SOME EFFECTS OF IRRIGATION AND SOIL COMPACTION ON POTATOES[1]

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Total annual precipitation in Maine is usually sufficient for high potato yields. There are years, however, when the distribution of rainfall during the growing season is such that drought conditions prevail. Consequently, some potato farmers in central and southern Maine are using supplemental irrigation, particularly on droughty soils. Studies were initiated in 1956 to determine the extent of benefit from supplemental irrigation on potato yields.

From 1959 to 1962 a separate study was conducted on the effect of sprayer traffic on soil compaction and potato yields.

Increases in yield due to irrigation were shown by Blake et al. (1), Brill et al. (4), Bradley and Pratt (2), Fulton and Murwin (6) and Jacobs et al. (8). Fulton and Murwin (6) concluded that the increase in yield resulting from irrigation is due to an increase in tuber size rather than an increase in the numbers of tubers. Taylor and Rognerud (11) found that irrigation before and during tuber iniation gave an increase in the number of tubers formed. Blake et al. (1) in New Jersey reported yield increases of from 5 to 191%. Pullen and Schrumpf (10) showed an increase in yield from irrigation on six farms in Maine. They indicate that the potato plant may need 1 inch of water per week during the growing season. From 1936-1955 weather records, they found that about 70% of the time less than 1 inch per week of rainfall can be expected.

Decreases in potato yield in rows where sprayer traffic occurs have been reported in the past (4, 7). Hardenburg (7) found that potato yields decreased from 10 to 50% because of sprayer damage. This yield reduction varied with the potato variety, with the Katahdin showing the greatest yield reduction. He attribued this reduction of yield to vine injury. Bushnell (5) suggested that insufficient porosity resulting from compaction was the principal factor in limiting yield on a Wooster silt loam. Jacobs and Russell (9) and Brasher (3) also indicated that loosening of the soil following traffic increased potato yields.

IRRIGATION STUDY

The irrigation experiment was conducted on a Melrose sandy loam at Old Town, Maine. Katahdin potatoes were planted in rows 36 inches apart with 9-inch seed piece spacing. An 8-12-12 fertilizer was applied at a rate of 1800 pounds per acre. The treatments were replicated four times. Water was applied to the irrigated plots when the available water in the soil dropped to 50% as measured with gypsum blocks. Soil moisture was measured twice a week with the blocks at a 6-inch depth prior to

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hilling. Table 1 summarizes the precipitation, time of planting and harvesting, and irrigation amounts and dates.

Table 2 shows the effect of water application on the yield of potatoes, number of tubers and specific gravity. A significant increase in yield resulted from irrigation in three years out of four. The irrigation treatments also resulted in a significant increase in the number of tubers produced for these years. There were no significant differences in specific gravity between the treatments.

TABLE 1.—*Precipitation, time of planting and harvesting, and irrigation amounts and dates, Old Town, Maine.*

Year	Precipitation—inches					Planting date	Harvest date	Irrigation	
	May	June	July	Aug.	Sept.			Date	Inches
1956	2.63	1.38	1.83	1.85	2.77	May 26	Sept. 20	July 23 Aug. 1 Aug. 14	1.0 1.5 1.0
1957	2.56	2.75	3.44	1.33	2.70	May 28	Sept. 28	June 24 July 9 Aug. 12	1.0 1.0 1.25
1959	0.63	6.96	2.99	5.22	2.76	May 22	Sept. 14	July 15 Sept. 7	1.0 0.75
1960	3.37	2.51	2.60	0.89	4.05	May 7	Sept. 15	July 1 July 20 Aug. 4 Sept. 2	1.5 2.0 0.75 1.0

TABLE 2.—*Yield of potatoes and tuber numbers as influenced by water application, Old Town, Maine.*

Year	Yield of potatoes		Number of tubers		Specific gravity	
	Irrigated	Non-irrigated	Irrigated	Non-irrigated	Irrigated	Non-irrigated
	Bu/Acre	Bu/Acre	No./Acre	No./Acre		
1956	502.2	372.2**	130,116	93,776**	1.072	1.074
1957	538.8	395.1**	89,390	62,080**	1.073	1.075
1959	410.0	365.0	72,116	65,340	1.060	1.062
1960	437.2	326.5**	64,733	50,215**	1.078	1.082

**Increase from irrigation significant at the 1% level.

Total rainfall for the 1960 growing season was 11.72 inches. The greatest deficit in soil moisture occurred from July 19 to September 6. Rainfall during that period amounted to 2.28 inches, of which only 0.89 inch fell in August. In 1959, rainfall distribution was adequate for the entire growing season, providing a total of 17.67 inches. This adequacy of rainfall probably accounts for the small difference in yield and number of tubers between the irrigation and nonirrigation treatments. Rainfall during the growing seasons of 1956 and 1957 was 7.85 and 12.65 inches, respectively, with extensive drought periods. The soil moisture regime for

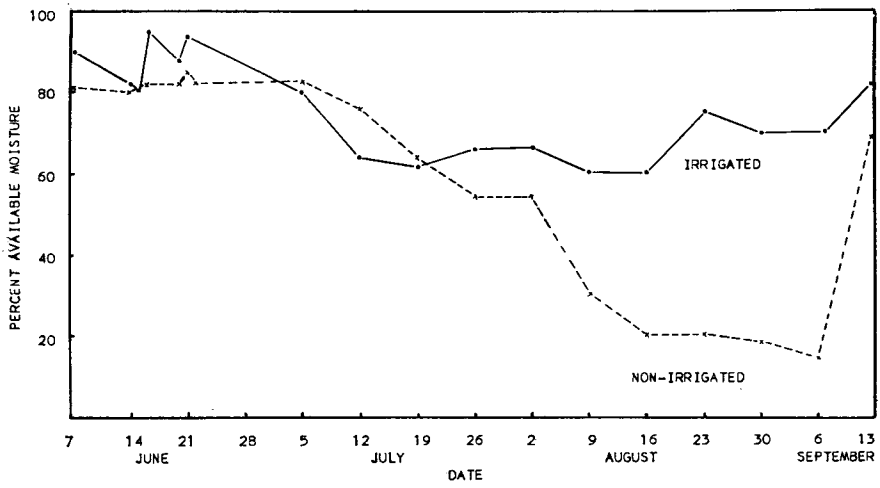

FIG. 1.—Soil moisture regime under irrigated and non-irrigated conditions, Orono, Maine. 1960.

1960 (Fig. 1) exemplifies the type of data collected for the years 1956, 1957 and 1959.

COMPACTION STUDY

The compaction experiment was initiated in 1959 on a Caribou loam soil at Presque Isle, Maine. The plots were four rows wide, two of which were subjected to simulated sprayer traffic. These plots were planted to Katahdin potatoes up-and-down-hill on an 8% slope. Compaction measurements were made with an impact penetrometer in the rows by recording the number of times an 8-lb weight was dropped on to a probe, a distance of 12 inches, until the probe penetrated 6 inches into the soil. The ease of penetration indicated the extent of compaction (Fig. 2). Vine damage was reduced by the use of specially constructed vine lifters. Yields were obtained from 9 plots in a continuous cropping system.

Potato yields as affected by tractor traffic are shown in Table 3. For the four years, yield differences were statistically significant for areas between rows where tractor traffic or no-traffic occurred. The average reduction in yield for the traffic rows was 31, 8, 14 and 14% for 1959, 1960, 1961 and 1962, respectively. Since 4 of 10 rows are affected by average sprayer traffic, yield reduction occurs on about 40% of the acreage.

Fig. 2 shows the difference in compaction between the traffic and no-traffic rows as measured with an impact penetrometer during 1961. Compaction was higher in the traffic rows throughout the entire season. Similar curves were obtained for 1959 and 1960.

The reduction in yield due to tractor traffic in potato rows may be a result of direct vine damage to the plants or to a change in the soil condition making it unfavorable for root growth. Studies at the Maine

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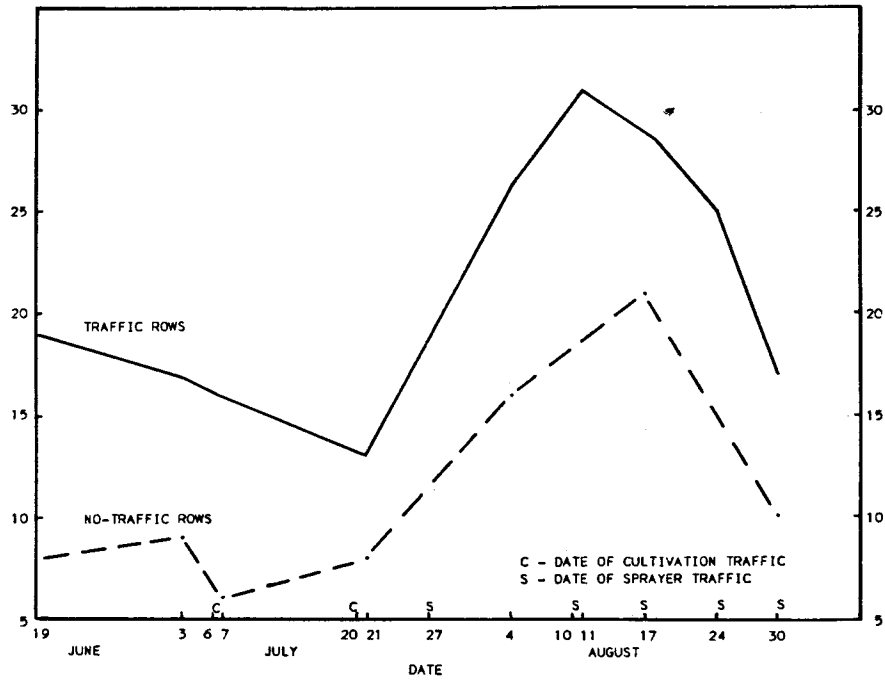

FIG. 2.—Impact penetrometer readings at 0-6 inches of soil depth for traffic and no-traffic potato rows. Presque Isle, Maine. 1961.

TABLE 3.—*The effect of tractor traffic on potato total yields. Presque Isle, Maine.*

Treatments	Years			
	1959	1960	1961	1962
	Bu/Acre	Bu/Acre	Bu/Acre	Bu/Acre
Traffic[1]	308.3	271.7	373.3	511.7
No-traffic[1]	455.5**	294.0*	431.7**	593.3**

[1]Each value represents the average of nine plots.
*Increase in yield at the 5% level.
**Increase in yield at the 1% level.

Agricultural Experiment Station[3] indicated that direct vine damage occurring prior to blossom resulted in negligible yield losses. Damage occurring after blossom resulted in yield reduction depending upon the extent of leaf area destroyed. With the vine lifters constructed for use in this study, the amount of vine damage seemed to be held to a minimum.

The soil conditions most affected by tractor traffic were compaction and water infiltration. Compaction was greatly increased in the traffic rows. Preliminary studies on infiltratoin indicate from 3 to 30 times greater infiltration in the no-traffic rows than in the sprayer traffic rows.

SUMMARY

Supplemental irrigation increased yield and number of tubers in three of the four years studied. There was no significant effect of irrigation on the specific gravity of Katahdin potatoes.

A separate study relating the effect of compaction on potato yield indicated that sprayer traffic reduced yields from 8 to 31%.

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