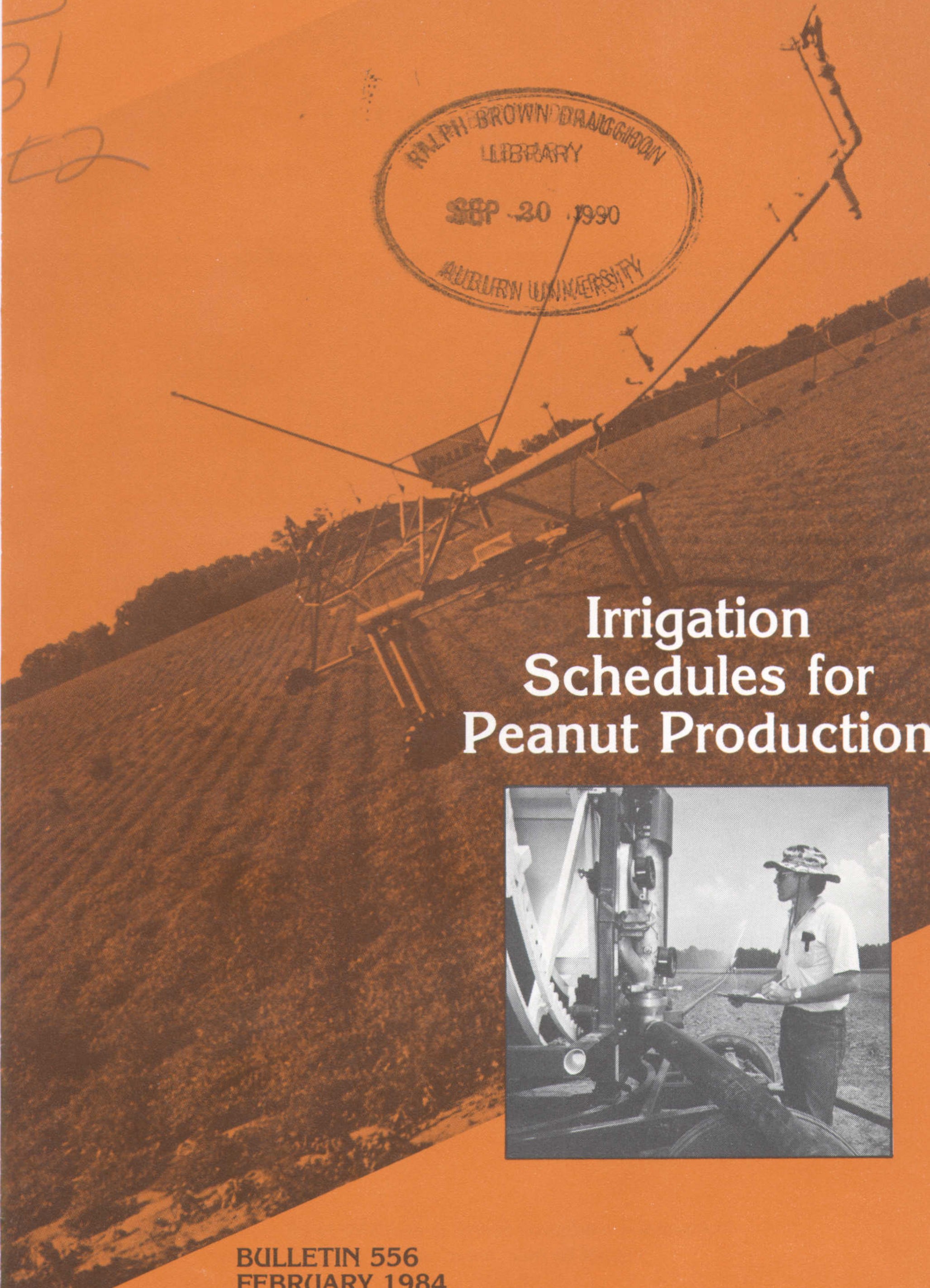

Irrigation Schedules for Peanut Production

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IRRIGATION SCHEDULES FOR PEANUT PRODUCTION

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INTRODUCTION

PEANUT PRODUCTION is a major farm enterprise in the Southeast and in southeast Alabama. In 1982, 177,000 acres of peanuts were harvested in Alabama with yields averaging 3,000 pounds per acre *(1)*.

Interest in and installation of equipment for peanut irrigation has become widespread in Alabama. Of the 177,000 acres of peanuts produced, approximately 40,000 acres are irrigated. Irrigation has been installed in an effort to stabilize and to boost yields. Equipment used to irrigate peanuts has primarily been center pivot-type and traveler-type systems.

It has become increasingly obvious that the ability to manage irrigation systems effectively is an important production aspect of irrigated peanuts. Inadequately operated or poorly designed systems usually prove to be less satisfactory than systems designed and utilized to maintain optimum levels of soil moisture during peak growth periods of the peanut crop. It is therefore imperative that peanut producers who irrigate or who are evaluating irrigation systems not only look at short-term drought situations, but also investigate the system's requirements for simplicity and labor and management inputs. These factors can make an irrigation system much more effective as compared to labor intensive, inadequately designed systems.

Efficient irrigation use for increased peanut yield and quality in

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the normally humid Southeast requires proper irrigation timing as well as effective soil moisture programs. In related research, Stansell et al. *(6)* noted that irrigation increased both quality and yield of peanuts in Georgia. They presented data, figure 1, relating water use of Florunner peanuts to plant age when grown under optimum soil water conditions. Optimum soil water conditions required wetting the top 24 inches of the soil profile to field capacity when the average water tension in the top 12 inches of the profile reached 20 centibars. Figure 1 shows that the peanut plant's water demand starts low, increases to a maximum value at approximately midseason (pegging and early pod formation), and then decreases gradually. Stansell et al. also found that plants were able to extract water from depths greater than 24 inches after approximately 75 days of age. They concluded that the ability of peanuts to utilize water at such depths explains, to some extent, their ability to withstand extended drought stress. Water extraction to a depth of 42 inches was recorded for Florigiant, Florunner, and Tifspan peanuts; however, the authors stated that restrictive zones, either mechanical or chemical, may prevent deep profile water extraction in some locations.

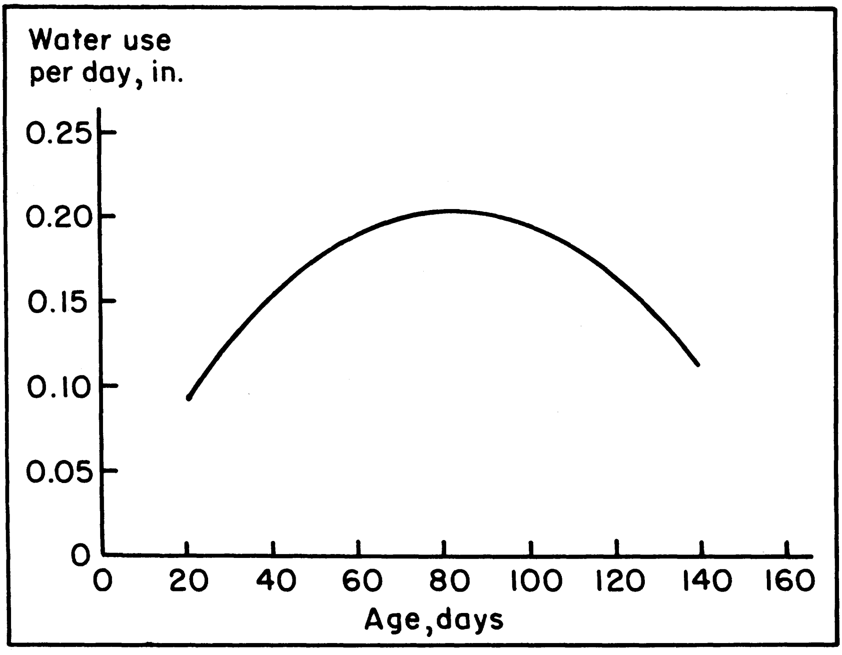

FIG. 1. Estimated daily water use by Florunner peanuts from Stansell et al. *(6)*.

In addition to determining water needs of the peanut plant, there have been efforts to identify periods in the plant's development which are more susceptible to stress. This follows the widely accepted principle that most nonforage crops are more sensitive to water deficits at certain growth stages than at others *(2, 4, 5)*. Hiler and Clark *(3)* developed a "stress day index method" to account for these differences in a quantitative manner. This method uses a stress day factor and a crop susceptibility factor to arrive at a plant's stress index. Six growth stages of the peanut plant were identified and susceptibility factors were assigned to each stage. This factor indicates the plant's susceptibility to given magnitudes of stress. The larger the crop susceptibility factor, the more damage there is to the plant by drought stress.

Their findings identified flowering and early pegging as the two most critical periods in the plant's development. This does not mean that the plant needs more water during these stages, but it does mean that lack of water will be more detrimental to the plant during this period. Other researchers have used different time periods to evaluate the effects of moisture stress on yield. Stansell *(7)*, used four, 35-day periods to divide the idealized 140-day growing season.

Stansell's research provides significant results. However, the work was conducted with disturbed soil profiles and with controlled moisture conditions eliminating rainfall. Utilization of these results in field conditions was not reported. The addition of rainfall and sprinkler irrigation provides additional uncertainties and increases the possibility of damage from disease. The results by Hiler and Clark, *(3)*, which were obtained in Texas for Spanish peanuts, have not been verified for other cultivars at other locations. Therefore, since much information is still needed to provide an adequate guide to irrigation of peanuts in Alabama, a series of experiments was initiated in 1975 at the Wiregrass Substation, Headland, Alabama.

The objective of this research was to determine yield and quality responses of peanuts to soil moisture levels so that the most effective irrigation-scheduling program could be determined.

EXPERIMENTAL PROCEDURE

Florunner peanuts were grown in field plots at the Wiregrass Substation during the 6-year period beginning in 1976 and ending in 1981. The plots were irrigated with impact sprinklers spaced on the corners of each plot to give uniform application in the plot area. The soil type in the test area is a Dothan sandy loam with characteristics as shown in table 1.

TABLE 1. SOIL CHARACTERISTICS OF DOTHAN SANDY LOAM

Horizon	Depth	Soil composition			Texture
		Sand	Silt	Clay	
	In.	*Pct.*	*Pct.*	*Pct.*	
AP	0-10	80.0	10.1	9.9	Sandy loam
B1	10-14	64.3	12.5	23.2	Light sandy clay loam
B21t	14-36	57.4	9.2	33.4	Sandy clay loam
B22t	36-50	56.1	7.5	36.4	Sandy clay loam

Tensiometers were used to monitor moisture tension in the soil profile. These devices measure the moisture tension in the range from 0 to 80 centibars, but cannot measure the tension between 80 centibars and the traditionally accepted plant permanent wilting point of 15 bars. However, much of the available moisture ranges from 0 to 0.8 bars. All irrigated treatments maintained moisture tension values in that range.

The tensiometers were installed at depths of 6, 12, 18, and 30 inches in the center of each plot to monitor soil moisture, figure 2. The 6-inch tensiometer was located approximately in the middle of the surface horizon, the 12-inch tensiometer in the middle of the thin transitional B1 layer, and the 18-inch and 30-inch tensiometers

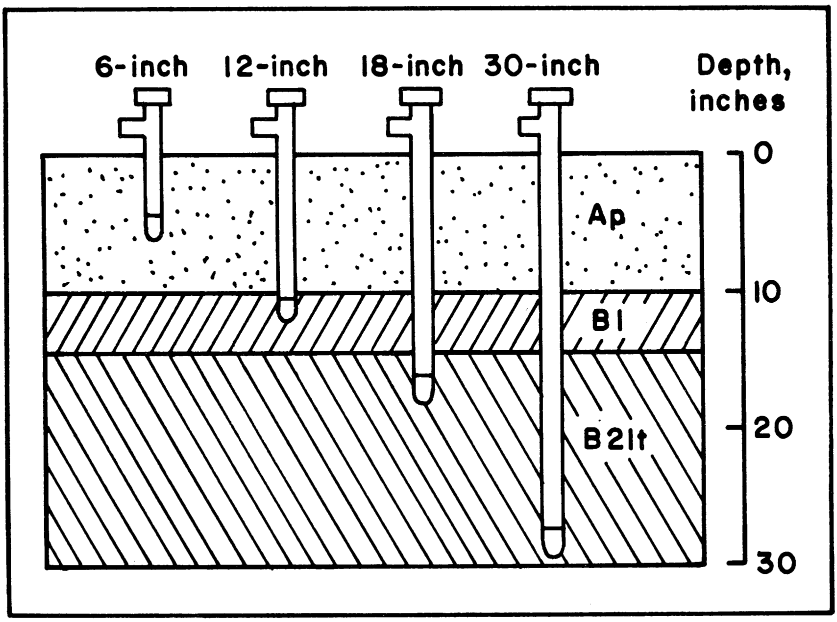

FIG. 2. Tensiometer-soil relationship.

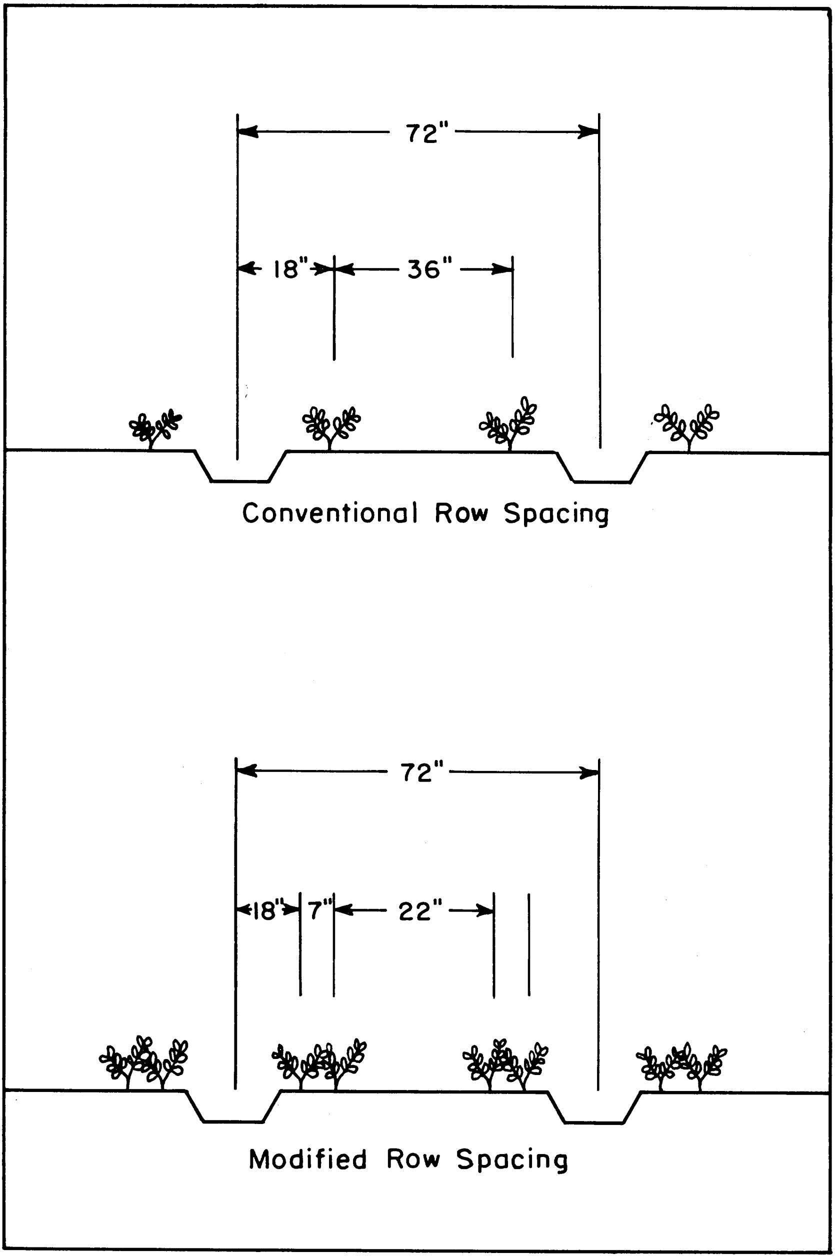

FIG. 3. Conventional 36-inch row spacing above with modified 7-inch spacings shown below.

in the B21t (Btl) horizon. Tensiometer readings, in centibars, were taken at approximately 8 a.m. Monday, Wednesday, and Friday. The 18-inch and 30-inch soil-moisture tensions were monitored but not used in irrigation decisions.

Treatments were assigned utilizing a randomized complete block design with each treatment having three or four replications. depending upon the year. Three experiments were included in the study at various times during the 6-year period. These experiments were utilized to address specific objectives relating to irrigation of peanuts. The experiments are as follows:

I. To determine the response of conventionally planted Florunner peanuts to several irrigation schedules (no irrigation, 60, 40, and 20 centibar soil-moisture tensions).

II. To determine the response of conventionally planted Florunner peanuts to different fungicide application methods (no application, application with conventional ground equipment, and application through the irrigation system).

III. To determine the response of irrigated and nonirrigated Florunner peanuts to planting date (three planting dates including one currently recommended date and two late dates) and row placement (a conventional 36-inch and a modified twin, 7-inch row spacing as shown in figure 3).

Other than treatment modifications, conventional management practices were followed. This included a full season leafspot control program consisting of Bravo 500 at the rate of 2⅛ pints per acre on 10- to 14-day intervals. The peanuts were planted on 36-inch rows at a rate of 100 pounds per acre or on twin, 7-inch rows at a rate of 110 pounds per acre. The plot area was planted in an annual corn-peanut rotation. Digging dates were determined by the arginine maturity index (AMI) in 1976 and 1977 *(8)*, and by the shell-out method during other years. Commercially available equipment was utilized in digging, combining, and handling the peanut crop. Yields are expressed as dry (12 percent) pod weights.

RESULTS

Rainfall

Yield increases as a result of irrigation were highly dependent upon rainfall amounts and distribution. During this 6-year study, rainfall amounts for the growing period varied from 18 to 26.5 inches, table 2. However, all 6 years contained periods requiring irrigation as defined by the methods of these experiments. Irrigation

TABLE 2. RAINFALL AND IRRIGATION APPLICATION AMOUNTS FOR PEANUT EXPERIMENT, 36-INCH ROW SPACING, WIREGRASS SUBSTATION

Year and irrigation treatment	Rainfall	Irrigation	Total water applied	Growing days
	In.	*In.*	*In.*	*Days*
1976				
Nonirrigated	26.5	0	26.5	156
60-centibar	26.5	3.0	29.5	156
40-centibar	26.5	4.3	30.8	156
1977				
Nonirrigated	21.6	1.0[1]	22.6	156
60-centibar	20.0	5.8	25.8	156
40-centibar	20.0	8.5	28.5	148
20-centibar	19.8	11.6	31.4	148
1978				
Nonirrigated	18.2	0	18.2	165
60-centibar	18.2	4.9	23.1	165
40-centibar	18.0	9.3	27.3	148
20-centibar	18.0	10.6	28.6	148
1979				
Nonirrigated	22.6	0	22.6	137
40-centibar	22.6	9.0	31.6	150
1980				
Nonirrigated	19.0	0	19.0	153
40-centibar	18.2	13.8	32.0	139
1981				
Nonirrigated	19.6	0	19.6	144
40-centibar	19.6	5.0	24.6	157

[1]A 1-inch application of water was made to all plots at planting time in 1977.

amounts varied from 3 to 14 inches for the irrigation treatments. The total amount of water the peanuts received ranged from 18 inches (nonirrigated) to 32 inches (irrigated). The required growing period ranged from 137 to 165 days, with the irrigated peanuts requiring the shorter growing period except during the 1979 season when the reverse was true.

Conventional Planting

Traditional 36-inch row spacing and recommended planting dates were utilized in the primary experiment which was conducted during the 6-year period from 1976 through 1981. (All planting and digging dates are presented in appendix table 1.) Yields from the nonirrigated treatments ranged from 2,090 to 5,130 pounds per acre with an average of 3,620 pounds per acre, table 3. (Yields from planting dates and row spacings are presented in appendix table 2.) The best nonirrigated yield of 5,130 pounds per acre occurred in 1978, a year with only 18.2 inches of well distributed rainfall during the growing period, table 2.

TABLE 3. YIELDS OF FLORUNNER PEANUTS FROM 1976 THROUGH 1981, BEST DIGGING, WIREGRASS SUBSTATION

Year	Yield/acre		
	Nonirrigated	Irrigated at 40cb	Difference
	Lb.	*Lb.*	*Lb.*
1976	3,400	4,870	+1,470
1977	3,650	3,380	− 280
1978	5,130	4,350[1]	− 780
1979	3,000	3,850	+ 850
1980	2,090	4,450	+2,360
1981	4,440	3,920	− 520
Treatment average	3,620	4,140	+ 520

[1]60-centibar treatment yielded 4,830 pounds per acre.

The lowest yields (2,090 pounds per acre) were obtained during the 1980 growing season, a season receiving 19 inches of poorly distributed rainfall, table 2. Irrigated yields (at 40-centibar treatment) varied from 3,380 to 4,870 pounds per acre for a 6-year treatment average of 4,140 pounds per acre. The 6-year average increase in yields of the 40-centibar irrigated treatments was 520 pounds per acre more than the nonirrigated treatments. The largest difference occurred in 1980, a year with good irrigated yields and poor nonirrigated yields. In 2 other years, 1976 and 1979, the irrigated treatments had higher yields. However, in 3 of the 6 years (1977, 1978, and 1981) nonirrigated treatments had yields that were slightly higher than the irrigated yields.

One factor that would be important in multi-cropping sequences was the decreased growing time for the irrigated peanuts, table 2. This averaged 12 days for the 3 years in which no yield increases were obtained, and 8 days for the 5-year period having the multi-digging program.

There were a number of factors affecting the yield during the 6-year period. One factor was rainfall amount and distribution and its affect on moisture availability to the plants. Three figures are utilized to evaluate the effectiveness of the rainfall and the effects of irrigation on yield. Figures 4 and 5 show rainfall patterns during the 6-year period, while figure 6 presents soil-moisture tension values for the same period.

The rainfall amounts for the 6-year period, figure 4, varied from 15.7 inches to 23.7 inches for the 140-day period following planting. The highest nonirrigated yield was obtained in 1978, a year with low rainfall (16.8 inches) during the 140-day growing period. Actually, a 26-day dry period in stage 4, figure 4, delayed maturity so that peak nonirrigated yields were obtained at 165 days, table 4. Irrigated

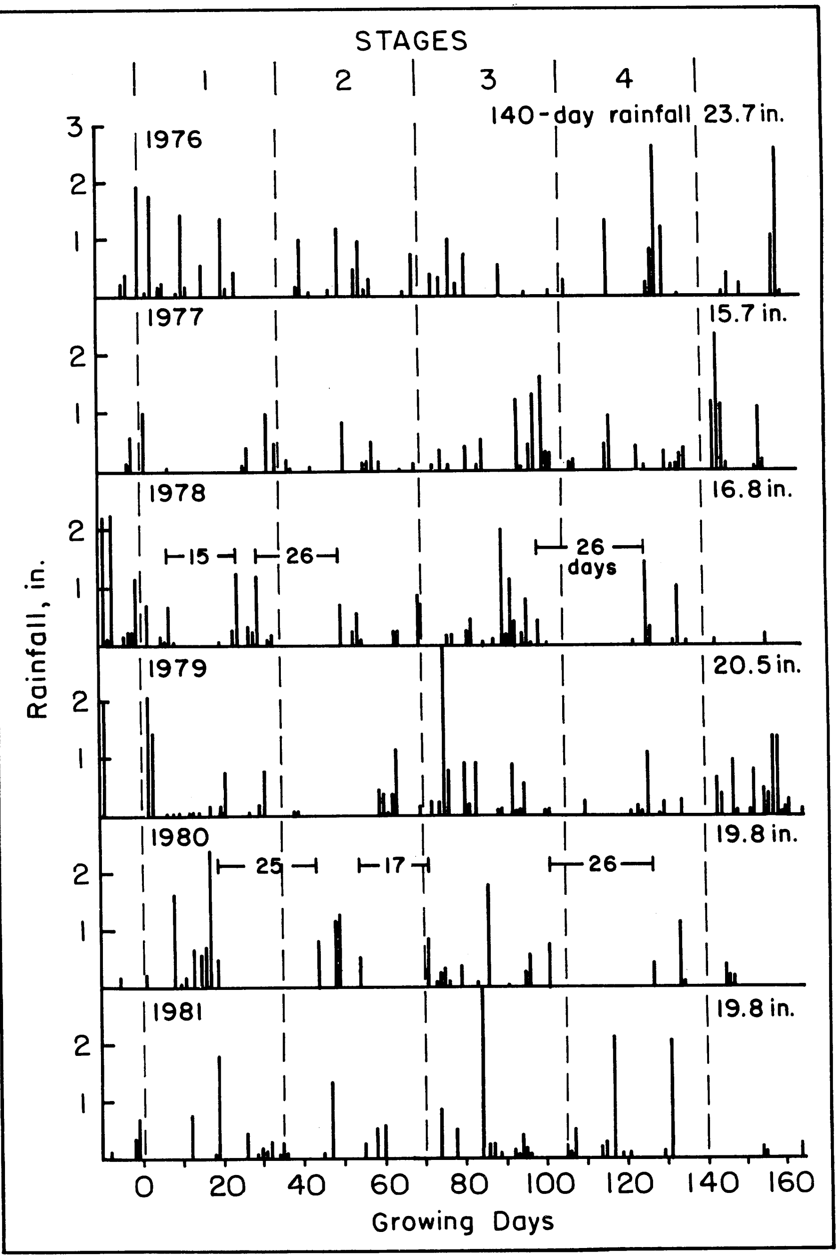

FIG. 4. Rainfall distribution for conventional planting experiment at Wiregrass Substation. Zero growing days initiated at planting with four, 35-day growing periods delineated.

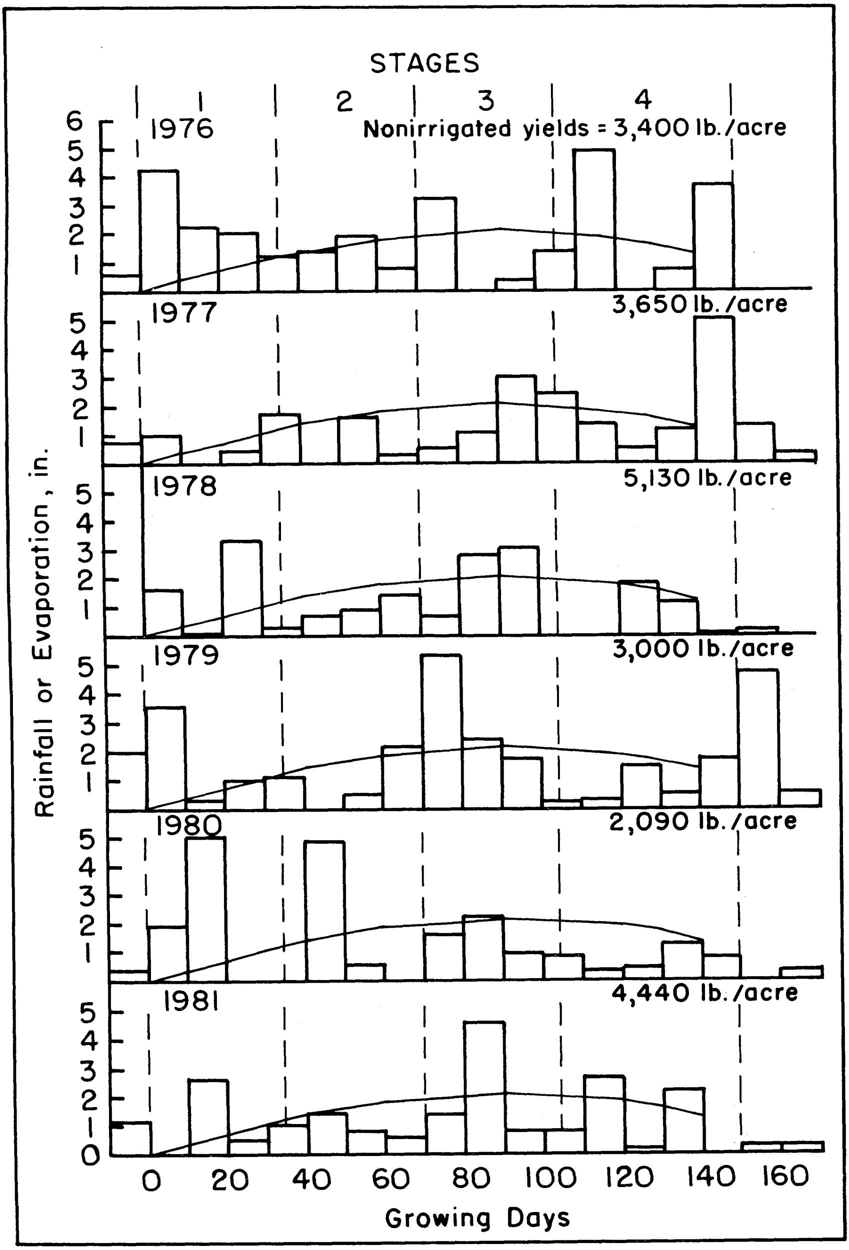

FIG. 5. Ten-day rainfall averages at Wiregrass Substation, and peanut water-usage requirements. Growing days based on planting dates of the conventional planting date treatments. Water usage based on results by Stansell et al. *(6)*.

TABLE 4. YIELDS OF FLORUNNER PEANUTS FROM 1976 THROUGH 1981, ALL DIGGINGS, WIREGRASS SUBSTATION

Year	Growing Period	Yield/acre			
		Nonirrigated	60cb	40cb	20cb
	Days	*Lb.*	*Lb.*	*Lb.*	*Lb.*
1976.	156	3,400[a]	4,660[b]	4,870[b]	--
1977.	148	2,620[c][1]	3,220[b]	3,380[b]	3,840[a]
	156	3,650[a]	3,360[a]	3,290[a]	3,330[a]
	167	3,490[a]	2,590[b]	2,140[c]	2,070[c]
1978.	139	3,850[b]	4,090[ab]	4,340[ab]	4,800[a]
	148	4,740[a]	4,820[a]	4,350[a]	5,050[a]
	165	5,130[a]	4,830[a]	3,970[a]	4,410[a]
1979.	137	3,000[a]		3,350[a]	
	150	2,910[a]		3,850[a]	
	160	2,280[a]		2,260[a]	
1980.	139	1,690[a]		4,450[b]	
	153	2,090[a]		3,980[b]	
1981.	144	4,040[a]		3,920[a]	
	157	4,440[a]		3,550[a]	

[1]Means within year and growing period with same letter are not significantly different (P = 0.05).

yields remained approximately the same for the first and second diggings at 139 and 148 days, and decreased at the 165-day digging with the highest irrigated yields being less than the nonirrigated yields, table 3.

The lowest nonirrigated yields of the 6-year study were in 1980. The dry periods of 1980 appeared to be similar to those of 1978. However, the no-rain period in stages 1 and 2 was 10 days longer than the first no-rain period in 1978. In addition, rainfall quantities in stage 3 were much lower in 1980 than in 1978.

Perhaps a more useful comparison of these 2 years is provided in the 10-day rainfall averages and the accompanying water usage requirements, figure 5. A 50-day period in stage 2 and early stage 3, with rainfall less than predicted water usage, characterized 1978. Following this was a 20-day period with adequate rainfall and a 20-day period (actually 26 days) with no rainfall. In 1980, a deficient period again existed in stage 2, but a much longer deficient period of 50 days existed during stages 3 and 4.

A comparison of the soil-moisture tension values at a 30-inch depth in the soil, figure 6, shows that moisture was being removed at that depth during both years. The water removal could be noted after approximately 50 days following planting. At that time the roots had penetrated to a sufficient depth to cause drying at 30 inches. One distinctly different characteristic of the nonirrigated treatment in 1978 was the decrease in tension (increased wetting) at the middle of stage 3. This is an indication that adequate moisture was available to the plants during the last half of stage 3. In 1980, symptoms of plant stress and the 30-inch soil moisture tension remained relatively high during this stage.

A comparison of the soil moisture tensions between all non-irrigated and irrigated treatments, figure 6, indicated that dryer

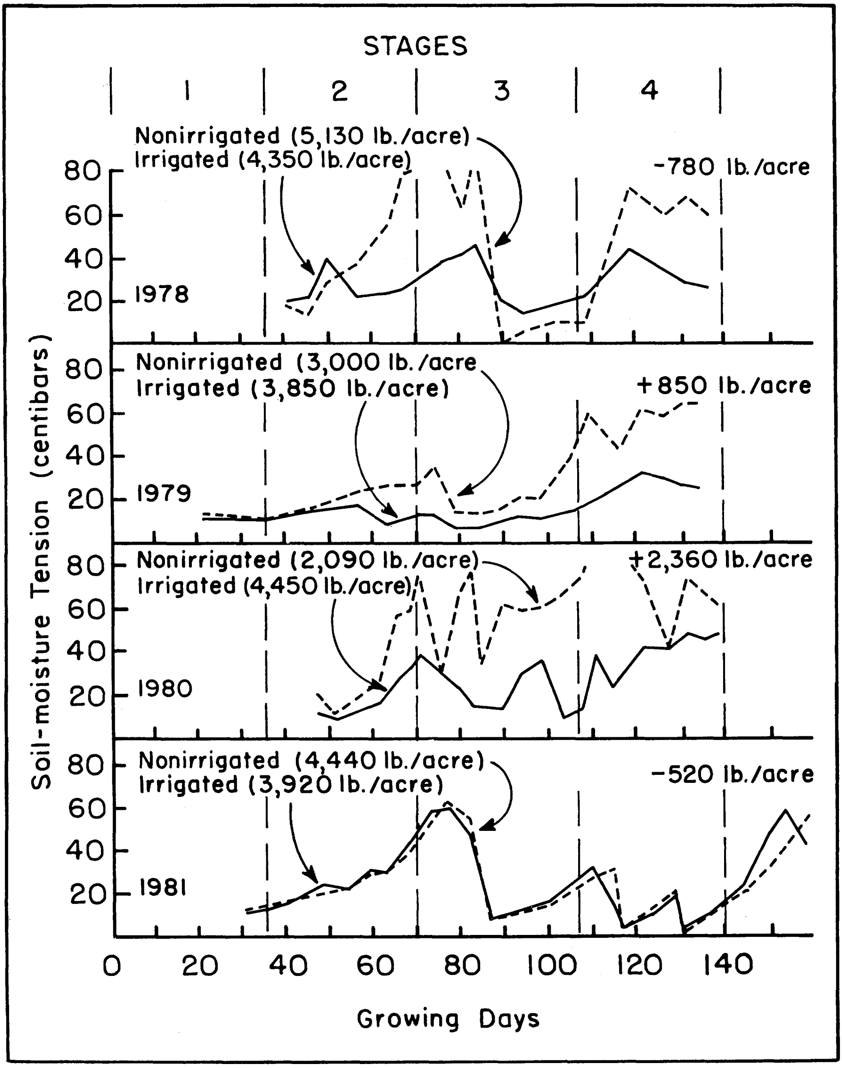

FIG. 6. Soil-moisture tension at 30-inch depth for 36-inch row spacing, Florunner peanuts at Wiregrass Substation. Zero growing days initiated at planting with four, 35-day growing periods delineated.

conditions at 30 inches generally produced lower yields. In 1981, the tensions were almost identical and there was no increased yield from irrigation even though the tensiometers at shallow depths indicated a dryer soil profile for the nonirrigated crop. In 1979, the nonirrigated treatment was slightly dryer during most of the season. The yield from the irrigated treatment was 850 pounds higher than the nonirrigated yields.

In general, yields tended to be at or above the 4,000-pound-per-acre value for all treatments where the soil-moisture tension at 30 inches remained below 60 centibars during most of the season. The exception is the 1979 nonirrigated treatments. This yield was approximately 3,000 pounds per acre. However, the yields of the irrigated treatments were also relatively low at 3,850 pounds per acre even though little moisture removal is indicated at the 30-inch depth.

The effectiveness of water on yield, table 5, shows a range varying from 110 to 265 pounds per acre per inch of total water the soil received. It is significant to note that both the most and least efficient utilization of water was found under nonirrigated conditions. The poorest utilization occurred in 1980, a year with low yields and fairly normal rainfall. The best utilization was in 1978, a year with high yields and similar average rainfall amounts. The distribution of rainfall and other contributing factors caused the differences. The addition of irrigation had a moderating effect with water utilization with values ranging from 118 to 209 pounds per acre per inch of water applied. However, these values still were quite variable, being affected by both the rainfall distribution and the effectiveness of irrigations.

Quality of harvested peanuts is another parameter which has significant impact on value. In this study, the assessment of quality was limited to a measure of the percentage of sound mature kernels

TABLE 5. EFFICIENCY OF WATER UTILIZATION FOR FLORUNNER PEANUTS, WIREGRASS SUBSTATION, 1976-1981

Year	Yield/acre/inch water			
	Nonirrigated	60cb	40cb	20cb
	Lb.	*Lb.*	*Lb.*	*Lb.*
1976	128	158	158	
1977	158	130	118	122
1978	265	209	159	176
1979	133		122	
1980	110		139	
1981	227		159	
Treatment averages	170		142	

(SMK) and sound splits (SS). The sum of these two parameters (SMK + SS) ranged from 63 to 78 percent, table 6. In some years there was no significant difference between the irrigated and nonirrigated treatments. This was true in 1979 and 1981 where no yield increases were obtained from irrigation. One digging in 1980, a dry year, indicated a higher quality peanut for nonirrigated peanuts. In other years, quality was generally increased with irrigation (see 1976, 1977, and 1978).

TABLE 6. QUALITY OF FLORUNNER PEANUTS FOR 36-INCH ROW SPACING AND CONVENTIONAL PLANTING DATES, WIREGRASS SUBSTATION

Year	Growing period	Seed quality, SMK + SS			
		Nonirrigated	60cb	40cb	20cb
	Days	*Pct.*	*Pct.*	*Pct.*	*Pct.*
1976...........	156	63[a1]	66[ab]	72[b]	--
1977...........	148	62[b]	72[a]	72[a]	75[a]
	156	74[a]	77[a]	78[a]	77[a]
	167	76[a]	77[a]	77[a]	74[a]
1978...........	139	72[a]	72[a]	72[a]	72[a]
	148	67[a]	73[b]	74[b]	74[b]
	165	71[ab]	74[b]	73[ab]	73[ab]
1979...........	137	71[a]		69[a]	
	150	75[a]		75[a]	
	160	71[a]		73[a]	
1980...........	139	73[a]		65[b]	
	153	63[b]		72[a]	
1981...........	144	69[a]		70[a]	
	157	73[a]		71[a]	

[1]Means within year and growing period with same letters are not statistically different (P = 0.05).

Planting Dates

Maximum utilization of resources continues to be a key ingredient in successful farming, as well as use of irrigation. Double cropping is one of the ways irrigation equipment and land can be more effectively utilized. Traditional planting dates are not always appropriate in times of changing technology, such as when changing from nonirrigated to irrigated crop production, or shifting to a multi-cropping program with irrigation. Therefore, a 2-year study was initiated to evaluate the potential for late planting of irrigated peanuts. Planting dates ranged from early May until late June and extended well beyond the traditional planting period.

The 2-year study provided two distinctly different growing seasons. All 1980 plantings were characterized by low yields from the nonirrigated treatments, table 7. These yields varied from 2,090 pounds per acre to 930 pounds per acre for the first and last plantings, respectively. In 1981, the nonirrigated yields were relatively high and were as good as the irrigated yields. The values ranged from 4,440 to 4,690 pounds per acre for the first and last plantings, respectively. Yields of the irrigated treatments were relatively high for both years and all plantings. The values ranged from 3,920 to 4,470 pounds per acre. Therefore, irrigation in 1980 resulted in large yield increases, whereas none was obtained in 1981.

TABLE 7. THE EFFECTS OF PLANTING DATES ON PEANUT YIELDS FOR 36-INCH ROW SPACING, WIREGRASS SUBSTATION

Planting date	Yield/acre[1]		
	Irrigated @ 40 cb	Nonirrigated	Difference (irrigated-nonirrigated)
	Lb.	*Lb.*	*Lb.*
First			
5/7/80	4,450	2,090	+2,360
5/8/81	3,920	4,440	− 520
Average	4,185	3,265	+ 920
Second			
6/3/80	4,190	2,050	+2,140
6/5/81	4,470	4,310	+ 160
Average	4,330	3,180	+1,150
Third			
6/18/80	4,190	930	+3,260
6/18/81	4,340	4,690	− 350
Average	4,265	2,810	+1,455

[1]All treatments harvested at two dates with highest yield reported. All yields and statistical significances are reported in appendix table 2.

Rainfall distribution was distinctly different for the 2 years of this experiment. Table 8 presents an overview of the water applied and rainfall received on peanuts planted at various dates. Major differences in total rainfall between the 2 years are not immediately apparent, although 1981 shows from 1 to 5 inches more rainfall during the growing season. Total irrigation application was much less in 1981 than that in 1980 and reflects the better distribution of rain in 1981 since the same irrigation schedules were evaluated. The 1981 crop received much less total water. Irrigation varied with planting date, depending on rainfall timing but no clear trend is apparent. In 1981, irrigation requirements increased with late planting; however, in 1980 the middle planting required the most water. Planting date also affected growing time to maturity, which decreased with late planting in 1981 but showed mixed results in 1980.

The comparison of the 10-day rainfall with the projected water-

TABLE 8. WATER APPLICATION AND GROWING TIME FOR 1980 AND 1981 FLORUNNER PEANUT EXPERIMENT, WIREGRASS SUBSTATION

Planting date	Treatment		Rainfall	Irrigation	Total water applied	Growing period
	Irrig.	Row spacing				
		In.	*In.*	*In.*	*In.*	*Days*
1980						
5/7	Yes	36	18.2	13.8	32.0	139
		7	18.2	13.8	32.0	139
	No	36	19.0	0	19.0	153
		7	19.0	0	19.0	153
6/3	Yes	36	12.1	16.1	28.2	135
		7	12.1	16.1	28.2	135
	No	36	12.1	0	12.1	135
		7	12.3	0	12.3	141
6/18	Yes	36	15.6	12.8	28.4	138
		7	15.6	12.8	28.4	138
	No	36	15.6	0	15.6	138[1]
		7	15.6	0	15.6	147[1]
1981						
5/8	Yes	36	19.6	5.0	24.6	144
		7	19.6	5.0	24.6	144
	No	36	19.9	0	19.9	157
		7	19.9	0	19.9	157
6/5	Yes	36	17.1	6.5	23.6	143
		7	17.1	6.5	23.6	143
	No	36	17.1	0	17.1	143
		7	16.9	0	16.9	129
6/18	Yes	36	17.7	7.2	24.9	134
		7	17.7	7.2	24.9	134
	No	36	17.7	0	17.7	134
		7	17.7	0	17.7	134

[1]Yield available for one dig only.

usage curve, figure 7, shows relatively long periods of time during the 1980 season in which rainfall was less than the projected water usage. There are deficient periods during all four stages for the first planting (May 7). The second and third plantings were characterized by a long deficient period beginning in stage 2 and ending near the end of stage 4. Likewise, 1981 also had deficient periods, but they were shorter in duration and generally did not exceed 30 days.

Soil-moisture tension generally reflects the dry periods of 1980 and 1981, figure 8. In all cases, the moisture tension was low (soil was wet) early in the growing season. Tensions began to increase in the 40 to 50 growing-day range. In 1980, the soil moisture tension in the nonirrigated plots had exceeded 60 centibars by the beginning of stage 3 and generally remained above that value for the remainder of the season. Yields were near or below 2,000 pounds per acre for those treatments. In 1981, the tension in the nonirrigated treatments generally remained below 60 centibars until the middle of the fourth stage (120 growing days). These yields were greater than

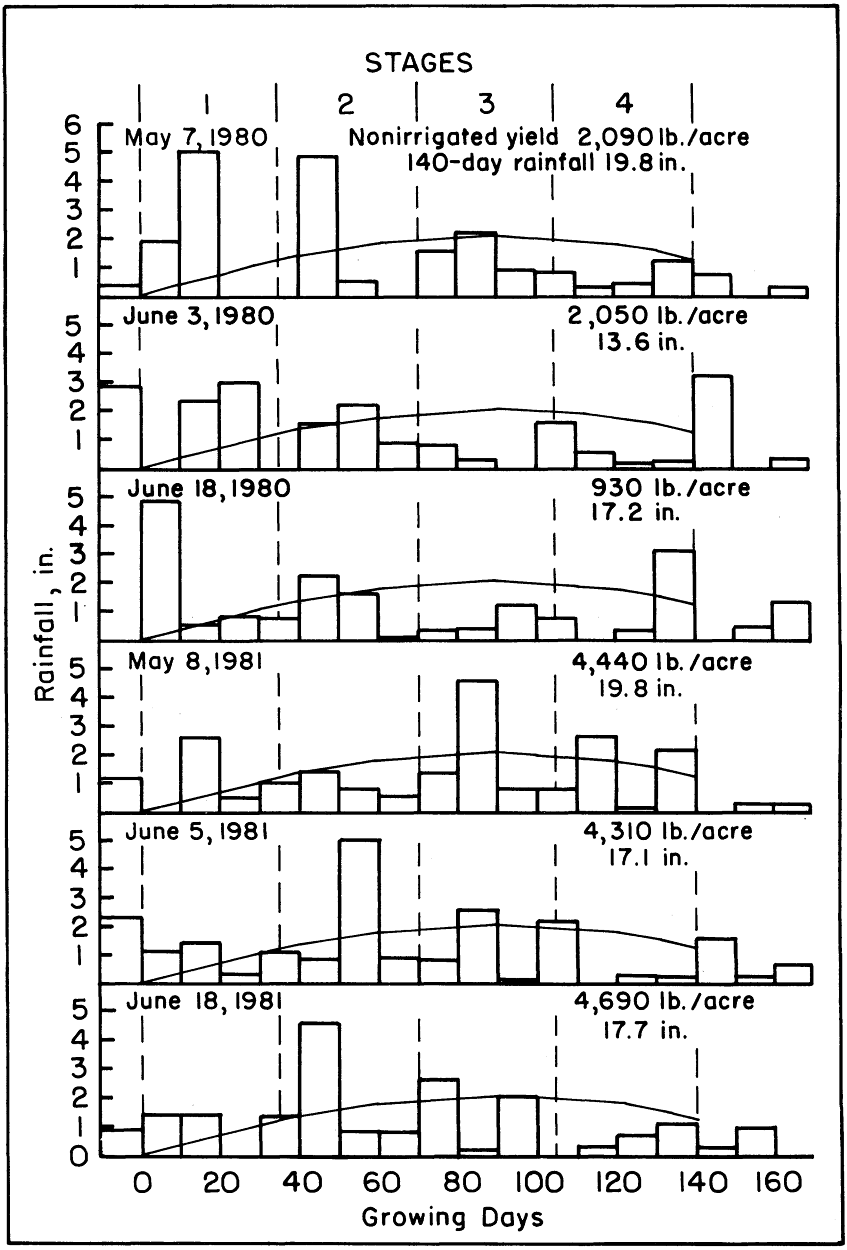

FIG. 7. Ten-day rainfall averages for planting-date experiment at Wiregrass Substation. Zero growing days initiated at planting with four, 35-day periods delineated. Water usage curve based on results by Stansell *(7)*.

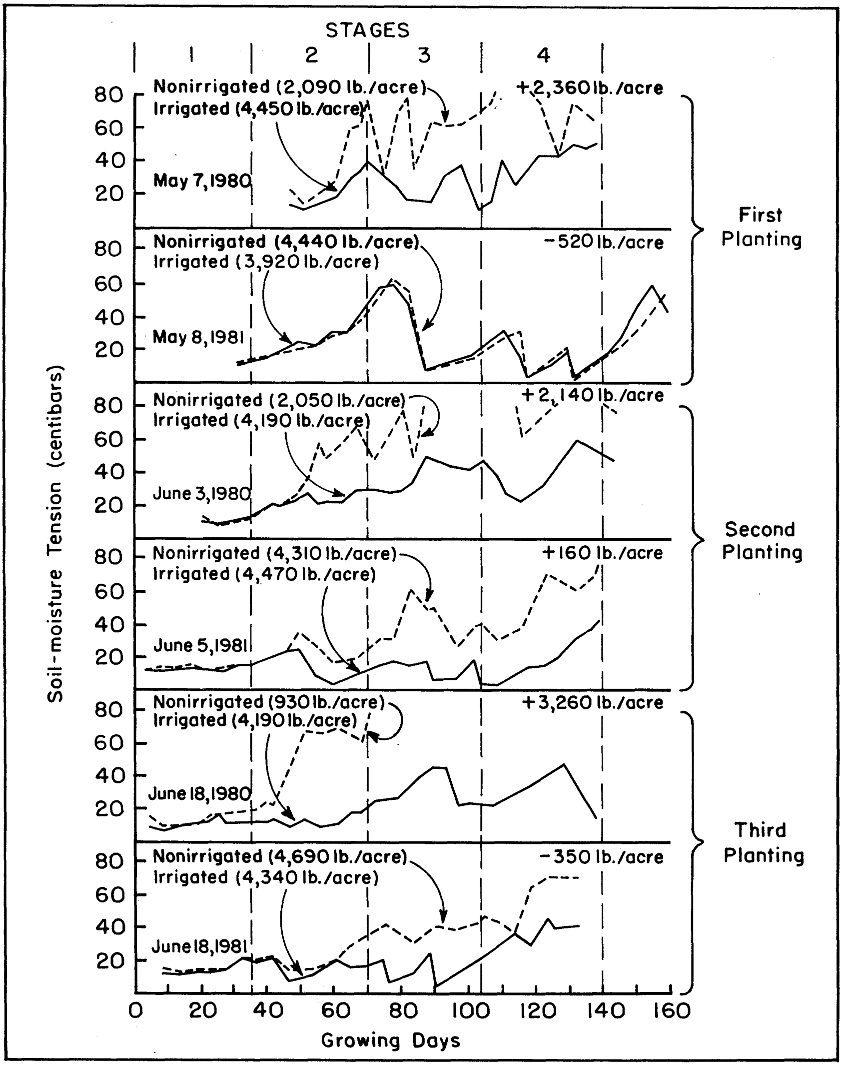

FIG. 8. Soil-moisture tension at 30-inch depth for planting date experiment, Wiregrass Substation. Zero growing days initiated at planting with four, 35-day growing periods delineated. Planting dates in upper left corner. Yield increases by irrigation in upper right corner.

4,000 pounds per acre. Tensions in all the irrigated treatments remained below the 60-centibar level with all yields in the 4,000 pound-per-acre range.

These results indicate that the 30-inch tensiometer readings may be a good predictor of overall moisture stress on the plant during late season. However, this would not be the case early in the season when the roots are shallow. Use of these tensiometer readings to trigger irrigation might be risky since applying adequate amounts of water to wet the 30-inch soil profile might prove difficult with limited soil intake rates and with movable irrigation systems.

Row Spacings

In several studies, alternate planting patterns indicated a potential for increased yields. One such pattern utilizing a twin-row concept (twin 7-inch) and a 10 percent increase in seeding rate, figure 3, was included in this study in 1980 and 1981. Both irrigation and planting dates were evaluated and compared to the conventionally planted peanuts, table 9. A comparison between the twin 7-inch and 36-inch row spacing showed the twin 7-inch to consistently have higher yields in irrigated treatments. The increases were 650 and 390 pounds per acre for 1980 and 1981, respectively. However, the comparison between the two patterns was not the same under nonirrigated conditions. The twin 7-inch produced a higher yield than the conventional 36-inch planting patterns for the early planted peanuts, but the reverse was true for the third planting. However, both treatments yielded less than 1,000 pounds per acre for the third planting. Mixed results were obtained from the second planting.

TABLE 9. THE EFFECTS OF LATE PLANTING AND MODIFIED ROW SPACING ON PEANUT YIELDS, BEST DIGGING[1], WIREGRASS SUBSTATION

Planting date	Yield/acre					
	Irrigated @ 40cb			Nonirrigated		
	36-in. row	Twin 7	Difference (twin-36)	36-in. row	Twin 7	Difference (twin-36)
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
1980						
5/7	4,450	4,990	+540	2,090	2,510	+420
6/3	4,190	5,090	+900	2,050	1,500	−550
6/18	4,190	4,690	+500	930	670	−260
Av.			+650			−130
1981						
5/8	3,920	4,710	+790	4,440	4,720	+280
6/5	4,470	4,690	+220	4,310	4,510	+200
6/18	4,340	4,500	+160	4,690	4,380	−310
Av.			+390			+ 60

[1]All treatments harvested at two dates with highest yield reported. All yields and statistical significances are reported in appendix table 2.

The quality of the peanuts was found not to be necessarily the highest at the same digging as the highest yield. Therefore, a useful comparison is to evaluate quality at the best yield conditions, table 10.

TABLE 10. QUALITY OF FLORUNNER PEANUTS AT BEST YIELD, WIREGRASS SUBSTATION, 1980, 1981

Planting date	Seed quality, SMK + SS			
	Irrigated @ 40cb		Nonirrigated	
	36-in. row	Twin 7	36-in. row	Twin 7
	Pct.	*Pct.*	*Pct.*	*Pct.*
1980				
5/7	65	72	63	68
6/3	74	76	67	71
6/18	76	80	71	75
Av.-row spacing	72[b]	76[a]	67[b]	72[a]
Av.-irrigation	74[a]		69[b]	
1981				
5/8	70	69	73	70
6/5	75	77	77	73
6/18	75	77	77	76
Av.-row spacing	73[a]	74[a]	76[a]	73[b]
Av.-irrigation	74[a]		74[a]	

[1]Means within irrigation classes with same letters are not statistically different (P = 0.05).

Two significant differences in quality can be noted during 1980, a year in which irrigated nuts had significantly higher yields. First, the twin, 7-inch row spacing produced significantly higher quality nuts than the 36-inch row spacing. Second, irrigated nuts had significantly higher quality than nonirrigated nuts.

However, in 1981, a year in which irrigation did not increase yields, quality of the irrigated and nonirrigated nuts was the same. The only significant difference was an increased quality of the 36-inch nonirrigated nuts as compared to the nonirrigated twin, 7-inch nuts.

A comparison of quality on a same-digging basis, appendix table 3, produced slightly different results for the comparisons between row spacings. No differences in quality between row spacings can be found on a same-digging basis. Therefore, the differences shown in table 10 relate to the differences in timing of the peak yield.

A comparison of quality between irrigated and nonirrigated treatments, appendix table 3, again showed significantly higher quality in irrigated peanuts during 1980, but the nonirrigated peanuts were higher by 1 percent during 1981, a year with no increase in yield from irrigation.

Quality of the harvested peanuts remained the same or was increased when the crop was planted at later dates, table 11. For example, the quality of the 36-inch row spacing treatment increased both years at the later planting dates. The increase in quality is also shown for the twin, 7-inch spacing in 1981. The differences were not large enough to be significant in 1980. The trends were the same for the nonirrigated treatments with the possible exception of the twin 7-inch in 1980. Although the values indicate a decrease in quality at the later planting, the variances are not statistically different.

TABLE 11. QUALITY OF FLORUNNER PEANUTS WITH VALUES AVERAGED FOR TWO DIGGING DATES, WIREGRASS SUBSTATION, 1980, 1981

Planting date	Seed quality, SMK + SS					
	Irrigated @ 40cb			Nonirrigated		
	36-in. row		Twin 7	36-in. row		Twin 7
	Pct.		Pct.	Pct.		Pct.
5/7/80	68.3[b1]		72.0[a]	68.2[a]		71.8[a]
6/3/80	75.7[a]		76.7[a]	69.2[a]		67.8[a]
Av. row spacing	72.0		74.3	68.6		69.8
Av. irrigation		73.2			69.2	
5/8/81	70.5[b]		69.5[b]	70.8[b]		69.2[b]
6/5/81	73.3[ab]		74.0[a]	74.8[a]		74.7[a]
6/18/81	75.3[a]		75.2[a]	76.0[a]		77.0[a]
Av. row spacing	73.1		72.9	73.9		73.6
Av. irrigation		73.0			73.8	

[1]The letter pairs a, b are used to denote statistical differences in the reported values for different planting dates for each year. No statistical comparison is implied between row spacings or irrigation.

Fungicide Application

Since 1976, experiments have been conducted at the Alabama Agricultural Experiment Station's Wiregrass Substation to determine if fungicides could be injected into irrigation lines to control peanut leafspot or white mold (stem rot) or both. Data from the last 3 years are presented in this report.

The fungi causing peanut leafspot are difficult to control, and only a few fungicides are recommended. The most difficult to control is late leafspot, primarily because it produces spores in large numbers on the lower leaf surface. It is difficult to apply fungicides to this area with a ground sprayer. Table 12 illustrates results from leafspot control tests, with comparisons between Bravo 500 applied by ground sprayer and Bravo 500 applied through-the-line (TTL), in both cases at 2⅛ pints per acre. The 1979 and 1980 tests were conducted using a pivot irrigation system; the 1978 test utilized a stationary high volume sprinkler system. For comparison, plots receiving fungicides applied by ground sprayer were always located in an area under the same irrigation system.

Results indicate that leafspot was usually slightly more severe in plots receiving Bravo through the irrigation system; however, yields for TTL Bravo plots were increased. Published information indicates that less than 10 percent of the Bravo applied TTL is retained on the foliage, while the rest is washed to the soil. TTL application of leafspot fungicides does a better job of treating the lower leaf surface because of the huge volume of water applied, resulting in a total wetting of the leaf. This may partially compensate for the low amount of fungicide retained by the leaf. Increased yields from TTL-applied Bravo may result from less equipment damage (eight fewer tractor trips), or from Bravo affecting pod and root diseases.

TABLE 12. COMPARISON OF EFFECTS OF FUNGICIDES APPLIED THROUGH THE IRRIGATION SYSTEM (TTL) AND BY GROUND SPRAYER ON PEANUT LEAFSPOT AND YIELD

Bravo applications	Yield (lb. per acre)			Pct. infected leaves			Pct. leaves lost		
	78	79	80	78	79	80	78	79	80
None	3,194	2,392	2,805	57	62	68	20	37	40
Bravo TTL	4,041	4,075	4,268	40	41	38	18	24	30
Bravo ground	3,823	3,853	3,188	21	15	61	12	9	36

A similar system was used to apply fungicides for control of white mold, except that only two applications were made. The first application (2½ gallons Terraclor 2EC or 2½ pints Vitavax 3F) was made in mid-July, and the second was made at the same rate 3 weeks later. All plots were also treated with Bravo to control leafspot; in the 1978 and 1979 tests, Bravo was applied TTL. Evaluation of treated plots indicated good control of white mold in all years, with yield increases in 2 of 3 years, table 13.

These data indicate that applying fungicides through the irrigation system is effective in controlling peanut diseases. This method is also more economical since it does not require tractors, spray rigs, or their operators. State labels [Alabama 24(c)] have been granted for the application of Bravo TTL for peanut leafspot control and for Terraclor TTL for white mold control. Delivery of some herbicides and Sevin by this method is also effective.

TABLE 13. EFFECTS OF FUNGICIDES APPLIED THROUGH THE IRRIGATION SYSTEM ON INCIDENCE OF WHITE MOLD AND YIELDS

White mold fungicide	Yields (lb. per acre)			White mold hits per 100 ft. row		
	78	79	80	78	79	80
None	4,219	4,075	4,268	10.5	14.0	9.9
Terraclor TTL[1]	4,503	4,897	4,290	5.0	2.7	8.2
Vitavax TTL	--	4,679	4,189	--	1.7	5.6

SUMMARY AND CONCLUSIONS

The objective of this 6-year study was to determine yield and quality responses of peanuts to soil moisture levels so that the most effective irrigation scheduling policy could be determined. Tensiometers were used to measure soil moisture tensions at four depths in the soil profile. Decisions to irrigate were based on tensiometer readings at 6 and 12 inches with the 18- and 30-inch values used only to monitor moisture. Forty centibars was used as the trigger.

Environmental conditions varied from year to year, with some years providing adequate moisture so that nonirrigated yields were as good as irrigated yields. There was an overall average increase in yield of 520 pounds per acre for the 36-inch row spacing peanuts planted during the recommended planting period. In addition to the yield increase, several other factors became evident: First, time to maturity was not necessarily the same for the irrigated and nonirrigated peanuts. Typically, dry periods tended to inactivate growth of the nonirrigated peanuts. Later rainfall reactivated growth causing the growing time to be longer in the nonirrigated treatments. Moisture was maintained for the irrigated treatments so they were more likely to be harvested at the expected 140-day growing season. Second, use of the 6- and 12-inch tensiometers to trigger irrigation resulted in the unneeded application of irrigation water during several years in which no response to irrigation was obtained. In these years, the 30-inch tensiometer indicated water availability at these greater depths. In fact, the 30-inch tensiometer appeared to be a relatively good indicator of peanut yield for all treatments. However, use of the 30-inch tensiometer as a trigger mechanism for irrigation is probably not appropriate because of the difficulty of applying amounts of water to adequately wet the soil profile to 30 inches. Therefore, a 12- or 18-inch tensiometer or some combination of tensiometers located at various depths might be utilized to provide a more reliable trigger mechanism.

An evaluation of peanut quality using sound mature kernels and sound splits indicated differences in quality between irrigated and nonirrigated peanuts for some years. Typically, the irrigated peanuts had the same or slightly higher quality than the nonirrigated peanuts.

Late planting dates were evaluated during a 2-year period. Three dates were used, one during the recommended period and two at 2-week intervals. The last planting was June 18 for both years. Yields in the 4,000-pound-per-acre range were maintained both years for all planting dates when irrigaton was utilized. In 1 year, rainfall was adequate to produce yields comparable to the irrigated treatments in all three planting dates. The other year, however, was a dry year with the nonirrigated yields dropping to 930 pounds per acre in the third planting. The only factor affecting the feasibility of planting at these later dates appeared to be moisture availability. In fact, peanut quality was improved with the later planting dates.

An alternate planting pattern was evaluated during the same 2-year period along with the 36-inch row spacing. The alternate pattern, called a twin 7-inch, utilized two rows spaced 7 inches apart in place of the usual single row, with a 10 percent increase in seeding rate. The twin, 7-inch row spacing had equal or higher yields than the 36-inch row spacing in all irrigated treatments including late plantings. This relationship was also true for the nonirrigated treatments that were planted during the recommended planting period. Mixed results were obtained for the later plantings under nonirrigated conditions.

Recommendations and guidelines for irrigation of peanuts have been developed by the Alabama Cooperative Extension Service and are presented in the Agricultural Engineering Series. These guidelines are based on results from a number of studies including this bulletin.

LITERATURE CITED

(1) ALABAMA CROP AND LIVESTOCK REPORTING SERVICE. January 1983.

(2) HAGAN, R.M. AND J.I. STEWART. 1972. Water Deficits - Irrigation Design and Programming. Journal of the Irrigation and Drainage Division. Proceedings of the American Society of Civil Engineers. 98(IR2):215-237.

(3) HILER, E.A. AND R.N. CLARK. 1971. Stress Day Index to Characterize Effects of Water Stress on Crop Yields. Trans. ASAE. 14(4):757-761.

(4) SALTER, P.J. AND J.E. GOODE. 1967. Crop Responses to Water at Different Stages of Growth. Commonwealth Agr. Bur., 246 pp.

(5) SHIPLEY, J. AND C. REIGER. 1970. Water Response in the Production of Irrigated Grain Sorghum, High Plains of Texas, 1969. Texas Agr. Exp. Sta. Prog. Rept. No. 2829.

(6) STANSELL, J.R., J.L. SHEPHERD, J.E. PALLAS, R.R. BRUCE, N.A. MINTON, D.K. BELL, AND L.W. MORGAN. 1976. Peanut Responses to Soil Water Variables in the Southeast. Peanut Science. 3(1):44-48.

(7) __________ . 1982. Personal Contact.

(8) WEETE, J.D., W.D. BRANCH, AND T.A. MCARDLE. 1979. Determining Peanut Harvest Dates in Alabama by the Arginine Maturity Index (AMI). Bull. 516. Ala. Agr. Exp. Sta., Auburn Univ.

APPENDIX

APPENDIX TABLE 1. PLANTING AND DIGGING DATES FOR PEANUT EXPERIMENT, WIREGRASS SUBSTATION

Year	Planting no.	Digging no.	Planting date	Digging date	Growing period
					Days
1976	-	-	May 11	Oct. 13	156
1977	-	1	Apr. 25	Sept. 19	148
		2	Apr. 25	Sept. 27	156
		3	Apr. 25	Oct. 12	167
1978	-	1	May 11	Sept. 27	139
		2	May 11	Oct. 6	148
		3	May 11	Oct. 23	165
1979	-	1	Apr. 23	Sept. 7	137
		2	Apr. 23	Sept. 20	150
		3	Apr. 23	Sept. 30	160
1980	1	1	May 7	Sept. 23	139
		2	May 7	Oct. 7	153
	2	1	June 3	Oct. 16	135
		2	June 3	Oct. 22	141
	3	1	June 18	Nov. 3	138
		2	June 18	Nov. 12	147
1981	1	1	May 8	Sept. 29	144
		2	May 8	Oct. 12	157
	2	1	June 5	Oct. 12	129
		2	June 5	Oct. 26	143
	3	1	June 18	Oct. 26	130
		2	June 18	Oct. 30	134

APPENDIX TABLE 2. YIELDS FROM PLANTING DATES AND ROW SPACINGS, FLORUNNER PEANUTS, ALL DIGGINGS, WIREGRASS SUBSTATION

Planting date	Growing days	Yield/acre			
		Irrigated @ 40cb		Nonirrigated	
		36-in. row	Twin 7	36-in. row	Twin 7
		Lb.	*Lb.*	*Lb.*	*Lb.*
1980					
5/7	139	4,450[b1]	4,990[a]	1,690[a]	1,950[a]
	153	3,980[a]	3,720[a]	2,090[b]	2,510[a]
6/3	135	4,190[b]	5,090[a]	2,050[a]	1,170[b]
	141	3,950[b]	4,520[a]	1,580[a]	1,500[a]
6/18	138	4,190[b]	4,690[a]	930	--
	147	4,110[a]	3,750[b]	--	670
1981					
5/8	144	3,920[a]	4,710[a]	4,040[a]	4,380[a]
	157	3,550[a]	4,250[a]	4,440[a]	4,720[a]
6/5	129	4,020[a]	4,080[a]	4,150[a]	4,510[a]
	143	4,470[a]	4,690[a]	4,310[a]	4,410[a]
6/18	130	3,770[a]	4,450[a]	3,920[a]	4,070[a]
	134	4,340[a]	4,500[a]	4,690[a]	4,380[a]

[1]Spacing means within irrigation classes with same letters are not different (P = 0.05).

APPENDIX TABLE 3. QUALITY OF FLORUNNER PEANUTS, WIREGASS SUBSTATION, 1980, 1981

Planting date	Growing period	Seed quality, SMK + SS			
		Irrigated @ 40cb		Nonirrigated	
		36-in. row	Twin 7	36-in. row	Twin 7
	Days	*Pct.*	*Pct.*	*Pct.*	*Pct.*
1980					
5/7	139	65[b1]	72[a]	73[a]	75[a]
	153	72[a]	72[a]	63[b]	68[a]
6/3	135	74[a]	76[a]	67[a]	64[a]
	141	77[a]	77[a]	71[a]	71[a]
6/18	138	(76[a])	(80[a])	(71)	(--)
	147	(77[a])	(78[a])	(--)	(75)
Av. row spacing		72[a2]	74[a]	69[a]	70[a]
Av. irrigation		73[a]		69[b]	
1981					
5/8	144	70[a]	68[a]	69[a]	68[a]
	157	71[a]	71[a]	73[a]	70[b]
6/5	129	72[a]	71[a]	72[a]	73[a]
	143	75[a]	77[a]	77[a]	77[a]
6/18	130	75[a]	73[a]	75[a]	77[a]
	134	75[a]	77[a]	77[a]	76[a]
Av. row spacing		73[a]	73[a]	74[a]	74[a]
Av. irrigation		73[b]		74[a]	

[1]Means within irrigation classes with same letters are not different (P = 0.05).
[2]Averages reported for 1980 include the first two plantings only and do not include numbers in parentheses.