 a	100 a	98 a	98 a	100 a
5	93 a	98 a	98 ab	86 b	92 a	97 a	94 a	95 a	99 a	99 a	100 a	99 a	99 a	100 a
6	99 a	99 a	99 ab	88 b	96 a	97 a	99 a	95 a	99 a	99 a	100 a	99 a	99 a	100 a

[1]Means within a column followed by the same letter are not significantly different at the 10% level according to DMRT.

[2]For treatment descriptions of weed management systems refer to Table 1.

Table 6. Influence of weed management systems on fresh weed weights averaged across all row patterns.

Weed control systems[4]	Weed fresh weight[1]					
	Broadleaf species[2]			Grass species[3]		
	1981	1982	1983	1981	1982	1983
	(kg/ha)					
1	1150 c	0 c	0 c	370 b	0 b	0 b
2	29570 a	6930 b	2220 a	10620 a	8310 a	2020 a
3	21250 b	16630 a	1060 b	370 b	0 b	140 b
4	22170 ab	7850 b	550 bc	0 b	0 b	0 b
5	6000 c	2540 c	180 bc	140 b	0 b	0 b
6	290 c	1850 c	140 bc	0 b	0 b	0 b

[1]Means followed by the same letter within a column are not significantly different at the 10% level according to DMRT.

[2]Broadleaf species consisted of sicklepod, Florida beggarweed and bristly starbur.

[3]Grass species consisted of Texas panicum and large crabgrass.

[4]For treatment descriptions of weed management systems refer to Table 1.

Table 7. Influence of weed management systems on peanut yield averaged across all row patterns.

Weed control systems[2]	Peanut yield[1]			
	1981	1982	1983	3-yr avg.
	(kg/ha)			
1	5050 a	4880 a	3480 a	4470 a
2	1340 d	1670 c	3580 a	2200 c
3	2310 c	1480 c	3390 a	2390 c
4	3630 b	3080 b	3290 a	3330 b
5	4750 a	5050 a	3270 a	4360 a
6	5120 a	5290 a	3360 a	4590 a

[1]Means followed by the same letter within a column are not significantly different at the 10% level according to DMRT.

[2]For treatment descriptions of weed management systems refer to Table 1.

when in combination with system 2 (weedy check). We believe this was due to the development of a more competitive crop canopy earlier in the season with these patterns. Wehtje *et al.* (22) showed a similar response.

Net returns to land and management. In the conventional row pattern, net returns to land management (NRLM) were highest and statistically the same for systems 4, 5, and 6 with dollar values ranging from $325 to $420/ha. Consequently, system 4 (benefin plus two cultivations) appears optimum for this row pattern (Table 8). The dual and triple patterns, however, required weed control system 5 (benefin plus alachlor plus two cultivations) to return highest NRLM of $529 and $439/ha, respectively. Therefore, it appears that the dual row pattern has a higher profit potential than the conventional, even though more herbicides were required to reach the full potential of this pattern. This may reflect the inability to cultivate the 18-cm band between the twin rows. More weed control inputs for the dual pattern is contrary to previous suggestions by Hauser and Buchanan (9).

Table 8. Net returns to land and management as influenced by weed management systems and row patterns.

Weed control systems[2]	3-yr average net returns to land and management[1]		
	Row patterns		
	Conventional	Dual	Triple
	($/ha)		
1	-821.00 c A	-1045.00 d B	-1262.00 d C
2	-9.00 b B	134.00 c A	36.00 c AB
3	38.00 b A	83.00 c A	72.00 bc A
4	325.00 a A	271.00 b A	160.00 b B
5	383.00 a B	529.00 a A	439.00 a AB
6	420.00 a A	505.00 a A	480.00 a A

[1]Means within a column followed by the same lower case letter or means within a row followed by the same upper case letter are not significantly different at the 10% level according to DMRT.

[2]For description of weed management systems refer to Table 1.

Summary

The results of this research and that of Hauser and Buchanan (9) and Wehtje *et al.* (22) show that the dual 8-cm row pattern is a plant arrangement that, for the majority, has shown higher peanut yields over conventional and some other narrow-row patterns. The reason for the increased yields are not yet clear. It appears that better crop/weed competition and/or the inherent ability to yield more are contributing factors. Regardless, peanut producers should adopt this production practice. Even though weed management requirements are slightly higher, net return potentials are better. Converting to this system will require only minor changes in existing equipment for planting, cultivating, and digging/inverting the dual 18-cm row pattern.

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