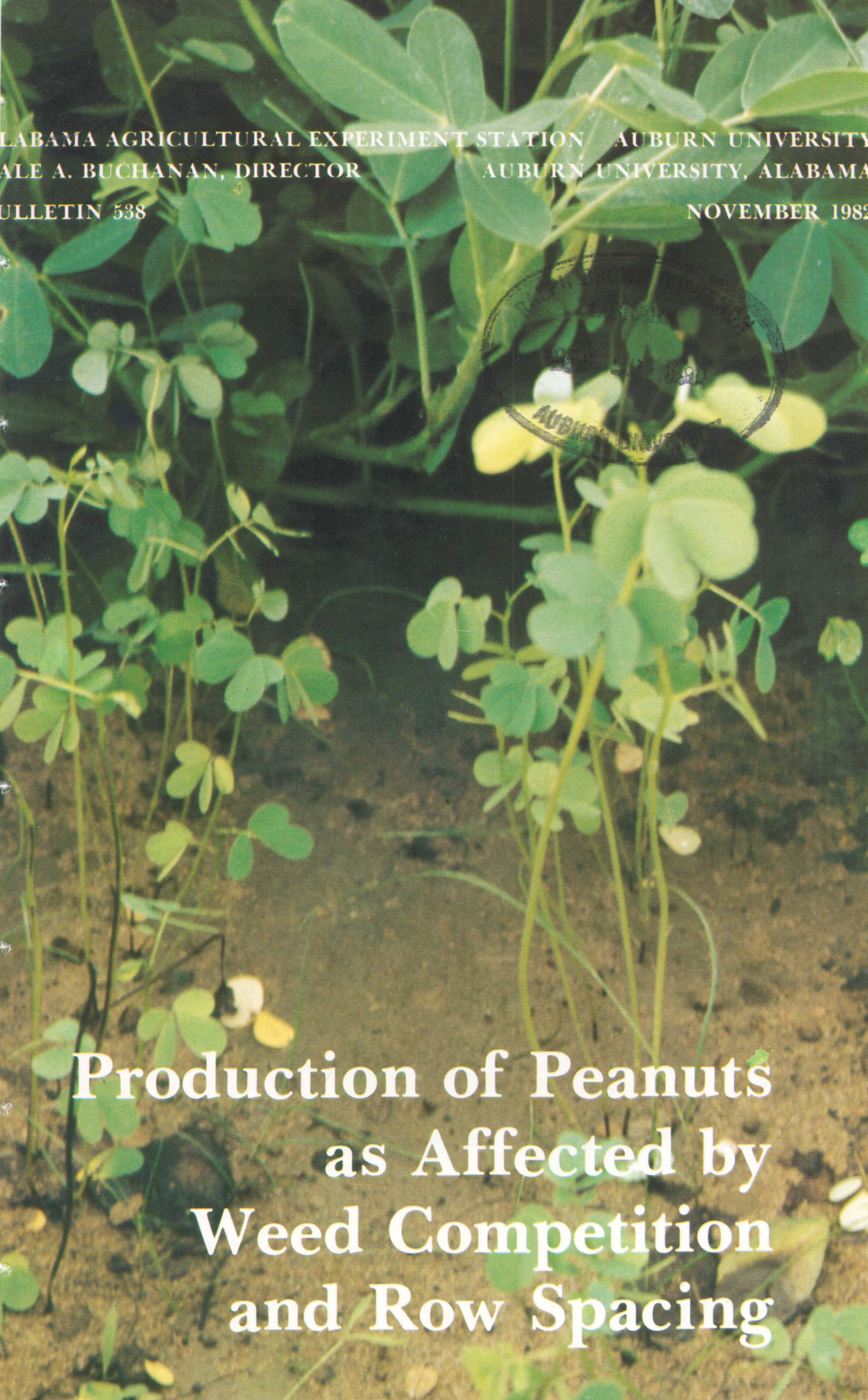

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Production of Peanuts as Affected by Weed Competition and Row Spacing

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Production of Peanuts as Affected by Weed Competition and Row Spacing[1]

Ellis Hauser and Gale A. Buchanan[2]

INTRODUCTION

Weed-Crop Competition Principles

An understanding of some principles involved in competition among plants provides an increased perspective of competition between weeds and peanuts. The first principle involves the competitive effects between plants. These effects depend upon the relative ability of the two plants to utilize growth factors in the environment. Similarities in foliar and root characteristics and methods of reproduction contribute to competitive relationships between weed and crop plants. The closer the similarity of plants, whether between or within species, the more they will compete with each other – this is one reason why the legumes Florida beggarweed [*Desmodium tortuosum* (Sw.) DC.], peanuts (*Arachis hypogaea* L.), and sicklepod (*Cassia obtusifolia* L.) are so competitive with each other.

The second principle is that the species which first occupies a given space has an advantage over later invading species. These late emerging weeds are less competitive. However, the degree of this competition varies with the crop and weed species. Therefore, growers should concentrate weed control efforts during the early part of the spring season.

The third principle of weed competition is that weed species vary in competitive effects on a given crop. For example, Texas panicum (*Panicum texanum* Buckl.) undoubtedly competes better with peanuts than does crabgrass [*Digitaria sanguinalis* (L.) Scop.].

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Two of the most troublesome weeds in peanuts grown in the southeastern Coastal Plain of the United States are Florida beggarweed and sicklepod. Both of these weeds compete vigorously with peanuts.

An understanding of competition dynamics for these broadleaf weeds is especially important, because the nature of the developing peanut foliage precludes the use of directed postemergence application of herbicides. Information is needed as to when these weeds emerge and compete most severely with the peanut crop. Unsuppressed broadleaf weeds and some grass weeds such as Texas panicum may tower 4 to 8 feet over peanuts at harvest, interfering with the harvest and also damaging the harvesting equipment. Knowledge of weed-crop competition will enable farmers to use herbicides, cultivation, and other weed control practices much more effectively.

Row Spacing

Studies of the effect of row spacing on the growth and yield of peanuts began in the 1890's (1) and since that time have continued on a limited basis. Early investigators emphasized the difficulty in cultivating peanuts in narrow-row plantings. Beattie et al. (2) pointed out that "in commercial practice the intervals between rows vary from a width sufficient for the passage of a mule to as much as 4 feet". Later, Parham (8) found that yields of Spanish peanuts were higher in 18-inch rows than in 24-, 30-, 36-, or 42-inch rows. However, alluding to the difficulty of cultivating narrow rows and to the large quantities of seed needed for planting, he suggested 26- to 30-inch row spacings as the most practical.

In more recent studies, Duke and Alexander (4) found that, in 2 out of 3 years, yields of large-seeded Virginia bunch-type peanuts were higher in close rows than in standard-width, 36-inch rows. Within the close-row patterns, yields were similar with either 12- or 18-inch rows. They further observed that peanuts planted in conventionally spaced rows produced more extra large kernels than did those planted in close rows. In contrast, row spacing did not significantly affect runner-type peanuts. In other research, Norden and Lipscomb (7) reported a significant 16 percent yield increase of 'bunch' lines of peanuts planted in 18-inch rows as compared to 36-inch rows. The 5 percent yield increase of runner lines was not statistically significant. They used an in-row seeding rate that resulted in equal plant populations in each of the row spacings employed.

Cox and Reid (3) conducted many spacing experiments in North Carolina. They reported that increasing peanut plant populations, either by higher seeding rate in the row, or by decreasing row widths, led to higher yields of peanuts. Decreasing row widths was generally the more effective and consistent means of increasing yields.

In Alabama, Mixon (6) failed to show a yield advantage when runner-type peanuts were planted in 12- and 18-inch rows as compared to 36-inch row spacing. He did suggest other possible advantages of close-row peanuts such as better opportunities for control of weeds and diseases with pesticides. Mixon's research did not include Florunner since this variety was not available at the time.

Much of the research conducted prior to 1950 was neither conclusive nor statistically analyzed. Most early investigators, however, did emphasize the difficulty of cultivating narrow-row plantings. With the precision cultivating equipment and herbicides that are available today, difficulty in cultivation is no longer a compelling reason for the use of conventional row spacing.

Statistically significant increases in yields from "close-rows" of runner-type peanuts have not been reported. Furthermore, no publications were found describing the effect of row spacing on Florunner, the most widely grown cultivar in the United States. The objectives of these studies, conducted from 1971 to 1981, were to determine (a) the effects of different periods of weed-free maintenance or weed competition on the yield of peanuts, (b) emergence dates of the weeds that are severe problems at harvest, (c) the effects of row spacing on yields of peanuts, and (d) the influence of row spacing on the weed-crop competitive relationships involved in growing Florunner peanuts.

EXPERIMENTAL PROCEDURE

Weed-Crop Competition Experiments

Experiments with sicklepod were conducted from 1971 to 1973 at Headland (Dothan loamy sand), and at Plains, Georgia (Greenville sandy clay loam). Studies with Florida beggarweed were conducted at Tifton, Georgia (Tifton loamy sand). Unless otherwise stated, all other experiments described were conducted at Headland and Plains.

In one experiment conducted at both locations, peanuts were maintained weed-free by hand-weeding for various periods of time, table 1, after peanuts cracked through the soil surface. At the end of the weed-free maintenance periods, weeds were allowed to emerge and remained undisturbed. In the other experiment, weeds were allowed to compete with the peanuts for specified periods of time after the peanuts cracked through the soil surface. At the end of each period of competition, the weeds were removed by hand and the peanuts were maintained weed-free until harvest.

In the combination competition-cultivation experiments, sweeps were set flat to cultivate shallow 4 weeks after the peanuts emerged. Stands of Florida beggarweed were erratic at Tifton because the planted seed did not emerge. To establish treatments without peanuts at Headland, the emerged peanut seedlings were removed by hand-hoeing shortly after emergence. At Plains and Tifton, peanuts were not planted in the no-peanut treatments. The whole plots were "weeks of weed-free maintenance" while the split and split-split plots were (a) peanuts versus none and (b) cultivation versus none, respectively.

At the end of each period of weed-free maintenance or competition, weeds were counted, harvested, and weighed. After the respective weed-free maintenance periods, the dates of newly emerging weeds were recorded by placing labels near the seedling weeds. Thus, the dates of emergence of weeds which eventually overtopped the peanuts could be identified. Peanuts were harvested by combine in August or September and the pod weights were recorded. Samples were taken from each plot for use in determining market value.

In all competition experiments sicklepod was planted to supplement the natural stands at Headland and Plains. Florida beggarweed stands were erratic at Tifton because of poor emergence. Other weeds were controlled with benefin (*N*-butyl-*N*- ethyl-α,α,α-trifluoro-2,6-dinitro-*p*-toluidine) at 1.5 pounds per acre incorporated 3 inches deep before planting at all locations. In addition, vernolate (*S*-propyl dypropylthiocarbamate) at 2.5 pounds per acre was injected for the control of nutsedge when the peanuts were planted at Tifton. Unwanted escaped weeds were hand-weeded shortly after they emerged.

Treatments were arranged in a randomized complete-block design with four replications for the weed-free maintenance experiments and in a split, split-split plot design for the competition-cultivation experiments. Individual plots consisted of four rows each 25 feet long (with the two center rows for harvest) at Headland and two rows (each 25 feet long) at Plains and Tifton. A check (two-row plot) containing the weed under study, but also planted to peanuts, was left between each treated plot at Plains and Tifton. Row width at Headland was 36 inches. At Plains and Tifton, a modified two-row pattern accommodated flat-bed culture with two rows 28 inches apart on the bed, with 36 inches between the rows on adjacent beds. 'Florunner' peanuts were planted at Headland, and 'Tifspan' at Plains and Tifton.

Recommendations of the Alabama and Georgia Cooperative Extension Services were used to control insects and diseases in all studies. Analyses of variance and Duncan's multiple range test were run on all data.

Experiments on the Quantitative Effects of Florida Beggarweed and Sicklepod on Peanuts

Immediately after planting Florunner peanuts at Headland at 100 pounds per acre, sufficient seeds of Florida beggarweed and sicklepod were sowed, with a hand-pushed planter to give 130 to 200 seedlings per 3 feet of row. The weed seedlings were thinned to 0, 0.5, 1.0, 3.0, 6.0, and 36.0 plants per yard of row after they grew to 1 inch and then again at 3 to 4 inches. All weeds except Florida beggarweed or sicklepod were removed by hand. Fresh weight of weeds, cut at the ground level, was determined about 2 weeks prior to peanut harvest. The in-shell peanuts were harvested, dried, and weighed.

Independent experiments were conducted with each weed species in randomized complete-block designs with four replications. The experimental design was based on an additive crop-weed interaction model, wherein the yields obtained from growing a crop at a constant population were affected by changes in weed and, therefore, total plant population density. Since the experimental variables were quantitative, regressions were determined for the effects of Florida beggarweed and sicklepod populations and fresh weights on peanut yields. Since the regression coefficients for the several years for each species were not homogeneous, the results are presented on an annual basis.

Row-Spacing Experiments

Experiments were conducted from 1974 to 1977. Both sicklepod and Florida beggarweed were included in Alabama experiments, but only sicklepod was studied in Georgia.

The experimental design was a split plot with four replications. Whole plots were dates of weed emergence. These included: (a) 0 weeks of weed-free maintenance, that is, weeds emerge with peanuts; (b) 2 weeks of weed-free maintenance, that is, weeds allowed to emerge about 2 weeks after the peanuts; (c) 5 weeks of weed-free maintenance, that is, weeds allowed to emerge about 5 weeks after the peanuts; and (d) season-long weed-free maintenance, that is, peanuts maintained free of weeds for the entire season. Florunner peanuts were planted in all experiments.

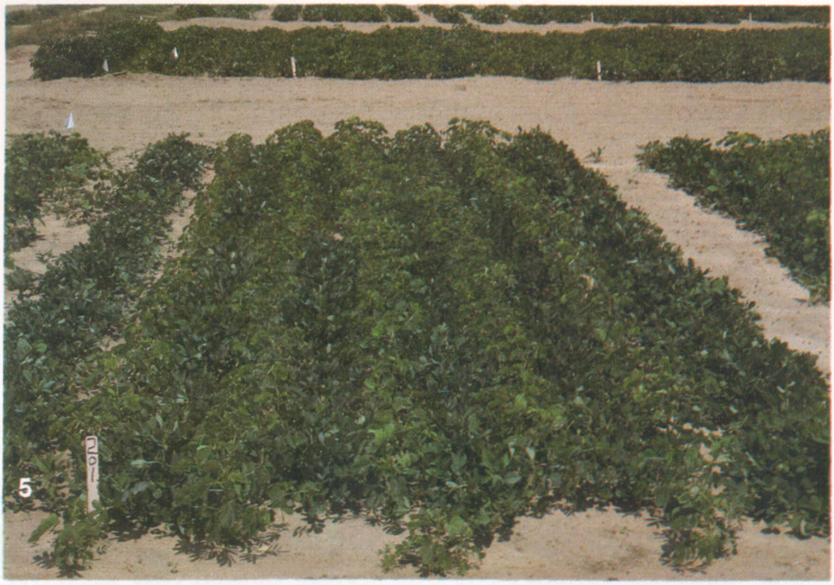
Split plots were row spacing of 32, 16, and 8 inches. The rows spaced 8 and 16 inches apart are referred to as "close-row" spacings. On the Greenville soil, the peanuts were planted on beds which measured 62 inches between the tractor wheel centers and about 50 inches from shoulder-to-shoulder of the bed. Two rows, 32 inches in width; 3 rows, 16 inches in width, and 5 rows, 8 inches in width were centered on each bed. On the Dothan soil, 2, 4, and 7 rows of peanuts were planted to give 32-, 16-, and 8-inch row spacings, respectively. The number of peanut seed planted per 3 feet of row was constant, 10 to 12 per 3 feet regardless of row spacing. In later research, other row patterns were used without the variable of weed-free maintenance intervals (1979 and 1980) and with "normalized" seeding rates (1977 to 1981).

Peanuts planted in (1) 32-inch, (2) 16-inch, and (3) 8-inch rows soon after emergence of sicklepod plant in rows, Wiregrass Substation.

Sicklepod and Florida beggarweed were planted with either hand-pushed or tractor-mounted planters to give about 30 plants per 3 feet of row of weeds. Seeds that had been appropriately scarified to ensure high germination were planted as follows: four rows of weeds per row of peanuts in peanut rows spaced 32 inches apart; two rows of weeds per row of peanuts in peanut rows spaced 16 inches apart; and one row of weeds per row of peanuts in peanut rows spaced 8 inches apart. In order to establish comparable border effects, weed seeds were always planted approximately 4 inches from the crop row.

Dates of weed emergence (weeks of weed-free maintenance) treatment were established by hand-hoeing and pulling for the specified times. For planted stands, weeds were planted near the end of the weed-free maintenance period. For "natural" stands, weed seed already in the soil were simply allowed to germinate after the weed-free maintenance periods were completed. If rain had not occurred within 5 days after the implementation of a weed treatment, the entire experimental area was irrigated using a sprinkler system.

Recommended insect and disease control practices were used. The entire experimental area was treated with benefin (Balan) applied as a preplant-incorporated treatment to control grasses and small-seeded broadleaf weeds. Undesirable escape weeds were removed by hand-pulling.



Peanuts planted in (4) 32-inch, (5) 16-inch, and (6) 8-inch rows soon after emergence of sicklepod plant in rows at Tifton, Georgia.

Weeds were harvested from an area of 9 square feet from each plot 2 to 3 weeks prior to harvesting peanuts. The weeds were removed at ground level and immediately weighed. Also, peanut shoots were harvested and weight was determined from a 9-square-foot section of row.

Row-Pattern Experiments

Research on different row configurations for peanuts was conducted from 1978 to 1980, with Ashburn, Georgia (Tifton loamy sand) as an additional location. The row patterns used are listed in table 12. Cultural procedures were similar to those used in the initial row-spacing studies. The cultivar used was Florunner.

RESULTS AND DISCUSSION

Research on Weed-Crop Competition

Effects of weed-free maintenance on the number and green weight of sicklepod plants. Counts of sicklepod plants that were visible above the canopy of peanut foliage showed that weed-free maintenance of peanuts for 4 weeks either minimized or eliminated competition from sicklepod for the remainder of the season, table 1. Although sicklepod frequently emerged after the fourth week, few broke through the thick canopy of peanut foliage. However, later observations and data led to the conclusion that 6 weeks of weed-free maintenance often would be required to suppress the weeds that germinate later in the season. Therefore, growers should strive to control the maximum number of weeds during the first 6 weeks after planting because the canopy of peanut leaves will suppress those weeds which emerge after the sixth week. Subsequent weeds which emerge are of no consequence because they do not break through the normal canopy of peanut leaves to either compete with the crop or to cause harvesting problems. To maximize these competitive effects peanut plants must grow vigorously with little or no stunting from intensive treatment with pesticides.

Weed-free maintenance and peanut yield. Yields of peanuts usually were not reduced if the crop was maintained weed-free for 4 weeks, table 2. Only 2 weeks of weed-free maintenance were required for normal yields of peanuts at Plains in 1971 and 1972. At Headland, in 1971, a marginal yield reduction occurred unless the plots were maintained weed-free for at least 6 weeks. These data indicate that weed-free maintenance for 6 weeks provided

TABLE 1. EFFECT OF VARIOUS PERIODS OF WEED-FREE MAINTENANCE ON THE NUMBER AND GREEN WEIGHTS OF SICKLEPOD PLANTS OBTAINED BEFORE PEANUTS WERE HARVESTED AT HEADLAND, ALABAMA AND PLAINS, GEORGIA, 1971 TO 1973

Weeks of weed-free maintenance	Number of sicklepod plants[a]					Green weights of sicklepod plants[a]					
	Headland[b]		Plains			Headland			Plains		
	1971	1973	1971	1972	1973	1971	1972	1973	1971	1972	1973
	Plants per yard					*Pounds per acre*					
0	86.3a	32.8a	4a	39a	20a	19,244a	17,806a	2,618a	14,220a	15,090a	20,800a
2	15.6b	20.6a	1b	2b	17a	10,489a	11,168a	909a	1,250b	1,390b	9,210a
4	1.8b	6.6b	1b	0b	Tb[c]	3,659a	2,527b	322b	810b	0b	60b
6	0.5b	3.9b	0b	0b	Tb	1,228b	323b	181b	0b	0b	30b
8	1.6b	2.7b	0b	0b	0b	296b	53b	70b	0b	0b	0b
10	1.8b	2.7b	0b	0b	0b	208b	0b	56b	0b	0b	0b
All season	1.9b	1.9b	0b	0b	0b	191b	0b	38b	0b	0b	0b

[a]Means followed by the same letter within the same column and in the same year do not differ significantly at the 1 percent level of probability by Duncan's multiple range test.

[b]Plants not counted at Headland in 1972.

[c]T is trace (less than 0.5 plant per yard square).

TABLE 2. EFFECTS OF DIFFERENT PERIODS OF WEED-FREE MAINTENANCE ON THE WEIGHT OF HARVESTED PEANUTS, HEADLAND, ALABAMA AND PLAINS, GEORGIA, 1971 TO 1973

Weeks of weed-free maintenance	Weight of harvested in-shell peanuts[a]					
	Headland			Plains		
	1971	1972	1973	1971	1972	1973
	Pounds per acre					
0	1,370c	1,040b	1,450b	1,780b	1,570b	920b
2	2,640c	1,740b	1,880b	3,010a	4,310a	1,600b
4	3,670b	2,740a	2,390a	3,210a	4,290a	2,870a
6	4,280ab	3,090a	2,550a	3,130a	4,400a	2,470a
8	4,540a	3,120a	2,500a	3,550a	4,030a	2,480a
10	4,560a	3,100a	2,500a	3,440a	4,330a	2,650a
All season	4,570a	2,790a	2,370a	3,380a	4,110a	2,530a

[a]Means followed by the same letter within the same column and in the same year do not differ significantly at the 1 percent level of probability by Duncan's multiple range test.

Peanuts planted in (7) 32-inch rows, (8) 16-inch rows, and (9) 8-inch rows soon after emergence of sicklepod plant in rows, Plains, Georgia.

adequate protection against yield reductions from weed competition.

Effects of sicklepod competition after peanut emergence. Ten to 14 weeks of sicklepod competition at the beginning of the season were required to reduce significantly the weight of harvested in-shell peanuts, table 3. Since no significant reductions in yield were observed with 10 weeks of competition in 1971, the intervals were increased to 14 and 18 weeks in 1972 and 1973. And, in

TABLE 3. EFFECTS OF VARIOUS PERIODS OF COMPETITION FROM SICKLEPOD ON THE HARVESTED WEIGHT OF PEANUTS, HEADLAND, ALABAMA AND PLAINS, GEORGIA, 1971 TO 1973

Weeks of weed-free maintenance	Weight of harvested in-shell peanuts[a,b]					
	Headland			Plains		
	1971	1972	1973	1971	1972	1973
	Pounds per acre					
0	4,520a	3,220a	2,640a	3,690a	4,090a	2,600a
2	4,510a	2,970a	2,840a	3,460a	3,990a	2,570a
4	4,670a	3,230a	2,340a	3,890a	4,020a	2,570a
6	4,200a	3,080a	2,670a	3,550a	3,640a	2,250a
8	4,090a	2,690a	2,660a	3,460a	3,460a	2,180a
10	3,810a	2,710a	2,740a	2,810b	3,090a	1,490a
14	———	1,730b	1,520b	———	1,290b	1,220b
18	———	820b	1,660b	———	1,600b	1,150b

[a]The 14 and 18 weeks of competition were not used in 1971.
[b]Means followed by the same letter within the same column and in the same year do not differ significantly at the 1 percent level of probability by Duncan's multiple range test.

three of the four experiments during 1972 and 1973, 14 weeks of competition were required to produce significant yield reductions.

Time of emergence of weeds in relation to their stands present when peanuts are harvested. The Florida beggarweed and sicklepod plants that towered over the peanuts at harvest grew from seedlings that were usually visible by 4, but at the latest, 6 weeks after the peanuts emerged. For example, at Tifton, some Florida beggarweed seedlings emerged after the sixth week and survived for several weeks but they did not break through the canopy of peanut leaves that completely covered the row middles at 7 to 9 weeks. Similar observations were made for sicklepod at Plains and at Headland.

Effects of presence or absence of peanuts or one cultivation on the growth of sicklepod and Florida beggarweed. Weed-free maintenance periods of 0, 4, and 8 weeks were used to evaluate the presence or absence of peanuts on the green weight of sicklepod, table 4. Combined analyses of variance showed that all variables except years were highly significant. Regardless of the weed-free period, the presence of peanuts decreased sicklepod weights. For example, the presence of peanuts, without cultivation, decreased the average weight of sicklepod by 3,000 pounds, 19 percent, at Headland and 5,000 pounds, 20 percent, at Plains when stands of weeds remained undisturbed (0-weeks weed-free maintenance). The single cultivation at 4 weeks reduced subsequent weed growth by about the same amount as the presence of peanuts without cultivation. Where presence of peanuts and the single cultivation were both used, weed weights were reduced an average of 70 percent at Headland and by 62 percent at Plains. The results clearly show that with no weed-free maintenance the presence of peanuts combined with one timely cultivation was far superior in reducing the growth of sicklepod than was either factor used alone.

With 4 weeks of weed-free maintenance, the presence of uncultivated peanuts, when compared to the check, reduced the average weight of sicklepod by 30 percent at Headland and by a surprising 95 percent at Plains, table 4. Cultivation alone was not effective in reducing weights of sicklepod after 4 weeks of weed-free maintenance. These data from the 4-week weed-free maintenance regime clearly show that many sicklepod plants emerged after the fourth week and, of course, a cultivation prior to emergence did not control them. However, simply having peanuts on the plots caused substantial suppression of sicklepod weights. If all the data are averaged for peanuts without cultivation (in the 4-week maintenance interval only) the reduction in sicklepod weight as compared to no peanuts was 62 percent.

With 8 weeks of weed-free maintenance, sicklepod weights decreased dramatically in the uncultivated check which shows that the weeds producing most of the weight emerged before the eighth week, table 4. A cultivation at 4 weeks had no effect on the weight of weeds which emerged after 8 weeks. However, compared to the 8-week uncultivated check, the presence of peanuts reduced sicklepod weight by 96 percent at Headland and by 99 percent at Plains. These data dramatically illustrate the powerful capacity of the canopy of peanut leaves to suppress the sicklepod seedlings which emerge after the eighth week. Not too surprisingly, as the peanut plants became larger, they influenced the growth of sicklepod more than when the two species were planted and emerged together. These results generally show that the peanut plant competes extremely well with sicklepod especially when the sicklepod germinates during the first 6 to 8 weeks after planting peanuts. This fact has not been recognized generally.

Results with Florida beggarweed, table 5, were similar to those with sicklepod except that the presence of peanuts (without cultivation) always reduced the weights of beggarweed more than did cultivation (without peanuts present). Also, the canopy of peanut foliage was extremely effective in suppressing the beggarweed which emerged after the fourth week.

TABLE 4. GREEN MATTER YIELD OF SICKLEPOD AS INFLUENCED BY SPECIFIC PERIODS OF WEED-FREE MAINTENANCE, PRESENCE OR ABSENCE OF PEANUTS AND CULTIVATION, HEADLAND, ALABAMA AND PLAINS, GEORGIA

Treatment			Green matter yield							
			Headland				Plains			
Weeks of weed-free maintenance	Peanuts	Cult.	1971	1972	1973	Av.	1971	1972	1973	Av.
			Pounds per acre							
0	No (check)	No	23,800	20,300	7,410	17,200	31,700	23,300	19,700	24,900
0	Yes	No	21,400	17,400	3,270	14,000	23,700	19,000	17,100	19,900
0	No	Yes	18,100	15,900	8,500	14,200	20,400	15,000	21,700	19,100
0	Yes	Yes	6,130	7,990	1,380	5,170	8,840	8,820	10,900	9,530
4	No (check)	No	12,000	12,500	6,720	10,400	15,200	6,640	7,770	9,880
4	Yes	No	6,300	2,550	483	3,100	1,410	48	0	486
4	No	Yes	10,800	11,800	6,970	9,860	17,900	7,950	9,420	11,800
4	Yes	Yes	5,500	2,180	445	2,700	1,030	484	30	515
8	No (check)	No	906	7,270	2,080	3,420	596	3,290	1,640	1,840
8	Yes	No	182	114	145	147	0	48	0	16
8	No	Yes	1,410	7,070	2,460	3,650	596	3,590	1,550	1,910
8	Yes	Yes	156	383	329	289	0	78	0	26

Analysis of variance[1]

Significant sources of variation	df				Combined analysis				Combined analysis
Year	2	———	———	———	0.0001	———	———	———	NS
Time	2	0.0002	0.0002	0.0420	0.0001	0.0005	0.0001	0.0004	0.0001
Year x time	4	———	———	———	0.0001	———	———	———	0.0155
Peanuts	1	0.0001	0.0001	0.0322	0.0001	0.0001	0.0001	0.0001	0.0001
Year x peanuts	2	———	———	———	0.0001	———	———	———	0.0727
Time x peanuts	2	0.0001	0.0387	NS	0.0214	0.0014	NS	0.0065	0.0001
Year x time x peanuts	4	———	———	———	0.0220	———	———	———	0.0203
Cult	1	0.0001	0.0001	0.0235	0.0001	0.0023	0.0001	0.0001	0.0001
Year x cult	2	———	———	———	0.0001	———	———	———	0.0330
Time x cult	2	0.0001	0.0001	0.0031	0.0001	0.0003	0.0001	0.0001	0.0001
Peanut x cult	1	0.0079	0.0413	NS	0.0340	NS	NS	NS	0.0412
Year x time x cult	4	———	———	———	0.0001	———	———	———	0.0174
Year x peanut x cult	2	———	———	———	0.0348	———	———	———	NS
Time x peanut x cult	2	0.0005	0.0056	NS	0.0028	NS	NS	NS	NS
Year x peanut x time x cult	4	———	———	———	0.0029	———	———	———	0.7716

[1]Probability of a larger value of F; NS indicates non-significance.

TABLE 5. GREEN MATTER YIELD OF FLORIDA BEGGARWEED AS INFLUENCED BY SPECIFIC PERIODS OF WEED-FREE MAINTENANCE, PRESENCE OR ABSENCE OF PEANUTS AND ONE CULTIVATION, TIFTON, GEORGIA

Treatment			Yield of green matter			Weight reduction
Weeks of weed-free maintenance	Peanuts	Cult.	1971	1972	Av.	
			Pounds per acre			*Pct.*
0	No (check)	No	21,600	13,300	17,450	—
0	Yes	No	2,230	8,310	5,270	70
0	No	Yes	12,400	7,350	9,880	44
0	Yes	Yes	120	1,530	825	95
4	No (check)	No	15,700	7,800	11,770	—
4	Yes	No	193	807	500	96
4	No	Yes	12,600	7,630	10,100	16
4	Yes	Yes	6	628	314	97
8	No (check)	No	3,430	3,280	3,350	—
8	Yes	No	24	30	27	99
8	No	Yes	1,990	3,840	2,920	13
8	Yes	Yes	24	36	30	99

Analysis of variance[1]

Significant sources of variation	df	1971	1972	Combined analysis
Time	2	0.0023	0.0044	0.0001
Peanuts	1	0.0001	0.0001	0.0001
Year x peanuts	2	———	———	0.0001
Time x peanuts	2	0.0010	NS	0.0001
Year x time x peanuts	4	———	———	0.0006
Cult	1	0.0318	0.0001	0.0001
Time x cult	2	NS	0.0001	0.0001
Year x time x cult	4	———	———	NS
Year x peanuts x cult	2	———	———	0.0374

[1]Probability of a larger value of F; NS indicates non-significance.

Quantitative effects of Florida beggarweed and sicklepod on peanut yield. Different densities of either Florida beggarweed or sicklepod were grown with a constant density of peanuts. Linear regressions were determined for the effects of Florida beggarweed and sicklepod populations and fresh weights on peanut yields.

The regression equations estimate the peanut yields which would be obtained with various levels of weed competition measured as populations or fresh weights, respectively, table 6. Mean peanut yields obtained with continuous hand weeding ranged from 1,960 to 6,670 pounds per acre during the 6 years studied. Nonetheless, the linear regressions indicate there were significant effects of weeds on peanut yields, independent of other effects.

The regression coefficients estimated the effect of each weed per 10 square yards or each pound of fresh weed weight on the

TABLE 6. LINEAR REGRESSION OF PEANUT YIELDS ON FLORIDA BEGGARWEED AND SICKLEPOD POPULATIONS AND GREEN WEIGHTS

	Florida beggarweed			Sicklepod		
Year	intercept[a]	regress.[b] coeffi.	r^2	intercept[a]	regress.[b] coeffi.	r^2
			Effects of weed populations (numbers)			
1970	———	———	——	1.96×10^3	—22.3**	0.65
1971	2.39×10^3	—17.6**	0.64	2.49×10^3	— 7.7**	0.57
1972	———	———	——	2.56×10^3	— 6.1*	0.42
1974	3.25×10^3	—30.2**	0.63	3.36×10^3	—15.2*	0.50
1975	6.10×10^3	—19.6**	0.57	6.25×10^3	—11.0 NS	0.17
1976	5.65×10^3	—15.8**	0.74	3.80×10^3	— 8.5 NS	0.31
			Effects of weed weights			
1970	———	———	——	2.16×10^3	—0.08**	0.77
1971	2.30×10^3	—0.15**	0.67	3.16×10^3	—0.09**	0.84
1972	———	———	——	3.30×10^3	—0.12**	0.78
1974	3.31×10^3	—0.74**	0.66	3.50×10^3	—0.12*	0.48
1975	6.67×10^3	—0.40**	0.63	6.20×10^3	—0.23 NS	0.34
1976	5.72×10^3	—0.53**	0.83	4.00×10^3	—0.15*	0.45

[a]Estimated yields (pounds per acre) of peanuts with no weeds.

[b]Estimated loss of peanut yields (in pounds per acre) for one weed per 10 square yards or one pound of weed weight per acre for Florida beggarweed and sicklepod, respectively; *, ** indicates significance of regression equation at the 5 percent and 1 percent levels, respectively.

yield of peanuts, table 6. Each beggarweed per 10 square yards reduced the yield of peanuts from 15.8 pounds per acre in 1976 to 30.2 pounds per acre in 1974 for an approximate two-fold difference among years. As measured by each pound of weed weight, a five-fold difference among years in peanut yield reductions was predicted from a low of 0.15 pound per acre in 1971 to a high of 0.74 in 1974. An examination of the coefficients of determination (r^2) indicates that predictions of peanut yields made on the basis of weight are somewhat better than those predicted using the number of Florida beggarweed as the independent variable.

Four-fold differences in the effects of sicklepod populations on peanut yield reductions were observed among years. One weed per 10 square yards reduced the yield of in-shell peanuts from 6.1 in 1972 to 22.3 pounds per acre in 1975. The range of differences estimated by weight of sicklepod was more narrow than for beggarweed varying from a low of 0.08 to a high of 0.23 pound per acre of in-shell peanuts from each pound of fresh weed weight. With one exception, 1974, the coefficients of determination (r^2) were higher, sometimes considerably higher, for weights of sicklepod than for plant number which indicates weight of sicklepod

Peanuts growing with sicklepod at heaviest density (10) and at a lower 1 weed per 1 foot of row, density (11), Wiregrass Substation.

accounts for more variation in peanut yields than does the number of sicklepod plants.

As estimated by the regression coefficients, the most severe peanut losses from Florida beggarweed are more than from sicklepod for both weed numbers (—30.2 vs. —22.3) and weed weight (—0.74 vs. —0.23) table 6. Therefore, dense stands of beggarweed can be expected to reduce peanut yields more than dense stands of sicklepod.

Comparisons of the coefficients of determination (r^2) indicate that in all years for Florida beggarweed, and 5 of 6 years for sicklepod, the fresh weights of the weeds accounted for more variation in peanut yields than did the number of weeds. However, in all cases, weed populations and weights were highly correlated (P 0.01). Thus, relative peanut yield losses attributable to these weeds may be estimated from either number or weights of weeds, but weight is somewhat better. Detailed data from the individual experiments are presented in figures 1 to 20.

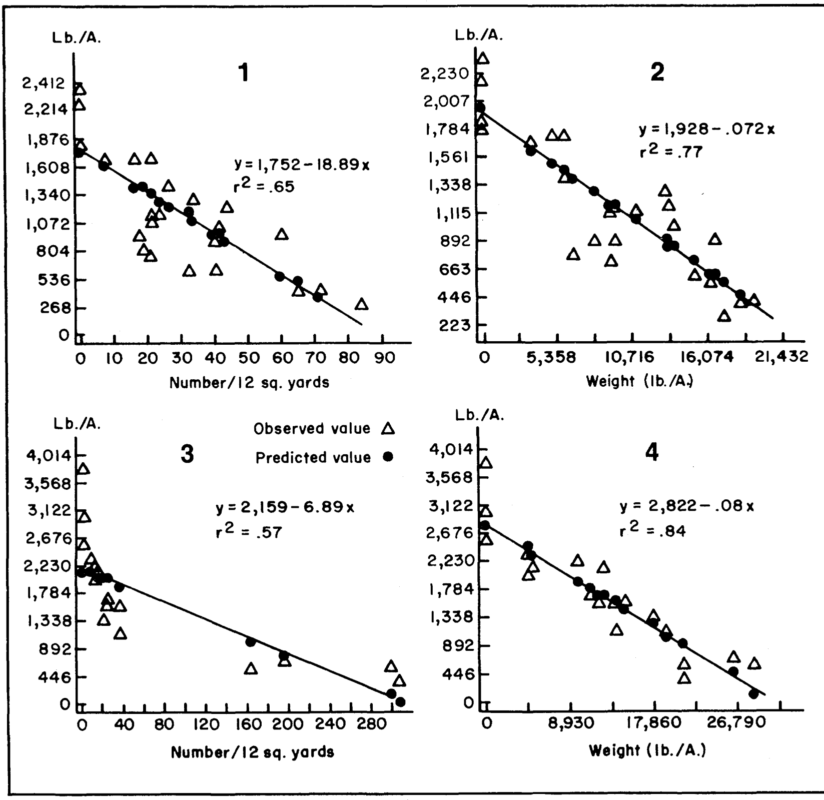
Research on Row Spacing

Effects of row spacing on the fresh weight of sicklepod plants. The effects of row spacing on the weight of sicklepod can be stated very simply: as the row spacing decreased, the weight of sicklepod similarly decreased. For example, in 4 years of research at Headland, weight of weeds was decreased 28 and 54 percent by reducing the row width from 32 to 16 to 8 inches, respectively, table 7. Comparable reductions at Plains were 21 and 37 percent, table 8. Florida beggarweed also responded to reductions in row spacing with 27 and 42 percent reductions in weight in the 16- and 8-inch rows, respectively, as compared to the standard 32-inch row width, table 9.

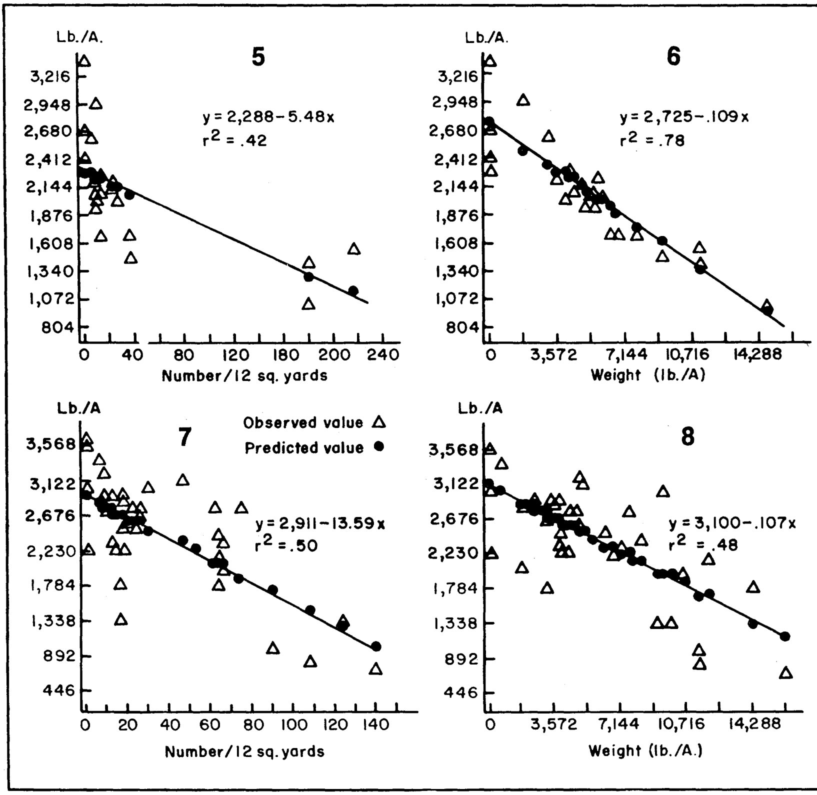
These results clearly indicate that farmers can, by manipulating row spacing, suppress about 25 to 50 percent of the weight of weeds by utilizing the powerful competitive capacity of the peanut plant.

Effects of row-spacing on the yield of peanuts. With weeds all season, yields of peanuts usually were much higher in close rows than in 32-inch rows, tables 10 and 11. If averaged across all experiments, yield increases (as compared to 32-inch rows), were 42 percent from 16-inch rows and 52 percent from 8-inch rows when weeds were present.

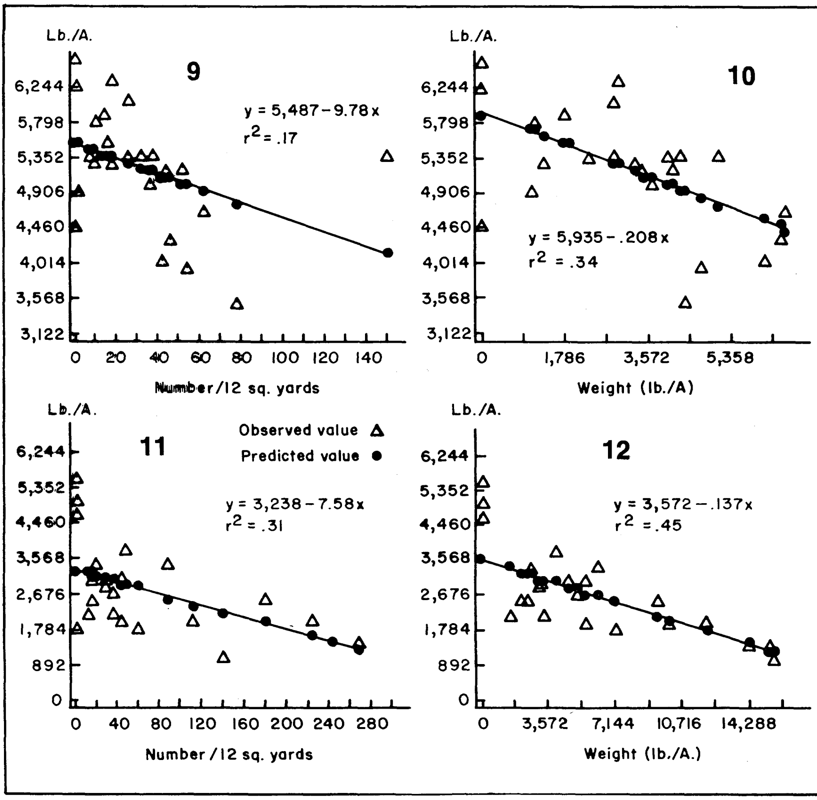
Except for the 1977 study at Plains and 16-inch rows in 1975 at Headland, peanuts grown without any weeds yielded more in



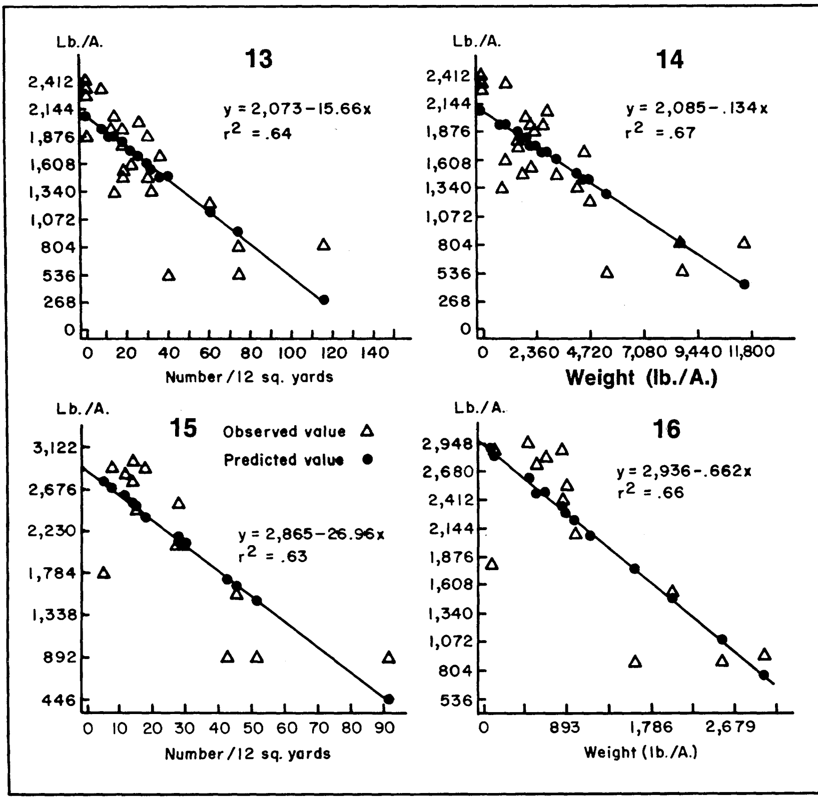
FIGS. 1-2-3-4. Peanut yield as affected by density of sicklepod, 1970 (1), peanut yield as affected by weight of sicklepod, 1970 (2), peanut yield as affected by density of sicklepod, 1971 (3), and peanut yield as affected by weight of sicklepod, 1971 (4).



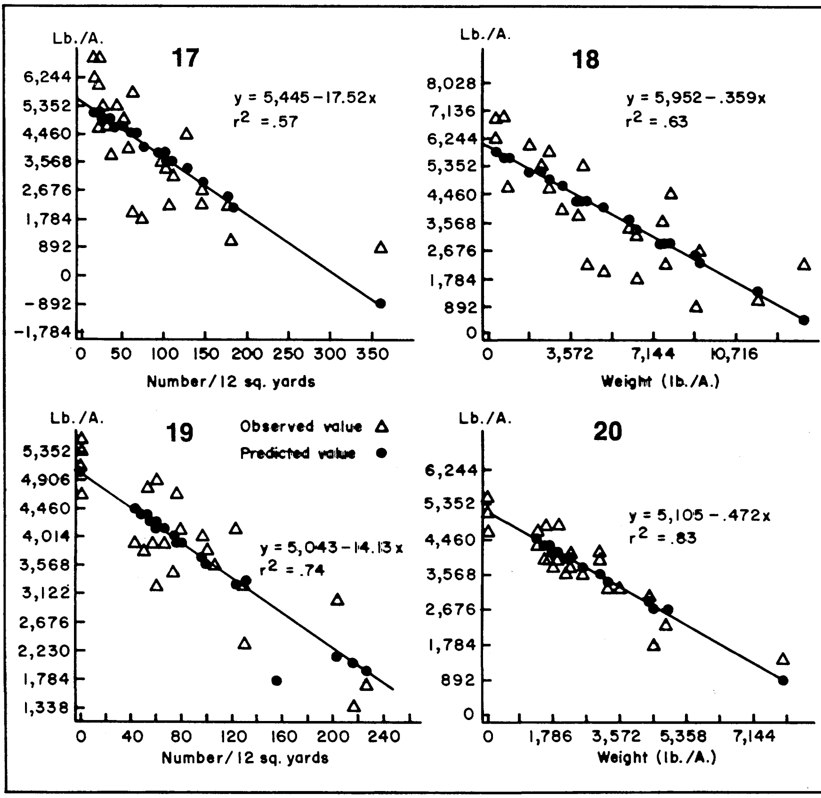
FIGS. 5-6-7-8. Peanut yield as affected by density of sicklepod, 1972 (5), peanut yield as affected by weight of sicklepod, 1972 (6), peanut yield as affected by density of sicklepod, 1974 (7), and peanut yield as affected by weight of sicklepod, 1974 (8).



FIGS. 9-10-11-12. Peanut yield as affected by density of sicklepod, 1975 (9), peanut yield as affected by weight of sicklepod, 1975 (10), peanut yield as affected by density of sicklepod, 1976 (11), and peanut yield as affected by weight of sicklepod, 1976 (12).



FIGS. 13-14-15-16. Peanut yield as affected by density of Florida beggarweed, 1971 (13), peanut yield as affected by weight of Florida beggarweed, 1971 (14), peanut yield as affected by density of Florida beggarweed, 1974 (15), and peanut yield as affected by weight of Florida beggarweed, 1974 (16).



FIGS. 17-18-19-20. Peanut yield as affected by density of Florida beggarweed, 1975 (17), peanut yield as affected by weight of Florida beggarweed, 1975 (18), peanut yield as affected by density of Florida beggarweed, 1976 (19), and peanut yield as affected by weight of Florida beggarweed, 1976 (20).

TABLE 7. EFFECT OF ROW SPACING OF PEANUTS ON THE GREEN WEIGHT OF SICKLEPOD, 1975 TO 1978, HEADLAND, ALABAMA

Row spacing	Green weight of sicklepod foliage[a]					Decrease
	1975	1976	1977	1978	Average	
In.	*Pounds per acre*					*Pct.*
32	4,930	7,450	7,270	1,541	5,300	–
16	3,700	5,240	5,620	821	3,840	28
8	2,480	3,820	4,550	533	2,845	54

[a]All means within years were significantly different at the 1 percent level.

closely spaced rows although the differences between row spacings were not as great as when weeds were present. It is believed that dry weather at Plains in 1977 minimized differences among the row spacings. Averaged across all experiments, peanut yields were 7 percent higher when planted in 16-inch rows than in 32-inch rows and 15 percent higher when planted in 8-inch rows than in 32-inch rows.

Feasibility of close-rows. Peanuts grown in the close-row configurations that were used from 1975 to 1978 cannot be successfully dug and inverted with most of the currently available equipment. However, two sets of twin rows (7-inches apart) per bed is a row pattern that is practical. The twin-row pattern gave good results on research plots in 1979 and 1980 at Headland, table 12. The twin rows should not be placed so close to the bed shoulders (or tractor wheel tracks) that the middle left between the twins is so wide that the canopy of peanut leaves over the middle develops too slowly (22 inches in these tests). On the other hand, if the sets of twin rows are placed too close to each other, harvesting difficulties may be encountered.

Based on these studies, rows spaced uniformly 8 inches apart across the bed are preferred, but this spacing would require modified digger-inverters.

TABLE 8. EFFECT OF ROW SPACING OF PEANUTS ON THE FRESH WEIGHT OF SICKLEPOD, 1975 TO 1978, PLAINS, GEORGIA

Row spacing	Green weight of sicklepod foliage[a]					Decrease
	1975	1976	1977	1978	Average	
In.	*Pounds per acre*					*Pct.*
32	15,550	8,560	1,690	2,540	7,080	–
16	12,900	6,500	1,140	1,690	5,560	21
8	10,860	4,930	700	1,380	4,470	37

[a]All means within years were significantly different at the 1 percent level.

TABLE 9. EFFECT OF ROW SPACING OF PEANUTS ON THE FRESH WEIGHT OF FLORIDA BEGGARWEED, 1975 TO 1977, HEADLAND, ALABAMA

Row spacing	Green weight of beggarweed[a]				Decrease
	1975	1976	1977	Average	
In.	*Pounds per acre*				*Pct.*
32	8,230	4,230	4,470	5,640	—
16	5,570	3,170	3,600	4,110	27
8	5,100	2,390	2,350	3,280	42

[a]All means within years were significantly different at the 1 percent level.

Research on row patterns. Several different row configurations were evaluated at Ashburn and Headland, in 1979, 1980, and 1981. The number of rows, the row spacing, and resultant yields for 1979 and 1980 are listed in table 12. In general, the twin rows were better than any other configuration. The data from Ashburn were confounded with unexpected variables which may have contributed to the minimal differences at that location. However, at Headland, statistical differences occurred with twin rows yielding highest, table 12. As compared to conventional rows (36 inches) the twin rows increased yields by 19 and 43 percent in 1979 and 1980, respectively. Even if the questionable and minimal yields for the twin rows from Ashburn are combined with the yields from Headland, the twin rows still average 11 percent higher than yields from conventional row spacings. It should be pointed out, however, that the 43 percent increased yield observed at Headland in 1980 is part of a peanut harvest characterized by low overall yield. It is possible that a lower percentage increase, attributable to twin rows, would have occurred if yields had been higher.

TABLE 10. YIELD OF PEANUTS GROWN WITH AND WITHOUT WEEDS IN CONVENTIONAL- AND NARROW-ROW SPACINGS, HEADLAND, ALABAMA

Row spacing inches	Weight of in-shell peanuts and percent increases due to close-rows							
	1975		1976		1977		1978	
	Lb./A.	*Pct. inc.*	*Lb./A.*	*Pct. inc.*	*Lb./A.*	*Pct. inc.*	*Lb./A.*	*Pct. inc.*
With weeds								
32	2,777	—	613	—	2,583	—	3,269	—
16	5,328	92	1,031	68	3,415	32	4,359	33
8	5,523	99	1,787	191	3,350	30	4,254	30
Without weeds								
32	6,307	—	4,373	—	4,044	—	4,117	—
16	5,542	12	4,745	9	4,392	9	4,811	17
8	7,389	17	5,430	24	4,723	17	4,771	16

TABLE 11. YIELD OF PEANUTS GROWN WITH AND WITHOUT WEEDS IN CONVENTIONAL- AND NARROW-ROW SPACINGS, PLAINS, GEORGIA

Row spacing inches	Weight of in-shell peanuts and pct. increases due to close-rows							
	1975		1976		1977		1978	
	Lb./A.	*Pct. inc.*	*Lb./A.*	*Pct. inc.*	*Lb./A.*	*Pct. inc.*	*Lb./A.*	*Pct. inc.*
With weeds								
32	266	—	1,060	—	2,244	—	3,746	—
16	469	76	1,857	75	2,381	6	4,601	23
8	602	126	2,521	138	2,640	18	4,844	29
Without weeds								
32	5,379	—	4,082	—	3,116	—	4,577	—
16	5,521	3	4,848	19	3,189	2	5,393	18
8	5,767	7	5,185	27	3,124	0	5,215	14

In 1981, no significant differences occurred among yields from peanuts grown in the different row configurations.

An examination of the data in tables 10, 11, and 12 shows that yield increases from close-row spacings occurred in 6 of the 7 years of this row-spacing research. Based on all of the research, it is believed that a reasonable anticipation for average yield increases of close-rows or twin rows (compared to conventional 32- or 36-inch spacings) would be 10 to 15 percent. And, as the data indicated, yield increases due to close-rows will be more for some years than for others.

TABLE 12. EFFECTS OF ROW PATTERNS ON THE YIELD OF FLORUNNER PEANUTS, ASHBURN, GEORGIA AND HEADLAND, ALABAMA 1979-1980

Rows per plot	Row spacing	Pod yields					Increase
		1979		1980			
		Ashburn[c]	Headland	Ashburn	Headland	Average	
No.	*In.*	*Pounds per acre*					*Pct.*
Two	36	5,480	2,670bc	2,640ab	1,860b	3,160	—
Three	18	5,930	2,620	2,390c	2,190bc	3,280	4
Three	12	5,280	2,980ab	2,330c	2,150b	3,180	1
Four	12	5,740	2,920abc	2,530abc	1,910b	3,270	4
Four	Twins[a,b]	5,500	3,190a	2,700a	2,660a	3,510	11

[a]The twin rows were planted 8 inches apart with 20 inches between the two sets of twin rows.

[b]In 1979, at Ashburn, the emergence of seed planted in twin rows was erratic and slow apparently due to inadvertent variation in the planting procedure. In 1980, herbicide residues from a previous crop produced random but severe injury to peanuts. Thus, the yields from Ashburn are confounded for both 1979 and 1980.

[c]Plot to plot variation resulting from discrepancies in the planting procedure, especially with the twin rows, apparently prevented significant differences in yield at Ashburn in 1979.

By harvest, peanut foliage was completely deteriorated at higher sicklepod densities, Wiregrass Substation.

Seeding rates for close rows. In some of these experiments, the pounds of seed used per acre were the same, regardless of row spacing, resulting in fewer seed per foot for close- or twin-rows than for traditional row spacings. In other experiments, the same number of seed per linear foot of row was used which resulted in 50 to 100 percent more seed per acre for the close rows than normally used in traditional spacings. In still other studies, the seeding rates were intermediate compared to the schemes described. Limited direct comparisons on the seeding systems used showed that the principal differences in yield of peanuts among row configurations were not dramatically affected by rate of seeding. In 1981, Knauft et al. (5) reported from Florida that in-row spacing differences of 4 and 6 inches for Florunner seed did not significantly affect yields but a spacing of 12 inches did reduce yields. Based on their data and observations of these Alabama and Georgia tests it is believed that from 10 to 30 percent increase in seeding rates may be desirable for close-rows, depending upon the row configuration selected and especially depending on germination of the peanut seed. For quality, high germination 90 percent seed, a 10 to 15 percent increase over the normal seeding rate will provide some insurance against skips in the stand that measure over 6 inches. For lower germinating seed, the seeding rate should be increased proportionately. For example, if the normal seeding rate for conventionally spaced rows is 100 pounds per acre, an increase of 15 percent in seeding rate for 90 percent germination seed (115 pounds of seed per acre) should provide adequate insurance against skips in stands for twin rows. For seed germinating 80 and 70 percent, the rate per acre should be increased by 25 and 35 percent to 125 and 135 pounds per acre, respectively, to maintain comparable uniformity in stands.

Are close-rows profitable? Current experience on farms indicates that certain close-row patterns provide good results. Peanuts planted in twin rows spaced 6 inches apart with 24 inches between the sets of twins will invert well. Somewhat more difficult to invert, but with better suppression of weeds and better utilization of environmental factors, are spacings utilizing twin rows 8 inches apart with 20 inches left between the sets of twins. Each of these systems is for peanuts planted with tractor wheel centers set on 72 inches. The row patterns can be modified for other tractor wheel spacings. Modification of present inverting equipment would permit a much wider selection of effective weed-suppressing row patterns. If farmers adopt close-row production systems, manufacturers will likely develop modified harvesting equipment which will accommodate these practices.

More weeds are suppressed with close-rows – this suppression of weeds contributes to higher crop yields even if only moderate stands of weeds are present. But even where weeds are controlled perfectly, close-rows in most instances promote a small-to-moderate increase in peanut yields.

And, undoubtedly, if close-row culture of peanuts is used, a less intensive herbicide sequence will be needed because 25 to 50 percent of the weight of the most troublesome broadleaf weeds will be suppressed by the canopy of peanut leaves, tables 7, 8, 9. With changing government programs and tight economic conditions, the utilization of close-rows to control weeds through crop competition may well provide a tool for increasing net profits in the future.

SUMMARY AND CONCLUSIONS

Experiments with peanuts involving weed-crop competition and crop row spacings were conducted from 1971 to 1981 in Alabama and in Georgia. The weeds studied were Florida beggarweed and sicklepod, currently the two most troublesome broadleaf weeds in the Southeastern peanut belt. Highlighted data and results are presented herein. The principal conclusions may be stated as follows:

1. When peanuts were maintained free of Florida beggarweed and sicklepod for about 6 weeks, the crop suppressed later emerging weeds if the peanut foliage was maintained in vigorous condition.

2. Weed-crop competition for at least 10 weeks, at the beginning of the season, was required for beggarweed or sicklepod to significantly reduce the yield of peanuts.

3. The beggarweed and sicklepod which overtop the peanuts during mid- to late-season were commonly and erroneously referred to as "late-season" weeds – actually these weeds emerge within the first 6 weeks after planting.

4. With no weed-free maintenance, the canopy of peanut foliage reduced the growth of sicklepod by 20 percent; however, if the peanuts were maintained weed-free for 4 weeks, subsequent growth of sicklepod was reduced 30 to 95 percent by crop competition.

5. Florida beggarweed reduced the yield of peanuts more than did sicklepod. Each beggarweed plant per 10 square yards reduced the yield of peanuts from 16 to 30 pounds per acre depending upon the year involved. Each sicklepod plant reduced the yield of peanuts from 6 to 22 pounds per acre depending on the year involved. These values have predictive capabilities for assessing loss of peanut yields to these two weeds.

6. Decreasing the row width of peanuts from 32 to 16 to 8 inches reduced the green weight of weeds from 21 to 54 percent with the greatest reductions occurring in 8-inch rows. Peanuts grown in close-rows produced substantially more peanuts in the presence of weeds and also produced moderately increased yield in the absence of weeds.

7. Of the various row configurations studied, two sets of twins (8 inches between rows and 20 inches between sets of twins) most effectively increased the yield of peanuts with projected yield increases of 10 to 15 percent.

8. Since 20 to 50 percent of the weights of Florida beggarweed and sicklepod were suppressed in close-row peanuts and the yields of peanuts generally were increased, the use of close-row configu-

rations will permit less intensive herbicide applications, thus increasing net profits per acre.

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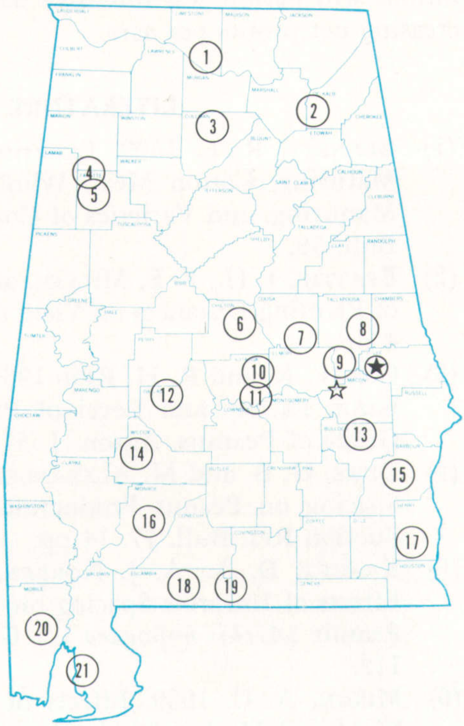

Research Unit Identification

⊛ Main Agricultural Experiment Station, Auburn.
☆ E. V. Smith Research Center, Shorter.

1. Tennessee Valley Substation, Belle Mina.
2. Sand Mountain Substation, Crossville.
3. North Alabama Horticulture Substation, Cullman.
4. Upper Coastal Plain Substation, Winfield.
5. Forestry Unit, Fayette County.
6. Chilton Area Horticulture Substation, Clanton.
7. Forestry Unit, Coosa County.
8. Piedmont Substation, Camp Hill.
9. Plant Breeding Unit, Tallassee.
10. Forestry Unit, Autauga County.
11. Prattville Experiment Field, Prattville.
12. Black Belt Substation, Marion Junction.
13. The Turnipseed-Ikenberry Place, Union Springs.
14. Lower Coastal Plain Substation, Camden.
15. Forestry Unit, Barbour County.
16. Monroeville Experiment Field, Monroeville.
17. Wiregrass Substation, Headland.
18. Brewton Experiment Field, Brewton.
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21. Gulf Coast Substation, Fairhope.