Influence of Twin Rows on Yield and Weed Control in Peanuts[1]

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ABSTRACT

Fresh weed weights and yields were compared between Florunner peanuts (*Arachis hypogaea* L.) grown in twin 18 cm rows and conventional 91 cm rows when subjected to a series of weed control systems ranging from none to intense. Reductions in grasses in the twin row spacing were evident in 2 out of 3 years in the untreated check, where grass infestations were at a maximum. Comparable reductions in broadleaves, and increases in yield were sporatic. While the twin row spacing affected weeds and yield in a favorable manner, the consistency was insufficient to premit any reduction in herbicide inputs.

Key Words: Herbicide, weed competition, benefin, vernolate, dinoseb.

Studies on the effects of row spacing on peanut production date from the early 1890's (1). As early as the 1940's a yield enhancement could be linked to narrow rows. However, adoption was limited since weed control. which relied on cultivation, was more difficult in narrow rows.

In more recent studies, Duke and Alexander (4) found that yields of virginia type cultivars were often higher in rows spaced closer than 90 to 100 cm. Norden and Lipscomb (9) reported a 16% yield increase for bunch-type cultivars in 46 cm rows as compared to 91 cm rows. A nonsignificant 5% yield increase was reported for runner types. In North Carolina, Cox and Reid (3) reported that decreased row width below 91 cm generally enhanced yields of spanish varieties. Mozingo and Coffelt (8) evaluated yield and grade for Florigiant and Virginia 81 Bunch when grown in single 91 cm and twin 17 cm rows. Row pattern did not affect yield or grade of Florigiant, while both were enhanced by twin rows with Virginia 81 Bunch.

The yield advantage of close rows has been well documented with spanish and virginia type cultivars. Comparable data for Florunner (the most widely grown cultivar in the United States) have been limited and contradictory. Mixon (7) failed to show a yield advantage when runner types were planted in 30 or 40 cm rows. In 1980, Buchanan and Hauser (2) reported that in either the presence or absence of weeds, Florunner yields increased as row width was decreased from 80 to 40 to 20 cm. In addition, weed competition (as measured by the green weight of weeds produced during the season) decreased as row width was decreased.

Hauser and Buchanan (5), in a split-plot design, evaluated peanut yields and the numbers and weight of sicklepod (*Cassia obtusifolia* L.) produced as influenced by periods of weed-free maintenance (whole-plot), intensity of herbicide system (sub-plot), and row spacing (subsub-plot). When averaged over all other variables, decreasing the row width resulted in increased peanut yields and decreased sicklepod infestation. Thus, it was concluded that narrow rows offer advantages of increased yield (approximately 15% compared to conventional row spacing) and weed suppression. It was proposed that narrow rows could be justified solely on their ability to suppress weeds, and consequently, herbicide usage could probably be reduced. If this proposal is correct, it should be possible to equate the weed-suppression benefit of narrow row patterns to a portion of the standard herbicide systems used in conventional row patterns. The objective of this study was to determine if twin rows could provide a yield advantage and thereby reduce herbicide requiements for Florunner production.

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Materials and Methods

Field experiments were conducted to determine the weed control requirements and resultant yields of peanuts grown in twin and conventionally spaced rows. Experiments were conducted at the Wiregrass Substation, Alabama Agricultural Experiment Station, Headland, AL, for 3 years (1981-83).

A split-plot design arranged as a randomized complete block with four replications was used. Whole-plots (6.2 by 6.2 m) were the weed control systems, and sub-plots were row patterns. Weed control systems ranged from none to very intense, utilizing herbicides common to peanut production (Table 1).

Table 1. Herbicides used in weed control systems.

Common name	Chemical Name
Benefin (Ben.)	*N*-butyl-*N*-ethyl-α-α-α-trifluoro-2,6-dinitro-*p*-toluidine
Vernolate (Ver.)	dipropylthiocarbamate *S*-propyl
Alachlor (Ala.)	2-chloro-2', 6'-diethyl-*N*-(methoxymethyl) acetanilide
Dinoseb (Din.)	2-*sec*-butyl-4,6-dinitrophenol
Naptalam	*N*-1-naphthylphthalamic acid
Dyanap[R] (Dyn.)	a 2:1 commercially prepared mixture of Dinoseb and Naptalam
Paraquat	chloride salt of 1,1'-dimethyl-4-4'-bipyridinium ion
2,4-DB	2,4-dichlorophenoxy butyric acid

Systems 3, 4 and 5 consisted of benefin, vernolate and the combination thereof, respectively, applied as preplant incorporated (PPI) treatments at the recommended rates (Table 2). To this combination

Table 2. Weed control systems applied to twin and conventionally spaced peanut rows; Headland, Alabama, 1981 through 1983.

Weed control systems	Rate (kg/ha)	Time of application[1]
1. Untreated check	------	------
2. Cultivation	------	3,5,8 weeks after planting
3. Ben.	1.68	PPI
4. Ver.	2.24	PPI
5. Ben. + Ver.	1.68 + 2.24	PPI
6. Ben. + Ver.	1.68 + 2.24	PPI
Ala.+ Dyn.	3.36 + 3.36	GC
7. Ben. + Ver.	1.68 + 2.24	PPI
Ala. + Dyn.	3.36 + 3.36	GC
Din.- once	0.86	2 weeks after GC
8. Ben. + Ver.	1.68 + 2.24	PPI
Ala.+ Dyn.	3.36 + 3.36	GC
Din.-twice	0.86	2 and 3 weeks after GC
9. Ben.+ Ver.	1.68 + 2.24	PPI
Ala. + Dyn.	3.36 + 3.36	GC
Din.-thrice[2]	0.86	2, 3 and 4 weeks after GC
10. Ben. + Ver.	1.68 + 2.24	PPI
Ala. + Dyn	3.36 + 3.36	GC
Din.-twice[2]	0.86	2 and 3 weeks after GC
2,4-DB	0.22	4 weeks after GC
11. Ben. + Ver.	1.12 + 0.86	PPI
Din.-thrice	3.0(1st),0.86 (2nd and 3rd)	GC, 2 and 3 weeks after GC
12. Ben. + Ver.	1.12 + 0.86	PPI
Paraquat (Par.)-twice	0.14	1, 2 and 3 weeks after GC
13. Cultivation + hand weeded		3,5 and 8 week after planting

[1]PPI= preplant incorporated, GC= ground cracking, growth stage where the crop is emerging or 'cracking' through the soil.

[2]Mutiple applications were at the same rate as indicated.

alachlor and Dyanap[R] (2:1 commercially prepared mixture of dinoseb and naptalam) were added (systems 6-10). This mixture was applied at ground cracking (GC). In addition to these four herbicides, (system 6) one to three additional applications of dinoseb were added to create systems 7-9. System 10 received a single application of 2,4-DB in lieu of the third application of dinoseb. These latter systems are typical of those used in peanut production in the Southeast. Systems 11 and 12 consisted of benefin + vernolate at a reduced rate, followed by three sequential applications of either dinoseb or paraquat.

Weed control by cultivation alone (system 2) and by cultivation plus hand weeding (system 13) were also included. Three cultivations were performed as needed each season. A sweep cultivator set just below the soil surface was used. Hand weeding was weekly, beginning with crop emergence and ending just prior to harvest.

Each whole plot was divided into two sub-plots, to which were randomly assigned one of two row patterns. One pattern consisted of rows evenly spaced 92 cm apart (conventional). The other pattern consisted of twin rows spaced 18 cm apart, with each set of twin rows separated by 74 cm. Conventional planting and harvesting machinery was easily adapted to this narrow-row pattern (6).

The test area was moldboard plowed, disked, and a level seedbed prepared. Florunner peanuts were planted to a depth of 5 cm in the last week of April or the first week of May. A seeding rate of 128 kg/ha was used for both row spacings. The experimental area consistently had heavy and uniform populations of sicklepod, Florida beggarweed [*Desmodium tortuosum* (sw.) DC], smallflower morningglory [*Jacquemontia tamnifolia* (L.) Griseb], Texas panicum (*Panicum texanum* Buckl.) and large crabgrass [*Digitaria sanguinalis* (L.) Scop.]. Insect and disease control practices were those recommended by the Alabama Cooperative Extension Service.

All herbicides were applied in water via a tractor mounted compressed air sprayer at a volume equivalent to 140 L/ha. Preplant herbicides were incorporated with a single pass of a power driven, vertical action tiller set for a depth of 10 to 13 cm. Pre-emergence applications were made within 1 day after planting. Postemergence application followed the schedule as close as weather permitted.

Within one to two weeks prior to harvest, broadleaf and grass weeds were harvested from a 1 m^2 section of each plot, and green weed weights were determined. Weeds were not separated by species. Peanuts were harvested in early September with conventional equipment. Harvested nuts were dried to 14% moisture and weighed.

The data were subjected to analysis of variance and means between systems separated by Duncan's multiple range test. Means between row spacings within a system were compared via the least significant difference. Both tests were at the 5% probability level.

Results and Discussion

Broadleaf weed control

Significant year-by-treatment interactions were detected, consequently results from each year are presented separately. In most cases interactions were attributable to slight changes in the ranking of treatment means between years; large differences have been noted. In 1981, all systems that contained both PPI and postemergence treatments had broadleaf weed control (as indicated by fresh weight) equivalent to the hoed check. Systems with only PPI treatments (systems 3,4 and 5) frequently had greater amounts of broadleaves than the untreated check; this is attributable to reduced competition from grasses. Systems with only PPI applications of benefin and/or vernolate had no better control than the untreated check. Cultivation alone provided intermediate control (Table 3). In 1982 (Table 4), control equal to the hoed checks was obtained in (i) treatments consisting of benefin plus vernolate (PPI), alachlor plus dinoseb (GC), and 1 or more applications of dinoseb (systems 7-100; (ii) the treatment of benefin plus vernolate (PPI) and paraquat applied postemergence (system 12); and (iii) cultivation alone (system 2). All systems that provided maximum control of broadleaf weeds in 1982 did likewise in 1983 (Table 5). In addition, in 1983 system 6 provided the maximum level of control due to less weed infestation.

Table 3. Influence of weed control system and row pattern on weight of broadleaf and grass weed, and peanut yield, Headland, Alabama 1981.

Weed control system[1]	Fresh weed weight: Broadleaf, Row pattern: Conv.	Twin	Mean	Grass, Row pattern: Conv.	Twin	Mean	Peanut yield: Conv.	Twin	Mean
	(kg/ha)								
1. untreated	2560	2130	2350a[2]	2180	2000	2090a	210	210	210e
2. cult. (thrice)	590	1170	880b	1180	1950	1570ab	1960	1860	1910d*
3. Ben.	2490	2010	2250a	110	0	60c	1340	2200	1770d
4. Ver.	2770	2620	2690a	1220	880	1040b	670	1060	860e
5. Ben. + Ver.	2190	1860	2020a	10	0	5c	1790	1960	1870d
6. Ben. + Ver.; Ala. + Dyn.	1160	160	660bc*	0	0	0c	3190	3950	3570c*
7. Ben. + Ver.; Ala. + Dyn; Din.	240	130	180bc	80	0	40c	4220	4680	4450ab[y]
8. Ben. + Ver.; Ala. + Dyn; Din. (twice)	630	290	460bc	290	0	150c	4500	4720	4610ab
9. Ben. + Ver.; Ala. + Dyn.; Din. (thrice)	480	200	340bc	80	350	220c	4710	5290	5000a*[x]
10. Ben. + Ver. Ala. + Dyn.; Din. (twice) 2,4-DB	*320	60	190bc[x]	0	0	0c	4680	4720	4700ab
11. Ben. + Ver.; Din. (thrice)	630	200	410bc[x]	160	0	80c	4090	4700	4390ab*
12. Ben. + Ver.; Par. (thrice)	680	380	530bc[y]	0	0	0c	3840	3970	3910bc
13. Hoed check	0	0	0c	0	0	0c	4450	4520	4490ab
LSD 0.05		630			630			470	

[1]Weed control systems are described in Table 1.

[2]Means in column with same letter are not significantly different as determined by Duncan's multiple range test at the 5% probability level.

*Signifies a significant difference with the conventional and twin row pattern as determined by the LSD at the 5% probability level.

[x]More effective in 81 than in 82 or 83.

[y]Less effective in 81 than in 82 or 83.

Table 4. Influence of weed control system and row pattern on weight of broadleaf and grass weed, and peanut yield, Headland, Alabama 1982.

Weed control system[1]	Fresh weed weight: Broadleaf, Row pattern: Conv.	Twin	Mean	Grass, Row pattern: Conv.	Twin	Mean	Peanut yield: Conv.	Twin	Mean
	(kg/ha)								
1. untreated	510	480	490b	1130	920	1020a*	2450	2630	2540cd[x]*
2. cult.(thrice)	150	520	340bcd[x]	560	750	650b	2400	1790	2090de
3. Ben.	1340	880	650a	20	80	50c	1750	1950	1850de
4. Ver.	750	1010	880a	180	180	180c.	1420	1540	1480e
5. Ben. + Ver.	1190	1240	1220a[y]	20	70	50c	1570	1050	1310e
6. Ben. + Ver.; Ala. + Dyn.	500	290	390bc	0	0	0c	4270	4580	4430ab[x]
7. Ben. + Ver.; Ala. + Dyn; Din.	290	200	240bcd	0	10	5c	5110	4920	5020a
8. Ben. + Ver.; Ala. + Dyn; Din. (twice)	330	260	790bcd	0	20	10c	4740	4880	4810ab
9. Ben. + Ver.; Ala. + Dyn.; Din. (thrice)	290	200	250bcd	0	40	20c	4140	4760	4450ab*
10. Ben. + Ver.; Ala. + Dyn.; Din. (twice) 2,4-DB	230	440	340bcd	20	230	130c	4170	4880	4470ab*
11. Ben. + Ver.; Din. (thrice)	500	410	450b	200	380	290c	3070	3120	3090c
12. Ben. + Ver.; Par. (twice)	70	80	80cd	40	0	20c	4330	4210	4270ab
13. Hoed check	0	0	0d	0	20	10c	3880	4430	4160[y]
LSD 0.05		390			210			590	

[1]Weed control systems are described in Table 1.

[2]Means in column with same letter are not significantly different as determined by Duncan's multiple range test at the 5% probability level.

*Signifies a significant difference with the conventional and twin row pattern as determined by the LSD at the 5% probability level.

[x]More effective in 82 than in 81 and 83.

[y]Less effective in 82 than in 81 and 83.

Across all years, systems 7-10, and 12 consistently provided optimum control of broadleaf weeds. Systems 7-10 included benefin plus vernolate applied PPI at the full rate, alachlor plus Dyanap[R] applied at GC, and at least one postemergence application of dinoseb. In system 12, benefin plus vernolate were applied PPI at the reduced rate; all subsequent weed control was accomplished with 3 applications of paraquat.

Table 5. Influence of weed control system and row pattern on weight of broadleaf and grass weed, and peanut yield, Headland, Alabama 1983.

Weed control system[1]	Fresh weed weight: Broadleaf, Row pattern: Conv.	Twin	Mean	Grass, Row pattern: Conv.	Twin	Mean	Peanut yield: Conv.	Twin	Mean
	(kg/ha)[2]								
1. untreated	610	680	650bc	980	590	790a*	2260	2140	2020c
2. cult. (thrice)	290	250	270cde	360	360	360bc	3730	2760	2990ab[x]
3. Ben.	1530	740	1130a*[x]	40	0	20d	2370	2810	2600abc*
4. Ver.	680	850	770ab	300	220	260c	1840	2610	2230bc
5. Ben. + Ver.	610	420	520bcd	0	0	0d	2160	2040	2090c
6. Ben. + Ver.; Ala. + Dyn.	260	210	230de	0	0	0d	3160	2810	2880ab
7. Ben. + Ver.; Ala. + Dyn; Din.	290	140	210de	0	0	0d	3250	3530	3390a
8. Ben. + Ver.; Ala. + Dyn; Din. (twice)	40	160	100de[y]	0	0	0d	3300	3250	3170a
9. Ben. + Ver.; Ala. + Dyn.; Din. (thrice)	330	100	220de*	40	0	20d	2410	3540	2970ab*
10. Ben. + Ver.; Ala. + Dyn.; Din. (twice) 2,4-DB	250	210	230de	60	0	30d	2410	3420	2910ab*[y]
11. Ben. + Ver.; Din. (thrice)	600	320	450bcd*	580	510	550b[x]	2980	2860	2910ab
12. Ben. + Ver.; Par. (thrice)	240	130	180de	10	0	5d	2800	2580	2740abc
13. Hoed check	0	0	0e	10	0	5d	3790	2960	3370a
LSD 0.05		230			160			540	

[1]Weed control systems are described in Table 1.

[2]Means in column with same letter are not significantly different as determined by Duncan's multiple range test at the 5% probability level.

*Signifies a significant difference with the conventional and twin row pattern as determined by the LSD at the 5% probability level.

[x]More effective in 83 than in 81 and 82.

[y]Less effective in 83 than in 81 and 82.

Reductions in the weight of broadleaf weeds by the twin row pattern was sporatic across weed control systems as well as years. The twin row pattern reduced broadleaf weed levels in system 3 in 1982 and 1983, system 6 in 1981 and with system 9 and 11 in 1983. However, within these systems, only with system 6 in 1981 and system 9 in 1983 was the overall level of broadleaf control comparable to the hoed check.

Grass control

In 1981, grass control was equivalent to the hoed check with all systems that included benefin (Table 3). Cultivation alone was no better than the untreated check. Vernolate alone provided intermediate control. In 1982, any system which included benefin or vernolate resulted in grass control equivalent to the hoed check. Cultivation provided intermediate control (Table 4). In 1983, all systems that contained benefin at 1.68 kg/ha or benefin at 1.12 kg/ha when supplemented with paraquat provided grass control comparable to the hoed check. The other systems provided less than satisfactory grass control (Table 5).

Only in the untreated checks in 1982 and 1983 did the twin row pattern reduce grasses. Grass control provided by any preplant herbicide was sufficient to nullify any measurable competitive benefit toward grasses provided by the twin row pattern. Thus, enhancement of the ability to compete due to the twin row pattern was manifested only in the absence of any grass control measures.

Peanut Yield

For all years, yields equal to or greater than the hoed check were achieved with systems 7-10 (Tables 3, 4, 5). These systems consistently provided maximum grass and broadleaf weed control and have the following in common: benefin plus vernolate (PPI), or alachlor plus Dyanap[R] (GC), and 1 to 3 postemergence applications of dinoseb.

Neither yields nor weed control were improved with systems with more than one postemergence herbicide application (System 7).

Twin rows out-yielded conventional rows in systems 3, 6, 9 and 11 in 1981, and systems 9 and 10 in 1982, and in systems 4, 9 and 10 in 1983. Conventional rows out-yielded twin rows in system 2 (cultivation) in 1982 and system 13 (hoed check) in 1983. Only with systems 9 and 10 did increased yields from twin rows occur concomitantly with maximum yields and minimal levels of both broadleaf and grass weeds. These two systems were very intense in terms of weed control, both receiving three postemergence herbicide applications. But they provided no greater weed control (nor yield) than with a single postemergence application (System 7). It is possible that the greater yield of the twin rows in system 9 and 10 may reflect less competition between peanut plants in twin rows, resulting in better recovery from the injury caused by excessive application of herbicides.

Summary

Yield improvement by twin rows was most pronounced when weed competition was reduced to a minimum by the more intense herbicide systems. Conversely, the ability of twin rows to compete with weeds was most pronounced when weed infestations were unacceptably high. This was especially true with grasses, where only in the heavily infested untreated check could a significant row spacing effect be detected (1982 and 1983). A similar, but less pronounced, trend was evident with the broadleaves. Only in two incidences did twin rows reduce broadleaf weights compared to the conventional pattern, where an overall acceptable level of control had been achieved (system 6 in 1981, system 9 in 1983).

Our results support the conclusion of Hauser and Buchanan (5, 6) in that when the twin row pattern did affect weeds and/or yields, it was in favorable manner. However, weed suppression was not a consistent nor frequent phenomena. Consquently, weed control inputs can not realistically be reduced compared to what is commonly used with conventionally spaced rows. Twin rows should be viewed as a supplement to a comprehensive weed control program. Its greatest potential benefit lies in yield improvement where acceptable weed control has already been achieved.

Literature Cited

1. Bennett, R. L. 1899. Experiments with peanuts, legume maturing, cotton meal, whole and crushed cotton seed manuring and varieties of cotton. Arkansas Agric. Exp. Stn. Bull. 58.
2. Buchanan, G. A., and E. W. Hauser. 1980. Influence of row spacing on the competitiveness and yield of peanuts. Weed Sci. 28:401-409.
3. Cox, R. R., and P. H. Reid. 1965. Interaction of plant population factors and level of production on the yield and grade of peanuts. Agron. J. 57:445-457.
4. Duke, G. B. and M. Alexander. 1964. Effects of close row spacing on peanut yield and peanut production requirements. USDA Prod. Res. Bull. 77.
5. Hauser, E. W. and G. A. Buchanan. 1981. Influence of row spacing, seeding rates, and herbicide systems on the competitiveness and yield of peanuts. Peanut Sci. 8:74-81.

6. Hauser, E. W. and G. A. Buchanan. 1982. Production of peanuts as affected by weed competition and row spacing. Alabama Agric. Exp. Stn. Bull. 538.35 pp.
7. Mixon, A. C. 1969. Effects of row and drill spacing on yield and market grade factors of peanuts. Auburn Univ. Agric. Exp. Stn. Bull. 381.
8. Mozingo, R. W. and T. A. Coffelt. 1984. Row pattern and seeding rate effects on value of virginia type peanuts. Agron. J. 76:460-462.
9. Norden, A. J. and R. W. Lipscomb. 1974. Influence of plant growth habit on peanut production in narrow rows. Crop Sci. 14:454-457.

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