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Irrigation of Soybean Varieties in Tennessee, 1962-1971

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FRONT COVER PHOTO: Left to right are Lee, Dorman, and Hill soybeans used in the experiment.

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INTRODUCTION

The Tennessee Crop Reporting Service reported 1,570,000 acres of soybeans harvested in Tennessee in 1973 with an average yield of 23.5 bushels per acre. In Tennessee soybeans are planted on soils having a wide range of characteristics, but little or none of the crop is irrigated.

A consideration of the high water requirement of soybeans, the expectation of dry periods during the growing seasons, and soil characteristics affecting available water holding capacity, suggests that supplemental irrigation will likely increase yields of soybeans.

Buntley (1) pointed out that producing a bushel of soybeans requires about 13,150 gallons of water at a 40-bushel-per-acre yield level. This is about 20 acre inches of water. Parks and Smith (11) reported a total water use of about 18 inches for a 32-bushel per acre yield of soybeans without irrigation. In this case, 1 acre inch of water produced about 1.7 bushels of soybeans. They showed an average daily use of 0.17 inches with a peak water use of twice this amount 6 to 10 weeks after planting.

Graves (5) determined that several adapted varieties planted in May and June at Jackson had a blooming period of 3 to 4 weeks during July and August with maturity in late September or October. Buntley (2) showed evapotranspiration often exceeded precipitation in Tennessee for periods during the soybean growing season, and found 12 and 14 bushels per acre lower yields in seasons when this occurred during flowering and pod-filling stages.

Fribourg (3) reported monthly mean precipitation at Jackson of 4.08, 4.46, and 3.28 inches for June, July, and August, respectively, totaling 11.82. He also reported that the probability of receiving 3 inches precipitation during a 4-week period was less than 60% in June and less than 50% in July and August. Van Bavel (15) calculated that at least 64 drouth days would occur in

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West Tennessee for 5 out of 10 years during the May-September period at a 2-inch soil moisture base, and that 2 out of 10 years at least 108 drouth days would occur. He also determined that at Memphis, for a 3-inch soil moisture base, as many as 15 drouth days could be expected in August 3 out of 4 years. Longwell, **et al.** (7) found that many silt loam soils in West Tennessee averaged 0.274 inches available water holding capacity per inch of soil depth or 3.28 inches per 12 inches of soil.

Parks, **et al.** (10) showed a significant soybean yield response to supplemental irrigation in 2 out of 3 years, reporting on part of the experiments completed in this publication.

Thompson and Brown (13) reported that irrigation significantly increased soybean yields on a rice soil in 3 years out of 4 for an average yearly increase of 7.5 bushels per acre.

Thompson and Caviness (14) reported that yield increases from irrigation on silt loams of Arkansas generally occurred in 6 or 7 years out of 10. They found much less frequent response on clay soils during the 1950's and early 1960's. In 1966-68 irrigation rather consistently increased yields on alluvial clay soils with varieties resistant to phytophthora rot.

Gerlow (4) reported average returns to land and management of $39 and $31 per acre for irrigated over non-irrigated soybeans in the Grand Prairie region of Arkansas.

Rogers (12) reported a 47% yield increase in 1 year of 3 at Auburn and a 46 and 50% yield increase in a 2-year experiment at Thorsby with the highest yield being 48 bushels per acre.

Grissom, **et al.** (6) reported yield increases of 6-10 bushels per acre from irrigation in the Yazoo-Mississippi Delta.

Mederski (8) of Ohio observed that varieties differ greatly in their capacity to withstand moisture stress. Under high moisture stress, stress-resistant varieties had yield reductions of about 20% compared to 40% for less stress resistant varieties. Yield reductions for all varieties ranged from 3 to 15 bushels per acre.

Nickell (9) emphasized applying water during pod-development and seed-filling stages and during dry periods in Kansas. If too much water was applied during the vegetative stage, lodging occurred. In 2 of 3 years a late-maturing strain produced highest yields with supplemental irrigation. Yields of 62.1, 74.0, and 80.3 bushels per acre were obtained in separate years.

EXPERIMENTAL PROCEDURE

Soybean varieties were grown in irrigation experiments at Jackson, Tennessee over a 10-year period, 1962-1971. The objectives were to determine the soybean yields at selected minimum moisture levels maintained throughout the growing season and to evaluate the relative response to irrigation of different soybean varieties, covering several maturity groups.

All experiments were conducted on a Memphis silt loam soil which is a well-drained upland soil developed from loess. It has a friable silt loam surface and a firm or friable silt loam to silty clay loam subsoil. The location at Jackson is a terrace phase of the series and is underlain by sand at about 5 feet. The soils of the Memphis series are productive and are widely used for row crops in Tennessee and adjoining states. Soil moisture data for the experimental site are shown in Table 1.

Table 1. Soil moisture data for Memphis silt loam, terrace phase, 0-2% slope at Jackson, Tennessee.

Soil depth	0-6 inches			6-12 inches			
Bulk density	1.33			1.38			
Moisture tension	Soil Moisture		Acre in. H_2O to reach F.C.	Soil Moisture		Acre in. H_2O to reach F.C.	Total acre in. H_2O for 0-12"
	Weight	Volume		Weight	Volume		
	%	%		%	%		
Field capacity	24.4	32.4	0	26.1	36.0	0	0
1 bar tension	14.0	18.6	0.83	20.4	28.1	.47	1.30
2 " "	9.0	12.0	1.22	16.7	23.0	.78	2.00
4 " "	7.5	10.0	1.34	14.1	19.5	.99	2.33
5 " "	6.5	8.6	1.43	12.8	17.7	1.10	2.53
7 " "	6.1	8.1	1.46	12.3	17.0	1.14	2.60
9 " "	5.5	7.3	1.51	10.9	15.0	1.26	2.77
12 " "	4.9	6.5	1.55	9.9	13.7	1.34	2.89
15 " "	4.6	6.1	1.58	9.6	13.3	1.36	2.94

A split-plot experimental design with three replications was used. Three levels of moisture or irrigation were used as main plots. These treatments were: no irrigation, irrigated at 5 bars tension, and irrigated at 2 bars tension. Irrigating Memphis soil at 2 and 5 bars tension means adding water when 67% and 87%, respectively, of the available water in the surface foot has been used. In each case, enough water was applied to bring the surface

foot of soil back to field capacity. Water was applied by furrow irrigation. The rainfall for June, July, and August, and the number, amounts, and dates of irrigation are shown in Table 2.

Table 2. Rainfall, number, amounts and dates of irrigations during soybean growing season, 1962-71.

Year	Rainfall June, July, August	Irrig. at 5 bars tension Applied 2.5 inches at each irrigation		Irrig. at 2 bars tension Applied 2.0 inches at each irrigation	
	Inches	Number	Dates	Number	Dates
1962	5.84	3	July 24 Aug. 17, 31	5	July 13, 30 Aug. 17, 24, 30
1963	7.00	2	Aug. 6, 23	4	July 24 Aug. 9, 15, 23
1964	17.13	0		2	Aug. 3, Sept. 14
1965	8.65	2	Aug. 18, Sept. 1	4	July 20 Aug. 3, 19, 30
1966	8.86	0		2	July 26, Sept. 6
1967	11.34	0		3	Aug. 17 Sept. 5, 20
1968	4.61	0		6	July 5, 22 Aug. 16, 27 Sept. 5
1969	8.94	0		4	July 7, 14, 22 Aug. 1
1970	10.94	0		3	July 13, 27 Aug. 20
1971	12.18	0		1	Aug. 2
Mean	11.82				

The split plots each year were varieties which contained three to four rows, 25 to 30 feet long. The 1962 to 1965 series included six varieties with three levels of moisture. These were mainly well-adapted varieties of Maturity Groups V and VI. From 1966 to 1971 ten varieties were included each year at two levels of moisture (no irrigation and irrigating at 2 bars tension). There were many changes in varieties during this period but Hill and Lee varieties were constant for the entire 10-year period.

Planting dates varied from May 6 to June 1, but in most years planting was about the third week in May. Planting was done on 6-inch high beds in 36-inch rows, with dams constructed across

the plot ends to prevent movement of water from one plot to another. Moisture data were obtained gravimetrically by periodic sampling at the 0 to 6-inch depth.

Fertilization the first year was 100 pounds per acre each of P_2O_5 and K_2O broadcast and disked into the soil. After this initial application, annual fertilization consisted of 200 to 300 pounds per acre of 0-20-20. Adequate pH levels were maintained and molybdenum was not used. Weed control included herbicides, cultivation, and hand weeding. Observations for maturity, height, lodging, shattering, seed quality, and purple stain were recorded. (See Appendix Table 2 for note-taking procedures.)

DISCUSSION OF RESULTS

The yield results and observations for each year are shown in Tables 3-6 and 8-13. The following discussion is mainly by periods in which varieties were common, with tables showing average yields and responses for those periods of years.

Results in 1962-1965: (Tables 3-7)

Table 3. Yields of irrigated soybean varieties, 1962*

Variety	No irrig.	Irrig. at 5 bars tension	Irrig. at 2 bars tension	Mean for varieties
		Bushels per acre		
Hill	19.9	36.8	41.4	32.7
Dorman	15.4	34.0	40.2	29.9
Hood	32.3	40.5	39.4	37.4
Ogden	26.5	40.0	48.5	38.3
Lee	36.6	44.0	46.9	42.5
Rebel	27.8	31.9	33.5	31.1
Mean for irrigation	26.4	37.9	41.7	....

L.S.D. (.05) between irrigation means 8.0; between variety means 3.9
(.01) between irrigation means 13.3; between variety means 5.3

*Planted May 14; frost October 24.

During this initial period six varieties were grown at three moisture levels. A significant response to irrigation was obtained in 1962, 1963, and 1965. In 1964, a small but nonsignificant increase of 3 bushels per acre was obtained from irrigation as adequate and well-distributed rainfall occurred.

In 1962, irrigating at 2 bars tension (67% available moisture used) required 10 inches of water applied in five irrigations and this produced a yield increase of 15 bushels per acre. In 1963 and 1965, this treatment required 8 inches of water in four irrigations and gave a 13-bushel-per-acre increase. Four inches of water were applied in two irrigations in 1964, but only a 3-bushel nonsignificant increase resulted. It was a relatively wet year with the June-July-August rainfall 5.5 inches above normal.

Table 4. Yields of irrigated soybean varieties, 1963*

Variety	No irrig.	Irrig. at 5 bars tension	Irrig. at 2 bars tension	Mean for varieties
		Bushels per acre		
Hill	27.5	31.4	41.2	33.4
Dorman	22.6	33.1	43.4	33.0
Hood	28.8	26.5	30.5	28.6
Ogden	14.2	28.9	35.6	26.3
Lee	27.5	31.2	37.3	31.9
Rebel	14.3	27.7	26.6	22.8
Mean for irrigation	22.5	29.8	35.8	....

L.S.D. (.05) between irrigation means 7.6; between variety means 5.5
(.01) between irrigation means N.S.; between variety means 7.5

*Planted May 21; frost October 29.

Table 5. Yields of irrigated soybean varieties, 1964*

Variety	No irrig.	Irrig. at 5 bars tension	Irrig. at 2 bars tension	Mean for varieties
		Bushels per acre		
Hill	39.6	38.6	42.6	40.3
Dorman	43.1	42.7	40.8	42.2
Hood	41.9	39.2	43.5	41.5
Ogden	32.5	36.5	40.6	36.5
Lee	34.9	28.9	38.8	34.2
Rebel	27.1	28.4	31.7	29.0
Mean for irrigation	36.5	35.7	39.7	....

L.S.D. (.05) between irrigation means N.S.; between variety means 5.3
(.01) between irrigation means N.S.; between variety means 7.2

*Planted May 29; frost October 20.

In 1962, the irrigating at 5 bars tension (87% available moisture used) required 7.5 inches of water in three applications and resulted in an 11-bushel-per-acre increase. In 1963, the same treatment required 5 inches of water applied in two irrigations and resulted in a 7-bushel-per-acre increase. No irrigation was required in 1964 for this treatment and yields were essentially the same as the unirrigated treatment. In 1965, this treatment required 5 inches of water in two applications and gave an increase of 12.5 bushels per acre.

A significant difference in yield among varieties was observed in each of the 4 years of the experiment. However, the average for the 4 years (Table 7) over all moisture levels indicated no

Table 6. Yields of irrigated soybean varieties, 1965*

Variety	No irrig.	Irrig. at 5 bars tension	Irrig. at 2 bars tension	Mean for varieties
		Bushels per acre		
Hill	29.4	44.4	44.6	39.5
Dorman	20.6	41.2	40.1	34.0
Hood	31.2	43.5	41.1	38.6
Ogden	24.8	39.2	41.0	35.0
Lee	35.0	42.7	45.0	40.9
Rebel	27.6	32.5	33.9	31.3
Mean for irrigation	28.1	40.6	41.0	....
L.S.D. (.05) between irrigation means 8.2; between variety means 3.7 (.01) between irrigation means N.S.; between variety means 4.9				

*Planted May 26; frost October 25.

Table 7. Average yields for six varieties at three moisture levels for 4 years, 1962-65

Variety	No irrig.	Irrig. at 5 bars tension	Irrig. at 2 bars tension	Mean for varieties
		Bushels per acre		
Hill	29.1	37.8	42.5	36.5
Dorman	25.4	37.8	41.1	34.8
Hood	33.6	37.4	38.6	36.5
Ogden	24.5	36.2	41.4	33.9
Lee	33.5	36.7	42.0	37.4
Rebel	24.2	30.1	31.4	28.6
Mean for irrigation	28.4	36.0	39.5	....
L.S.D. (.05) between irrigation means 2.8; between variety means 2.2 (.01) between irrigation means 3.8; between variety means 2.9				

great yield differences among the five recommended varieties of soybeans. However, the yield of the late-maturing, non-recommended Rebel beans was somewhat lower than that of the other five.

When the yield of beans without irrigation is considered, the varieties Lee and Hood yielded significantly more than the other varieties. The low yield of the Ogden beans in 1963 was attributed to the loss of beans through shattering before harvest.

Considering the yields obtained when high moisture levels (2 bars treatment) were maintained, there was no great difference among varieties Hill, Dorman, Hood, Ogden, or Lee. The yield of the Rebel variety with irrigation was lower than that of these five.

Average yield increases from irrigation (Table 7) were larger from the earlier-maturing varieties—Dorman and Hill—than from Hood and Lee at both irrigation levels. This was true in (total) bushels per acre and also in bushels per acre-inch of water added.

The total yield increases from the 5-bar treatment were not as large as from the 2-bar treatment—7.6 bushels per acre compared to 11.1. However, response per inch of water added was higher from the 5-bar treatment—giving a 1.7 bushels per acre inch increase compared to 1.5 bushels per acre for the 2-bar treatment.

Results in 1966 to 1971: (Tables 8-14)

Table 8. Yields of irrigated soybean varieties, 1966*

Variety	No irrig.	Irrig. at 2 bars tension	Mean for varieties
		Bushels per acre	
Patterson	40.6	40.5	40.5
Dare	32.6	41.0	36.8
Dyer	40.6	42.9	41.8
Hill	36.6	44.9	40.7
Davis	32.5	39.9	36.2
Hinn	33.8	40.6	37.2
Lee	33.1	41.5	37.2
Pickett	35.4	40.2	37.8
Semmes	36.3	36.8	36.6
Mean for irrig.	35.7	40.9	....

L.S.D. (.05) between irrig. means 3.2; between variety means 4.1
(.01) between irrig. means N.S.; between variety means N.S.

*Planted June 1; frost November 3.

Table 9. Yields of irrigated soybean varieties, 1967*

Variety	No irrig.	Irrig. at 2 bars tension	Mean for varieties
	Bushels per acre		
Custer	36.7	46.5	41.6
Dare	37.1	45.5	41.3
Dyer	38.7	45.7	42.2
Hill	36.5	43.6	40.1
Davis	33.8	44.9	39.3
Lee	33.1	44.1	38.6
Pickett	36.3	39.8	38.0
Semmes	31.2	36.4	33.8
Bragg	29.4	40.8	35.1
Mean for irrig.	34.8	43.0	....

L.S.D. (.05) between irrig. means N.S.; between variety means N.S.
(.01) between irrig. means N.S.; between variety means N.S.

*Planted May 22; frost November 4.

Table 10. Yields of irrigated soybean varieties, 1968*

Variety	No irrig.	Irrig. at 2 bars tension	Mean for varieties
	Bushels per acre		
Wayne	28.7	51.4	40.0
Custer	16.0	40.1	28.1
Kent	18.9	45.8	32.4
Dare	13.3	41.3	27.3
Hill	13.2	42.9	29.7
York	19.9	46.3	33.1
Lee	29.1	46.3	37.7
Lee 68	29.8	44.5	37.2
Pickett	29.3	43.6	36.5
Bragg	25.7	42.8	34.3
Mean for irrig.	22.4	44.5	....

L.S.D. (.05) between irrig. means 9.3; between variety means 5.0
(.01) between irrig. means 21.4; between variety means 6.6

*Planted May 24; frost October 29.

Table 11. Yields of irrigated soybean varieties, 1969*

Variety	No irrig.	Irrig. at 2 bars tension	Mean for varieties
		Bushels per acre	
Wayne	32.6	50.3	41.5
Custer	33.8	46.8	40.3
Kent	39.4	50.5	44.9
Dare	39.2	43.3	41.3
Hill	40.8	51.3	46.0
York	41.4	46.9	44.2
Lee	32.2	38.5	35.4
Lee 68	36.3	37.9	37.1
Pickett	36.8	39.3	38.1
Bragg	26.7	32.1	29.4
Mean for irrig.	35.9	43.7	....

L.S.D. (.05) between irrig. means 6.3; between moisture means 3.5
(.01) between irrig. means N.S.; between moisture means 4.6

*Planted May 6; frost October 28.

Table 12. Yields of irrigated soybean varieties, 1970*

Variety	No irrig.	Irrig. at 2 bars tension	Mean for varieties
		Bushels per acre	
Dare	42.2	47.9	45.0
Dyer	37.9	45.0	41.4
Hill	38.3	46.1	42.2
Mack	44.9	50.8	47.9
York	42.5	47.9	45.2
Hood	39.0	45.0	42.0
Lee	38.2	39.9	39.1
Lee 68	36.8	41.3	39.1
Pickett	35.7	38.9	37.3
Pickett 71	37.9	42.1	40.0
Mean for irrig.	39.4	44.5	....

L.S.D. (.05) between irrig. means N.S.; between variety means 4.9
(.01) between irrig means N.S.; between variety means 6.5

*Planted May 13; frost November 16.

Table 13. Yields of irrigated soybean varieties, 1971*

Variety	No irrig.	Irrig. at 2 bars tension	Mean for varieties
		Bushels per acre	
Dare	44.2	39.7	42.0
Dyer	43.1	39.6	41.4
Hill	38.9	39.5	39.2
Mack	49.0	48.3	48.7
York	47.0	49.6	48.3
Hood	41.4	39.1	40.2
Lee	36.8	38.3	37.8
Lee 68	39.5	37.9	38.7
Pickett	35.2	34.8	35.0
Pickett 71	35.9	36.3	36.1
Mean for irrig.	41.1	40.4	....

L.S.D. (.05) between irrig. means N.S.; between variety means 5.3
(.01) between irrig. means N.S.; between variety means 7.2

*Planted May 18; frost November 4.

In this 6-year period, only two moisture levels were maintained—irrigating at 2 bars tension and no irrigation. Varietal entries varied during this period and some entries were included for only 2 or 3 years. The results are shown by separate years in Tables 8-13. In 3 of the 6 years, rainfall was above normal during June, July, and August and responses to irrigation were not significant. In 2 years, increases were statistically significant, when precipitation was slightly below normal. In 1968, precipitation was very low; 12 inches of water was applied with an average increase for all varieties of 22.4 bushels per acre, and 29.7 bushels per acre for the Hill variety. Pickett 71 performed much like Pickett, and Lee 68 performed much like Lee in those years when both were included.

Yield differences among adapted varieties were not large without irrigation, but increased when high-moisture levels were maintained. Hill responded more than later-maturing varieties with a yield increase of 3.9 to 29.7 bushels per acre over the last 6 years (Table 14). There was a distinct pattern for earlier-maturing varieties to show larger increases per acre and higher returns per inch of water applied. This is well illustrated in Table

Table 14. Yields of soybeans varieties by maturity groups as affected by irrigation, 1962-71*

Maturity group	Variety	Irrig.	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	Average
III	Wayne	0							28.7	32.6			30.7 (2)**
40.8		+							51.4	50.3			50.9 (2)
								Bushels per acre					
IV	Custer	0						36.7	16.0	33.8			28.8 (3)
38.0		+						46.5	40.1	46.8			44.5 (3)
	Kent	0							18.9	39.4			29.2 (2)
		+							45.8	50.5			48.2 (2)
	Patterson	0					40.6						40.6 (1)
		+					40.5						40.5 (1)
Mean for no irrigation							40.6	36.7	17.5	36.6			30.9
Mean for irrigation							40.5	46.5	43.0	48.7			45.1
Yield change from irrigation							−0.1	+9.8	+25.5	+12.1			+14.2
V	Dare	0					32.6	37.1	13.3	39.2	40.6	42.5	34.2 (6)
39.3		+					41.0	45.5	41.3	43.3	47.9	39.7	43.1 (6)
	Dyer	0					40.6	38.7			36.1	44.2	39.9 (4)
		+					42.9	45.7			45.0	39.6	43.3 (4)
	Mack	0									43.7	48.0	45.9 (2)
		+									50.8	48.3	49.6 (2)
	York	0							19.9	41.4	45.0	46.7	38.3 (4)
		+							46.3	46.9	47.9	49.6	47.7 (4)
	Hill	0	19.9	27.5	39.6	29.4	36.6	36.5	13.2	40.8	34.5	38.9	31.7 (10)
		+	41.4	41.2	42.6	44.6	44.9	43.6	42.9	51.3	46.1	42.8	44.1 (10)
	Dorman	0	15.4	22.6	43.1	20.6							25.4 (4)
		+	40.2	43.4	40.8	40.1							41.1 (4)
Mean for no irrigation			17.7	25.1	41.4	25.0	36.6	37.4	15.5	40.5	40.0	44.1	34.3
Mean for irrigation			40.8	42.3	41.7	42.4	42.9	44.9	43.5	47.2	47.5	44.0	44.2
Yield change from irrigation			+23.1	+17.2	+0.3	+17.4	+6.3	+7.5	+28.0	+6.7	+7.5	−0.1	+9.9
	Number		5	4	2	4	2	3	6	4	3	1	3.4
	Inches		10	8	4	8	4	6	12	8	6	2	6.8

Table 14. Yields of soybeans varieties by maturity groups as affected by irrigation, 1962-71* (continued).

Maturity group	Variety	Irrig.	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	Average
			Bushels per acre										
VI 37.2	Davis	0					32.5	33.8					33.2 (2)
		+					39.9	44.9					42.4 (2)
	Hinn	0					33.8						33.8 (1)
		+					40.6						40.6 (1)
	Hood	0	32.3	28.8	41.9	31.2					32.5	40.3	34.5 (6)
		+	39.4	30.5	43.5	41.1					45.0	39.1	39.8 (6)
	Lee	0	36.6	27.5	34.9	35.0	33.1	33.1	29.1	32.2	32.7	41.1	33.5 (10)
		+	46.9	37.3	38.8	45.0	41.5	44.1	46.3	38.5	39.9	38.8	41.7 (10)
	Lee 68	0							29.8	36.3	36.3	29.3	32.9 (4)
		+							44.5	37.9	41.3	37.9	40.4 (4)
	Pickett	0					35.4	36.3	29.3	36.8	35.5	32.9	34.4 (6)
		+					40.2	39.8	43.6	39.3	38.9	34.8	39.4 (6)
	Pickett 71	0									34.5	39.3	36.9 (2)
		+									42.1	36.3	39.2 (2)
	Semmes	0					36.3	42.2					39.3 (2)
		+					36.8	36.4					36.6 (2)
	Ogden	0	26.5	14.2	32.5	24.8							24.5 (4)
		+	48.5	35.6	40.6	41.0							41.4 (4)
Mean for no irrigation			31.8	23.5	36.4	30.3	34.2	37.5	29.4	35.1	34.3	36.6	33.8
Mean for irrigation			44.9	34.5	41.0	42.4	39.8	42.4	44.8	38.6	41.4	37.4	40.5
Yield change from irrigation			+13.1	+11.0	+ 4.6	+12.1	+5.6	+4.9	+15.4	+3.5	+7.1	+0.8	+6.7
VII 30.1	Bragg	0						29.4	25.7	26.7			27.3 (3)
		+						40.8	42.8	32.1			38.6 (3)
	Rebel	0	27.8	14.3	27.1	27.6							24.2 (4)
		+	33.5	27.7	31.7	33.9							31.7 (4)
Yield change from irrigation			+5.7	+13.4	+4.6	+6.3		+11.4	+17.1	+5.4			+9.2

*Irrigations were applied when soil moisture level at 6 inches reached 2 bars tension.

**Number of years tested.

14 where the average variety response from irrigation for maturity groups IV, V, and VI was 14.2, 9.9, and 6.7 bushels per acre, respectively. This point may be partly explained by a shorter fruiting period for early varieties in which moisture is critical. With a longer fruiting period as characteristic of the later-maturing varieties, a greater utilization of natural precipitation over a longer period is made and the magnitude of the effects of short drouth periods on yields is not as great.

The overall performance of all varieties for the 10-year period is shown in Table 14. In 4 years during June, July, and August, precipitation was near or above normal. In these years 2 to 6 inches of water was applied, but yield increases were not significant. In some cases rain came soon after irrigation. In the other 6 years significant increases were made ranging from 6.1 to 22.1 bushels per acre. The greatest increase was in 1968 when 12 inches of water gave yield increases ranging from 15 to almost 30 bushels per acre depending upon the variety. Bushel increases per inch of water were up to 1.9 and averaged 1.4 for all years and 1.5 for the 6 years when yields were significantly increased. For the 10 years, an average of 6.8 inches water was required to maintain the 2-bar tension.

Performance of the Hill and Lee varieties—which were the only two varieties included in all tests—is shown in Table 14. For the 10-year period, Hill was more responsive with an average increase of 12.4 bushels per acre compared to 8.2 for Lee. On a basis of water applied, Hill averaged 1.8 bu. per inch to 1.2 for Lee. The greatest increases were in 1968—17.2 bushels for Lee and 29.7 for Hill. In that year, Hill returned an increase of 2.5 bushels for each inch of irrigated water. The greatest response by Lee was in 1967 with 11 bushels per acre or 1.8 bushels per inch of water applied. Without irrigation, the 10-year average for Hill was 31.7 bushels compared to 33.5 bushels for Lee. With irrigation, Hill averaged 44.1 bushels per acre to 41.7 for Lee.

The greater response of earlier-maturing varieties suggests planning to plant varieties of maturity group V on soils of higher moisture holding capacity. The results also show that on soils of lower water holding capacity, planting toybeans of a later Maturity Group (Group VI) would be more profitable over time.

SUMMARY

For the 10-year period, average yield increases in response to irrigation were 9.3 bushels per acre for all soybean varieties, 12.4 for Hill and 8.2 for Lee. These are increases respectively of 1.4, 1.8, and 1.2 bushels per acre inch of added water. In the 4 years compared, maintaining the higher moisture level (2-bar treatment) resulted in some higher yields than the intermediate moisture level treatment, but response per inch of water was slightly lower.

Significant yield responses to the 2-bar irrigation treatment were obtained in 6 out of 10 years when June, July, and August precipitation was below normal. The greatest increase was 29.7 bushels per acre for the Hill variety in 1968.

The 2-bar irrigation treatment required an average of 8 inches of water in these 6 years with an average increase of 10 bushels per acre for the Lee variety, 16 bushels for the Hill variety, and 13 bushels overall average increase for all varieties. These are, respectively, 1.25, 2.0, and 1.62 bushels per acre increase per inch of water applied.

There was a definite trend for earlier-maturing varieties to be more responsive to irrigation. Varieties such as Hill and York of Group V were more responsive than Lee and Pickett of Group VI. However, at a given moisture tension yields among varieties were not greatly different. Results suggest planting varieties of Maturity Group V on soils of greater moisture supply where two maturity groups are grown to spread harvest dates. This also has a management advantage in harvesting before soil is too soft due to fall rains. Varieties from Maturity Group VI should be selected for soils of lower moisture supplying capacity where periods of moisture stress may be expected.

Data on the effect of irrigation on maturity date of the soybeans was also obtained in these experiments. Maturity in soybeans may be defined as the date when the pods are dry and most of the leaves have dropped and under most conditions the stems are also dry. Maturity dates for unirrigated and 2-bar tension irrigation treatment are shown in Table 15. These data indicate that maturity dates of soybeans in Maturity Group VI were delayed little if any by irrigation. Irrigated soybeans in Maturity Group V matured several days later than unirrigated soybeans.

In 1962 and 1968 when the most irrigations were applied, maturity was delayed 10 days for the Hill variety.

Characteristics other than yield were also affected by irrigation, as lodging was increased—often dramatically and suddenly; seed quality was generally improved; and shattering was decreased.

Table 15. Maturity dates for soybeans not irrigated and irrigated at 2 bars tension, 1962-71

Year	1962	1963	1964	1966	1967	1968	1969	1970	1971
Planting date	**May 14**	**May 21**	**May 29**	**June 1**	**May 22**	**May 24**	**May 6**	**May 13**	**May 18**
Number of irrigations	**5**	**4**	**2**	**2**	**3**	**6**	**4**	**3**	**1**
Varieties									
MATURITY GROUP III									
Wayne						Aug. 28*	Sept. 7		
						Sept. 4	Sept. 7		
MATURITY GROUP IV									
Custer					Sept. 15	Sept. 10	Oct. 23		
					Sept. 15	Sept. 20	Sept. 21		
Kent						Sept. 12	Oct. 2		
						Sept. 18	Sept. 27		
Patterson				Sept. 15					
				Sept. 15					
MATURITY GROUP V									
Dare				Oct. 15	Oct. 6	Oct. 10	Oct. 3	Oct. 6	Oct. 8
				Oct. 15	Oct. 9	Oct. 18	Oct. 9	Oct. 9	Oct. 8
Dyer				Oct. 15	Oct. 2			Oct. 2	Oct. 3
				Oct. 15	Oct. 6			Oct. 12	Oct. 4
Mack								Oct. 7	Oct. 4
								Oct. 10	Oct. 6
York						Sept. 30	Oct. 4	Oct. 9	Oct. 6
						Oct. 22	Oct. 5	Oct. 12	Oct. 6
Hill	Sept. 26	Sept. 22	Sept. 22	Sept. 30	Sept. 26	Sept. 20	Sept. 22	Sept. 20	Sept. 27
	Oct. 6	Sept. 25	Sept. 22	Sept. 30	Oct. 4	Oct. 1	Sept. 22	Sept. 29	Sept. 27
Dorman	Sept. 20	Sept. 20	Sept. 26						
	Sept. 30	Sept. 27	Sept. 26						

Table 15. Maturity dates for soybeans not irrigated and irrigated at 2 bars tension, 1962-71 (continued)

Year	1962	1963	1964	1966	1967	1968	1969	1970	1971
Planting date	May 14	May 21	May 29	June 1	May 22	May 24	May 6	May 13	May 18
Number of irrigations	5	4	2	2	3	6	4	3	1
MATURITY GROUP VI									
Davis				Nov. 3	Oct. 23				
				Nov. 3	Oct. 26				
Hinn				Oct. 27					
				Oct. 27					
Hood	Oct. 17	Oct. 2	Oct. 15					Oct. 17	Oct. 10
	Oct. 15	Oct. 8	Oct. 20					Oct. 16	Oct. 10
Lee	Oct. 20	Oct. 13	Oct. 26	Oct. 29	Oct. 24	Nov. 13	Oct. 20	Oct. 22	Oct. 18
	Oct. 21	Oct. 13	Oct. 26	Oct. 29	Oct. 24	Nov. 4	Oct. 18	Oct. 20	Oct. 19
Lee 68						Nov. 13	Oct. 21	Oct. 19	Oct. 20
						Nov. 4	Oct. 20	Oct. 21	Oct. 21
Pickett				Nov. 3	Oct. 24	Nov. 13	Oct. 23	Oct. 23	Oct. 19
				Nov. 3	Nov. 4	Nov. 13	Oct. 22	Oct. 23	Oct. 19
Pickett 71								Oct. 24	Oct. 19
								Oct. 22	Oct. 19
Semmes				Frost	Frost				
Ogden	Oct. 17	Oct. 6	Oct. 18						
	Oct. 13	Oct. 9	Oct. 24						
MATURITY GROUP VII									
Bragg						Nov. 13	Oct. 30		
					Frost	Nov. 4	Oct. 30		
Rebel		Oct. 25							
	Frost	Oct. 25	Frost						

*No irrigation—upper value. Irrigated at 2 bars tension—lower value.

No data obtained in 1965.

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