IRRIGATION TO INCREASE SWEET POTATO PRODUCTION

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Irrigation to supplement rainfall is necessary in most years to obtain best yields of horticultural crops. If adequate soil moisture to meet the needs of sweet potatoes or other crops is not provided, many of the recommended practices, such as better seed selection, use of improved varieties, proper fertilization and others are of little economical advantage.

The value of irrigation water to increase sweet potato yields has been reported by several research workers Hernandez *et al* (1956) and (1965) Jones (1961), Lambeth (1956), Peterson (1961), Ware and Johnson (1958).

Irrigation studies were conducted on a Richland silt loam soil at the Sweet Potato Research Center, Chase, Louisiana for several years to determine the effects of supplemental irrigation on sweet potato production.

MATERIALS AND METHODS

The irrigation water to the test plots was applied either as a furrow application or with a sprinkler system. The Richland silt loam soil used had an infiltration rate of 0.5 inch of water per hour. The sprinkler system was designed to irrigate 40 acres in a 10-day period when irrigating 10 hours per day, and applying 2.5 inches of water for each setting of 2 acres. A total of 720 feet of lateral 4-inch lines with 36 sprinkler nozzles was needed to cover 2 acres. Each nozzle delivered 12.5 gallons per minute and the nozzles were spaced 40 feet x 60 feet apart. There were 700 feet of 5-inch main water line. Part of this system or furrow irrigation was used to irrigate the experimental plots.

The physical analysis of this silt loam soil showed that the field capacity was 19.5 percent on an oven-dry weight basis and the wilting point was 6.5 percent. Since the water held in the soil between the field capacity and the wilting point is available to the plant, this is usually called "available water". In this case the available water amounted to 13.0 percent.

In these experiments the soil moisture samples were obtained in the topsoil, the upper 10-inch layer of soil, and in the subsoil, the 10 to 18-inch layer of soil. The soil moisture on all of the samples was determined in duplicate on an oven-dry weight basis.

The temperature and relative humidity were continuously recorded on a hygrothermograph.

Four sweet potato varieties were used over a 6-year period. Randomized block experimental design was used in 1953-56. A rate of 600 pounds of 6-12-6 per acre was used in all experiments.

In 1964 and 1965 a split plot design was used to study levels of soil moisture x rate of nitrogen. The irrigation levels were as follows : check (natural rainfall); soil above 25 percent moisture ; and soil above 50 percent moisture. The main plots were irrigated treatments and nitrogen levels of 0, 30, 60 and 90 pounds per acre were the sub-plots. Sixty pounds of each P_2O_5 and K_2O were applied to all plots.

Rainfall in inches at Chase in 1964 was as follows : June 1.49 ; July 3.80 ; August 3.03 ; September 3.84 and October 1.00. In 1965 rainfall in inches was as follows : June 1.15 ; July 0.86 ; August 3.86 and September 6.59. *Centennial* variety was used in 1964 and 1965.

RESULTS AND DISCUSSION

The 4-year monthly rainfall for the major portion of each growing season at Chase and for each year at Winnsboro (5 miles north of Chase) is shown in Table 1. The rainfall shown for Chase was recorded approximately 1/16 mile from the test plots.

Table 1. Rainfall in inches for 4 years (1950 through 1956)

	1953		1954		1955		1956	
Month	Chase	Winns-boro	Chase	Winns-boro	Chase	Winns-boro	Chase	Winns-boro
Jan.		3.94		4.96		5.65		2.21
Feb.		6.82		1.94		7.27		10.57
March	—	7.01	—	3.14	—	2.27		4.57
April	7.00	6.69	9.65	4.02	6.40	6.36	4.09	4.66
May	15.00	16.38	6.85	10.04	7.26	8.59	4.19	3.88
June	0.00	0.63	0.72	1.83	3.76	9.81	2.42	1.94
July	2.50	2.18	1.30	4.67	6.38	9.80	3.24	2.86
Aug.	1.80	1.06	0.90	1.26	1.62	1.90	5.00	5.83
Sept.	0.60	0.73	1.55	1.81	2.86	2.06	1.08	0.79
Oct.	0.92	0.92	1.61	1.61	1.00	1.00	1.86	1.93
Nov.		1.67		1.51		4.53		1.96
Dec.		8.38		2.89		2.80		9.24
Annual Rainfall	—	56.41	—	39.68		62.34		50.44

There was unequal distribution of rain within and between years. The months showing the lowest average rainfall were June, August, September, and October. Rainfall in general was highest in the early part of the growing season when water requirement of the plants was lowest.

Two irrigation tests were conducted in 1953. *Earlyport* variety was used in the first test and *Goldrush* and *Earlyport* in the second.

There was an unusually large amount of rainfall in 1953 in May ; none in June ; and little in August through October (Table 1).

The first test was watered with approximately 1.5 inches of water per irrigation on June 17, July 7 and August 3. At the period that *Earlyport* was beginning to set storage roots, the soil in the non-irrigated plots was very low in moisture. There were practically no roots set in the non-irrigated plots, while in the irrigated plots there was a good set of sweet potato roots. The irrigated plots produced 234 bushels of marketable sweet potatoes per acre as compared with 10 bushels per acre for the non-irrigated plots (Table 2). There was an increase in yield of 49.8 bushels for each acre-inch of irrigation water applied in this early test.

In the second test using *Goldrush* variety, the irrigated plots produced 146 bushels per acre as compared with 80 bushels for the non-irrigated plots. The irrigated plots received approximately 1½ inches of water per irrigation on July 3 and 10, and on August 7 and 17. *Earlyport* produced 158.1 bushels per acre on the irrigated plots as compared with 95.8 bushels on the non-irrigated plots. It produced an average increase in yield of 10.4 bushels for each acre-inch of water applied.

In 1954 two irrigation tests were conducted. All of the plots had the same soil moisture content at planting time. The first irrigation was given on June 17.

As shown in Table 1, the rainfall at Chase was low in June, July, August, September and October, 1964. In the non-irrigated plots the soil moisture dropped below 20 percent available moisture and by July 20 it had declined to 5 percent, and it remained below that for most of the season. The irrigated plots were given six irrigations using 1.5 to 2 inches of water per irrigation. In the irrigated plots the soil remained above 30 percent available water and rose to approximately 82 to 100 percent available moisture immediately after each irrigation. The irrigated plots produced 386.0 bushels of sweet potatoes per acre as compared with 70.2 bushels on the non-irrigated plots (Table 2). There was an increase in yield of 28.7 bushels for each acre-inch of irrigation water applied in this test.

In the second test with *Goldrush* in 1964, the irrigated plots produced 274.9 bushels of marketable roots compared with 110.2 bushels for the non-irrigated plots (Table 2).

Table 2. Effects of Irrigation on the Yield of Sweet Potatoes

Variety	Planted	Harvested	Irrigated	Non-Irrigated	Irri/Non-Irri.
Earlyport	4/23/53	8/24/53	234.0	10.0	224.0
Goldrush	6/18/53	8/ 8/53	146.0	80.0	66.0
Earlyport	6/18/53	8/ 8/53	158.1	95.8	62.3
Goldrush	5/27/54	9/21/54	386.0	70.2	315.8
Goldrush	6/18/54	10/8/54	274.9	110.2	164.7
Goldrush	6/ 6/55	10/18/55	345.6	283.5	62.1
Unit I. P. R.	5/ 7/56	10/14/56	359.0	175.6	183.4
		Average	271.9	117.9	154.0*

**Significant at .01 percent level.*

In 1955 there were frequent rains from June through the middle of August. The soil moisture for this period remained mostly above 50 percent available.

However, little rain fell in late August, September and October, and topsoil dropped below 12 percent available moisture after mid-August and declined sharply thereafter. The irrigated plots were watered on August 19 and September 8 with approximately 1.5 inches per irrigation. The irrigated plots produced 345.6 bushels of marketable sweet potatoes per acre compared with 283.5 bushels for the non-irrigated plots.

In 1956 there were frequent light showers throughout the growing season which caused sharp rises in soil moisture ; however, the effects of these light rains were of short duration. There was low rainfall in June and July and especially in September and October (Table 1). The irrigated plots were watered four times. The irrigated plots produced 359.0 bushels per acre compared with 175.6 bushels for the non-irrigated plots. There was an increase of 17.5 bushels per acre-inch of irrigation water used.

The yield data for the different soil moisture levels are shown for 1964 in Table 3 and for 1965 in Table 4.

Table 3. Effect of Different Soil Moisture Levels on Yield in bushels per acre of Sweet Potatoes in 1964

Treatment	U.S. No. 1	U.S. No. 2	Culls	Jumbos	Total
Check (Natural Rainfall)	196	60	12	18	286
Above 25% Moisture	205	72	15	33	325
Above 50% Moisture	234	88	16	62	400
lsd @ .05	ns	ns	ns	11	71

Table 4. Effect of Different Soil Moisture Levels on Yield in bushels per acre of Sweet Potatoes in 1965

Treatment	U.S. No. 1	U.S. No. 2	Culls	Total
Check (Natural Rainfall)	174	81	22	277
Above 25% Moisture	248	79	26	353
Above 50% Moisture	250	106	33	389
lsd @ .05	70	ns	ns	86

As shown in Tables 3 and 4, the yields from irrigation treatments were significantly higher for total yield in 1964 and for yield of U.S. No. 1 roots and total in 1965.

The data for levels of nitrogen are shown in Tables 5 and 6.

Table 5. Effect of Different Nitrogen Levels on Yield in bushels per acre of Sweet Potatoes in 1964

Treatment Lbs. per Acre	U.S. No. 1	U.S. No. 2	Culls	Jumbos	Total
0 Nitrogen	247	85	14	30	376
30 Nitrogen	208	76	15	51	350
60 Nitrogen	224	76	13	40	353
90 Nitrogen	167	56	15	30	268
lsd @ .05	57	25	ns	ns	71

Table 6. Effect of Different Nitrogen Levels on Yield in bushels per acre of Sweet Potatoes in 1965

Treatment Lbs. per Acre	U.S. No. 1	U.S. No. 2	Culls	Total
0 Nitrogen	259	112	26	397
30 Nitrogen	248	86	25	359
60 Nitrogen	210	78	27	315
90 Nitrogen	178	78	30	286
lsd @ .05	58	ns	ns	72

The silt loam soil used showed no response to levels of nitrogen.

SUMMARY

The water requirement for high fleshy root production varied during any growing season. Usually sweet potato transplants have little or no feed (or fibrous) roots at the time of planting. If the soil contains available soil moisture with soil temperature above 70°F in the top soil where the feed roots develop first, the root system grows rapidly, whereas, if the soil moisture is very low, the roots develop poorly.

Sweet potatoes required an average of 0.10 acre-inch per day in the early part of the growing season. This gradually increased to as much as 0.25 acre-inch of water in midsummer, depending on stage of plant growth, temperature, humidity, wind, and other environmental factors.

High soil moisture levels over a period of several days, 40 to 50 days after transplanting – especially with good fertility, can cause sweet potato plants to become excessively vegetative at the expense of storage root formation and growth.

Drought approximately 40 days after transplanting of sweet potatoes, allowing the soil to drop much below 20 percent available moisture for a few weeks before fleshy root set, caused great reduction in yield. Also droughts in the latter part of the growing season will slow down fleshy root growth and reduce yields of marketable roots.

The use of irrigation water in 1953-1956 produced an average increase of 154 bushels of marketable sweet potato roots per acre or an increase of approximately 23 bushels for each acre-inch of irrigation water used.

Supplemental irrigation significantly increased sweet potato yields in 1964 and 1965. However, there was no response of sweet potato to nitrogen levels used.

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