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Irrigation of Russet Burbank Potatoes in Idaho

G. L. Corey and Victor I. Myers

Department of Agricultural Engineering

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Recommendations

Results of these tests warrant the following recommendations for soils and conditions similar to those described in the experimental plots:

1. Irrigate when the soil moisture indicates the need, preferably before the available moisture is 50 percent depleted. Withholding water until a certain date, or irrigating on a fixed schedule, regardless of weather and soil conditions may result in potatoes of inferior grades.
2. In general, the first irrigation should come within 40 days after planting. An early first irrigation is good insurance against pointed-end and bottle-necked tubers.
3. Irrigate with light, frequent applications (every 5 or 6 days) during the early and hot part of the season.
4. Irrigate less often (every 12 to 14 days) during the latter, cooler part of the season.
5. Use short irrigation runs to permit light applications of water and to avoid excessive deep percolation losses.

Irrigation of Russet Burbank Potatoes In Idaho

G. L. COREY AND VICTOR I. MYERS*

Russet Burbank potatoes grown in Idaho have acquired a reputation for quality over the entire nation. According to the 1954 census, 153,000 acres of potatoes were harvested in the state, most of them of the Russet variety. It is well known to most farmers that potatoes are more sensitive to the moisture condition of the soil than are most other crops.

Poor grades of Idaho potatoes often are due to faulty irrigation practices. In order to secure the best results, it is necessary to know as much as possible about the moisture requirements with respect to quantity and timing of irrigations. The farmer should know at which periods in the life of the potato plant it becomes critical to apply frequent applications of water to preserve the quality of the crop.

The results of irrigation experiments reported in this bulletin are intended to show the critical aspects of irrigation as applied to the production of potatoes. It should be realized, however, that many factors must be considered in deciding when to irrigate and how much water to apply. The kind of soil, weather conditions, depth of plant roots and other variables all influence the irrigation cycle.

Climatic Conditions

The experimental work was carried out on the University of Idaho Branch Experiment Station at Aberdeen, Idaho, in the Snake River Plains. Because of the relatively high elevation (4400 feet) in the area, cool nights and moderately warm and sunny days are experienced. These factors favor the production of good quality potatoes. The average frost-free period experienced in the area is 102 days. Precipitation is very low, averaging only 8.79 inches at Aberdeen, of which 3.42 inches falls during the period May 1 to September 30.

The mean monthly temperatures for the growing season are presented in Table 1 for the years 1951, 1952 and 1953, when the irrigation project was underway.

Table 1.—Mean monthly temperatures and departures from normal for Aberdeen Branch Experiment Station.

Month	1951		1952		1953	
	Temp °F	Depart.	Temp °F	Depart.	Temp °F	Depart.
May	55.5	+1.8	55.9	+2.2	48.6	—5.1
June	57.7	—3.5	62.0	+0.8	59.7	—1.5
July	70.0	0.0	67.5	—2.5	71.1	+1.1
August	66.3	—1.0	68.5	+1.2	67.8	+0.5
September	59.2	+1.7	59.9	+2.4	61.7	+4.2

* Formerly Assistant Irrigationist, Agricultural Experiment Station, Aberdeen; Assistant Professor of Agricultural Engineering and Irrigationist, Agricultural Experiment Station, Moscow.

Methods of Procedure

The type of soil on which the irrigation studies were made was a silt loam. Although the topography was quite flat, the plots were well drained. Each year of the experiments, which continued from 1951 through 1953, the potatoes were planted in a field that had been plowed out of red clover. To provide good early moisture conditions for plant growth, the entire field was uniformly irrigated before planting. All plots were fertilized with approximately 40 pounds of available nitrogen and 80 pounds of available phosphorus per acre prior to planting. A 9-inch to 11-inch spacing of seed pieces was maintained in planting, and all potatoes planted were certified. The plots were replicated five times in 1951 and 1953 and four times in 1952.

Experimental Treatments

The different treatments consisted of three frequencies of irrigation based on the amount of moisture in the soil at the time of irrigation. The treatments are referred to as short, medium and long frequencies. The long frequency treatment received the least number of applications and had the longest periods between irrigations. Water was not applied in this treatment until the plants showed a marked visible drought stress, a time when they were near the wilting point. In the medium treatment, water was applied when about two-thirds of the moisture available to plants was gone out of the top 2 feet of the soil. In the short treatment, water was added when about one-third of the available soil moisture was depleted in the upper 2 feet of the root zone.

When it was determined that the plots needed irrigation, water was applied until the soil was wet across the row at the depth of the seed piece, or about 4 inches below the ground surface. The penetration of water and lateral extent of wetting were frequently checked during irrigation with a probe or shovel until the above condition had been reached.

In the year 1951, two treatments were added to measure the effect of heavier applications of water on yield and grade of tubers. In these supplementary treatments, water was applied at the short and medium frequencies; however, the irrigation stream was applied until the soil was wet across the row on the surface instead of at the depth of the seed piece.

In 1951, sprinkler irrigation was included in the research, along with a continuation of the furrow irrigation investigations. Four irrigation frequencies were studied for the sprinkler method and five frequencies for the furrow method.

Data and Measurements Taken

Consumptive use, defined as water that evaporates from the soil surface and that consumed by the plants, was determined from soil samples. The consumptive use between irrigations was computed as the difference in soil moisture contained in the samples taken before and after each irrigation, or simply the amount added to replace the depleted moisture. Samples were taken just prior to, and 48 hours after, irrigation at the 0-12 and 12-24 inch depths. A correction was made for the consumptive use that occurred during the interval between samplings. All soil samples were weighed, oven dried for 24 hours at 110° C, and reweighed, to determine the moisture present in the soil at time of sampling.

Although soil moisture samples, which provided consumptive use data, were taken from the top 2 feet of soil, it is true that in deep soils potato plants approaching maturity abstract water from depths greater than 2 feet. However, since the rate of root development is about the same regardless of irrigation treatment, as long as soil moisture did not approach the wilting point (6) moisture data from the 0-2 foot depth gave a good comparison of moisture use between the various treatments. The recorded values of seasonal consumptive use were probably no more than 15 percent lower than would have been recorded had the moisture measurements been taken to greater depths. This estimate is based on the fact that (a) it takes a considerable portion of the season for roots to reach the 3-foot depth, and (b) approximately 70 percent of the soil moisture used by mature potato plants comes from the top 50 percent of the root zone (5).

A comparison of the amounts of water applied by the sprinkler and furrow methods of irrigation was obtained by measuring the water applied in either case. The sprinkler application rate was determined by measuring the water pressure in the sprinkler lines, which was maintained as close as possible to 35 psi (pounds per square inch). Rating tables were used to convert nozzle pressures into terms of discharge. The water applied by the furrow method was determined by measuring the furrow streams with a can of known volume and a stop watch. Runoff from the surface plots was determined by the same method.

In 1952, a portion of each plot of each irrigation treatment was harvested at regular 10-day intervals beginning July 9 and ending August 28, for a total of seven harvest dates. Each harvest date the vines and tubers were weighed and the potatoes graded to obtain a record of development as the season progressed. The sorted grades were of the same specifications as those followed at harvest time.

Soil temperatures were measured in each plot during the growing season of 1951. Temperatures were taken with a soil thermometer at the 6-inch and 12-inch depths, at approximately the same time each day.

In taking yield data, an effort was made to sort the potatoes so the results would reveal not only the quantity in grades other than U.S. No. 1, but also the specific physical factors that caused them to be so classified. This is an important feature since poorly timed irrigation may cause certain growth irregularities but not appear to be the cause of others. Each year after harvest the potatoes were sorted into the following grades:

1. U.S. No. 1's—tubers not less than $1\frac{7}{8}''$ in length with no irregularities or blemishes.
2. Pointed end.
3. Knobs.
4. Undersized.

The specific gravity of samples of U.S. No. 1's from each plot was determined each year, using the following mechanical procedure.

1. A random sample of about 10 pounds was taken from each experimental plot.
2. The sample was placed in an open mesh sack and weighed.
3. The sample was then weighed while completely immersed in water.
4. Specific gravity was then computed by the following formula:

$$\text{specific gravity} = \frac{\text{weight in air}}{\text{weight in air} - \text{weight in water}}$$

The disease, early dying caused by *Verticillium Albo-atrum*, Reinke and Berth, was measured in each treatment at various times during the season to determine the effect, if any, of irrigation on this disease. The early symptoms of the Verticillium disease are characterized by flaccid, drooping leaves. Only one stem or part of a stalk in a plant may be wilted. All infected stalks eventually die before the end of the season. With such readily recognizable symptoms it was relatively easy to judge the severity of the disease in a given plant on a given date.

The severity of Verticillium was measured in each irrigation treatment by rating 50 plants. Arbitrary numerical values were assigned to indicate the extent to which each plant was affected by the disease. Plants were thus classified as healthy 0, slightly infected 1, moderately infected 3, severely infected 5, or dead 10. A severity index for each irrigation treatment was then computed as follows:

$$\text{Severity index} = \frac{(\text{number of plants in each class})\ (\text{class wt.}) \times 10}{\text{Total plants rated}}$$

The severity index thus computed gave values ranging from 0= all healthy plants to 100=all dead plants.

Experimental Results

Consumptive Use

The records of water measurements and of soil moisture determinations were used as a basis for determining the following for each irrigation treatment: (1) when to irrigate, (2) the rate of use of water by the crop, and (3) the seasonal irrigation requirements.

Data for computing consumptive use were taken in 1952 and 1953 on each of the irrigation treatments. Since the moisture used between irrigations was computed from soil samples taken just prior to each irrigation, the sum of all these moisture deficiency values gave the seasonal use of water. Average daily consumptive use was obtained by dividing seasonal use by the number of days in the irrigation season. The seasonal and average daily consumptive use values for each irrigation treatment are shown in Table 2 for the years 1952 and 1953. The plots irrigated at the short frequency consumed 0.6 inches more water than the medium frequency which in turn consumed 1.3 inches more water than the plots irrigated at the long frequency.

Table 2.—Total seasonal and average daily consumptive use of water by Russet Burbank potatoes, under three ranges of soil moisture.

	Frequency of Irrigation	No. of Irrigations	Ave. Irrig. Interval Days	Consumptive use Total Inches	Consumptive use Average Daily Inches
1952	Short	10	9.3	12.5	0.108
1952	Medium	6	13.6	9.5	0.081
1952	Long	4	20.0	8.5	0.073
1953	Short	9	9.0	9.3	0.078
1953	Medium	5	13.5	11.2	0.094
1953	Long	3	25.0	9.4	0.079
Average	Short	9.5	9.2	10.9	0.093
Average	Medium	5.5	13.6	10.3	0.088
Average	Long	3.5	22.5	9.0	0.076

The increased consumptive use, caused by irrigating more often, resulted primarily from the increased opportunity for evaporation from the soil surface.

The figure of total number of irrigations varied considerably between treatments and was a direct function of the number of days between irrigations, called the irrigation interval. Averages of these figures for the various treatments and for the two years when data were recorded are shown in Table 2. The averages gave good comparisons between the treatments but it was especially significant that the irrigation intervals varied considerably during the season. For example, in the short frequency treatment, the soil was irrigated every 5 or 6 days during the hot part of July, whereas late in the season the interval between irrigations was as long as 12 days.

The periods of peak consumptive use are shown in Figure 1 along with average seasonal consumptive use rates for each year and for the various treatments. Peak rates are especially important in the design of irrigation systems.

Yields

The various irrigation treatments were applied to determine whether the additional water of the short frequency treatment would give an increase in yield without having an injurious effect on grade of tubers. Yield data are presented in Table 3 according to grading standards described earlier in this bulletin, for the three irrigation treatments and for each year of the experiments. In addition to showing total yields and yields of U.S. No. 1's in hundred weight per acre, the percent that each grade is of the total yield is tabulated. On comparing the figures in Table 3 it will be noted

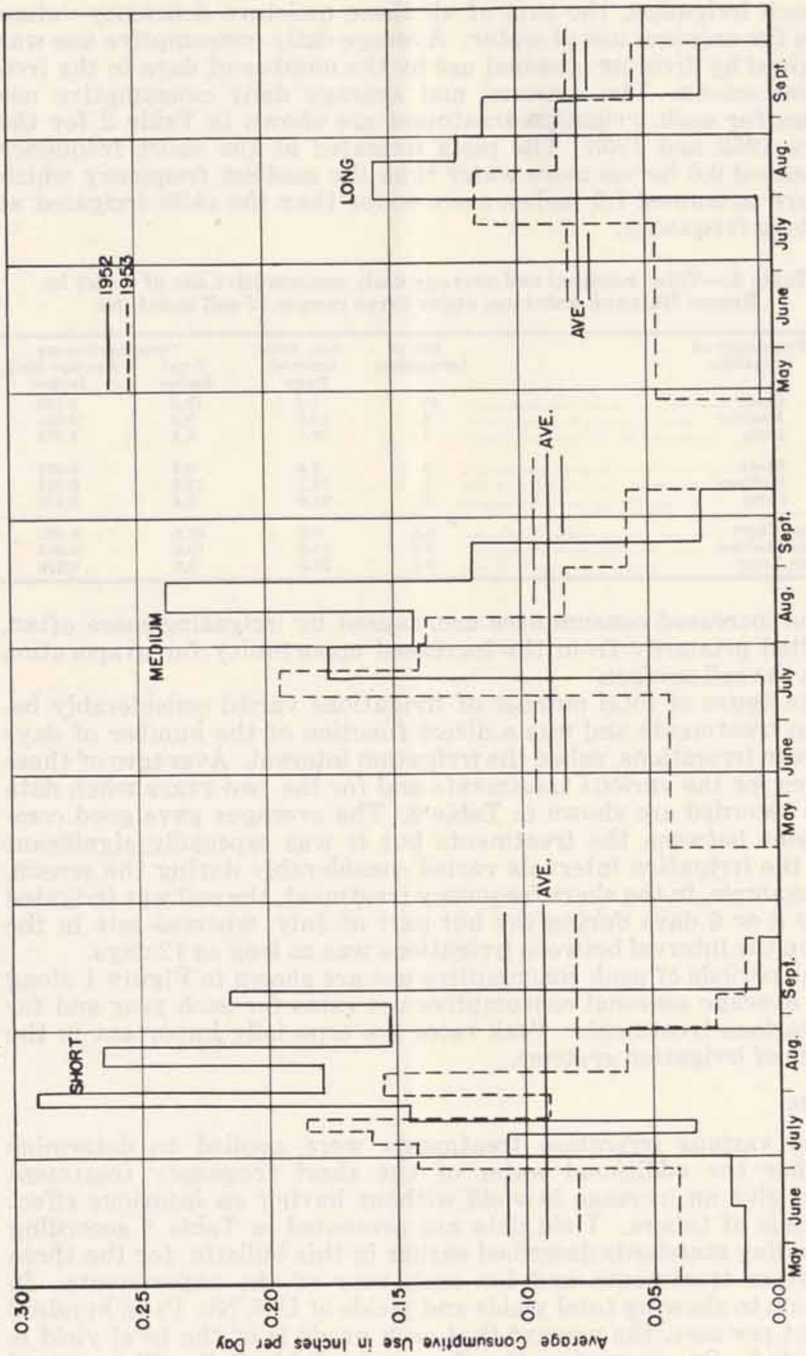

Figure 1.—Daily consumptive use rates for potatoes at three frequencies of irrigation. Each graph is the average of four plots and covers a period of about 120 days.

that the yield of U.S. No. 1's was significantly reduced by the long frequency irrigation treatment although the total yield for all treatments was about the same. The medium treatment produced a yield that was about 1200 pounds less than the short frequency treatment, but the difference was not statistically significant.

Table 3.—Relative yields of Russet Burbank potatoes and percentages of total yield of various grades for three irrigation treatments. Figures represent averages of four plots.

Frequency Treatment		Total yield cwt/acre	U.S. No. 1's cwt/acre	Percent U.S. No. 1's	Percent Pointed end & bottle neck	Percent knobby	Percent undersized
Short	1951	317.0	220.0	69.5	6.2	5.0	15.8
	1952	268.8	203.0	75.2	5.6	0.7	17.2
	1953	270.8	162.6	60.0	13.7	10.5	13.3
Medium	1951	312.8	189.6	60.4	13.6	6.2	14.3
	1952	251.6	175.8	69.8	9.3	2.2	17.2
	1953	236.7	109.3	47.5	28.7	9.0	13.8
Long	1951	282.0	109.3	36.8	35.0	4.9	18.6
	1952	253.1	103.5	35.0	37.9	5.8	15.7
	1953	230.9	105.2	45.5	37.0	8.0	9.3
Short Average		285.5	195.2	68.2	8.5	5.4	15.4
Medium Average		267.0	158.2	59.2	17.2	5.8	15.1
Long Average		255.3	106.0	40.0	36.6	6.2	14.5
1951 Average		303.9	173.0	55.6	18.3	5.4	16.2
1952 Average		257.8	160.8	60.8	17.5	2.9	16.7
1953 Average		246.1	125.7	51.0	26.5	9.2	12.1
		Least significant differences for experiment variables					
Level of statistical significance		**0.05* 0.01****	**0.05 0.01**	**0.05 0.01**	**0.05 0.01**	**0.05 0.01**	**0.05 0.01**
Irrigation x year		N.S.***	N.S.	4.6 6.3	N.S.	N.S.	N.S.
Irrigation		N.S.	40.7 61.7	21.8 N.S.	8.6 13.0	N.S.	N.S.
Year		29.0 39.7	32.5 N.S.	2.7 3.7	7.3 N.S.	2.6 3.5	2.8 3.8

* .05, Significant at 5 percent level
** .01, Significant at 1 percent level
*** N.S., Not Significant

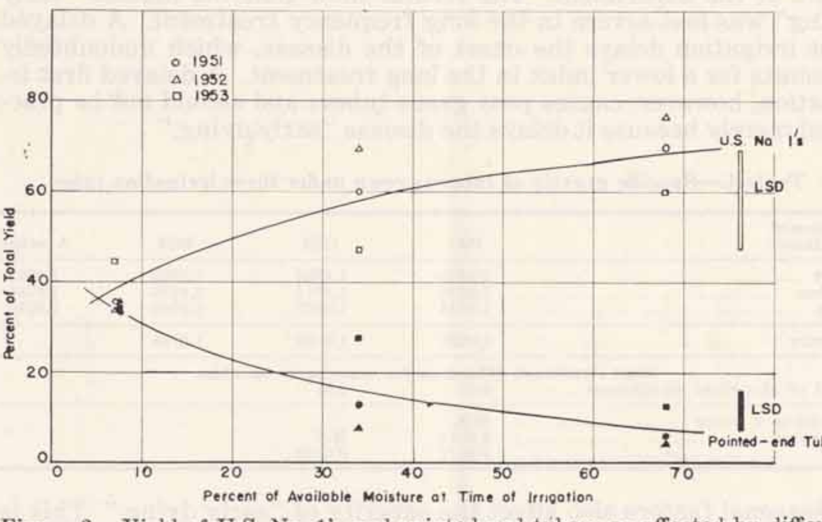

Figure 2.—Yield of U.S. No. 1's and pointed-end tubers as affected by different levels of soil moisture.

The percentage of tubers having pointed-ends or bottle-necks was significantly affected by the irrigation treatments. With the long irrigation frequency treatments, these off-type tubers increased in percent at about the same rate that the percent of U.S. No. 1's decreased. This is shown graphically in Figure 2. Knobby and undersized tubers, on the other hand, remained about 25 percent of the total, regardless of irrigation frequency. There was a significant difference in the percentage of these potatoes between years of the treatments. It was evident that seasonal factors had a greater effect on the yield of knobby and undersized tubers than did the irrigation rates.

Specific Gravity

Specific gravity is a measure of the starch content in potatoes and is closely related to cooking quality and other characteristics (1). The method used in determining specific gravity was described earlier in this bulletin. Table 4 shows a comparison of the values of specific gravity for tubers for three irrigation frequency treatments and for the three years of the experiments. A comparison of averages of specific gravity for the three treatments showed that the short irrigation frequency resulted in a specific gravity significantly greater than for the long frequency. There was also significant variation in the average specific gravity from year to year, an indication that seasonal differences and perhaps fertility are influencing factors. In 1952 the values were especially low.

Verticillium Wilt

Table 5 gives a comparison of Verticillium wilt (early dying) ratings for the three irrigation frequency treatments and for the three years of the experiment. The results show that the disease "early dying" was less severe in the long frequency treatment. A delayed first irrigation delays the onset of the disease, which undoubtedly accounts for a lower index in the long treatment. A delayed first irrigation, however, causes poor grade tubers and should not be practiced merely because it delays the disease "early dying."

Table 4.—Specific gravity of tubers grown under three irrigation rates

Frequency Treatment	1951	1952	1953	Average
Short	1.0845	1.0734	1.0828	1.0802
Medium	1.0830	1.0714	1.0770	1.0780
Long	1.0824	1.0631	1.0763	1.0740
Average	1.0833	1.0693	1.0796	
Least significant differences for experiment variables				
Level of statistical significance	0.05	0.01		
Irrigation x years	N.S.			
Irrigation	0.0044	N.S.		
Year	0.0041	0.0056		

Seasonal factors also affect the severity of "early dying." This is shown in Table 5 by the significant index differences between years.

Effect of Heavy Soaking

In 1951, a comparison was made between the practices of allowing the water to soak across the row only at the seed-piece depth and allowing the water to run until the row was soaked across at the surface. Table 6 shows a comparison of several important factors of yield and quality as affected by the two comparative irrigation practices. It was demonstrated that nothing was gained by the heavy soaking. In fact, a great amount of water was wasted by the practice. It took 15 more acre-inches per acre, during the season, to soak across the row at the heavy rate and 5 more at the medium rate, compared to soaking across at the seed-piece depth.

Water rot was no problem in the experimental field, but, had any been encountered, it is likely that it would have been much more severe on the heavily soaked plots (2), (3), (4).

Effect of Irrigation on Soil Temperatures

Daily temperature readings were taken in each plot during the hot weather in 1951. Readings were started on July 10 and discontinued on August 12, and were taken each day at the 6- and 12-inch depths with a soil thermometer. Readings were taken the same time each day to maintain consistency.

The readings in degrees F. were totaled for the observation period to give a cumulative temperature for each of the 6- and 12-inch depths in each plot. These cumulative temperatures are shown in Table 7. There were significant temperature differences between the several irrigation rates, with the most frequent rate resulting in cooler soils.

Table 5.—Early dying indexes for potatoes grown under three irrigation rates. Indexes were taken at mid-September.

Frequency Treatment	1951	1952	1953	Average
Short	23.7	35.7	36.9	32.1
Medium	21.1	40.1	41.0	34.1
Long	23.1	27.4	33 6	28.0
Average	22.6	34.4	37.2	
Least significant differences for experiment variables				
Level of statistical significance	0.05	0.01		
Irrigation x years	N.S.			
Irrigation	4.2	N.S.		
Year	4.1	5.6		

The effect of soil temperature on the quality of tubers is shown in Figure 3. Soil temperature is shown in degree days above 65°F. for convenience in plotting. For example, on a day when the soil thermometer registered 70°F., 5 degree days were added to the cumulative total. The graph shows that there is a high degree of correlation between the percentage of pointed-end and bottle-necked tubers and the cumulative soil temperatures at the 12-inch soil depth. Higher soil temperatures result in larger percentages of malformed tubers.

Table 6.—Effect of heavy soaking at each irrigation on several factors of yield and quality of Russet potatoes irrigated at two moisture levels. Each figure represents the average of five plots.

Treatment	Water Applied Acre Inches Per acre	Total Yield cwt/acre	U.S. No. 1 cwt/acre	Pointed end cwt/acre	Knobby cwt/acre	Undersized cwt/acre	Specific Gravity	Early Dying Severity Index
Short Rate—Heavy Soaking	32	318.8	213.3	19.9	11.6	54.1	1.0838	24.3
Short Rate—Light Soaking	17	319.8	213.1	20.2	21.7	50.1	1.0845	22.8
Medium Rate—Heavy Soaking	17	307.5	192.7	42.0	19.5	36.2	1.0832	20.8
Medium Rate—Light Soaking	12	310.5	177.8	54.8	17.2	45.3	1.0830	21.2

All differences between heavy and light soaking are non-significant.

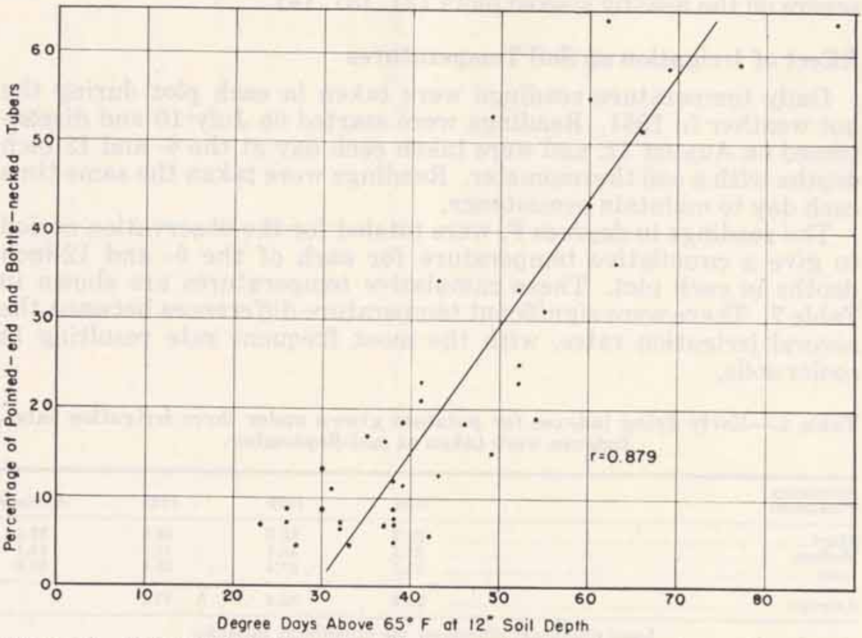

Figure 3.—Relationship between soil temperature and percentage of pointed-end and bottle-necked tubers.

Since potatoes are a cool-temperature crop, it is essential that the soil be kept near optimum temperatures by frequent, light applications of water.

Rate of Tuber Development

A portion of each experimental plot was harvested every 10 days during the 1952 growing season to determine the rate of tuber development and the time when the malformed tubers were being formed. Each 10-day period the vines were weighed, the tubers counted and weighed, and graded into classes of smooth, knobby, pointed-end, or bottle-necked potatoes.

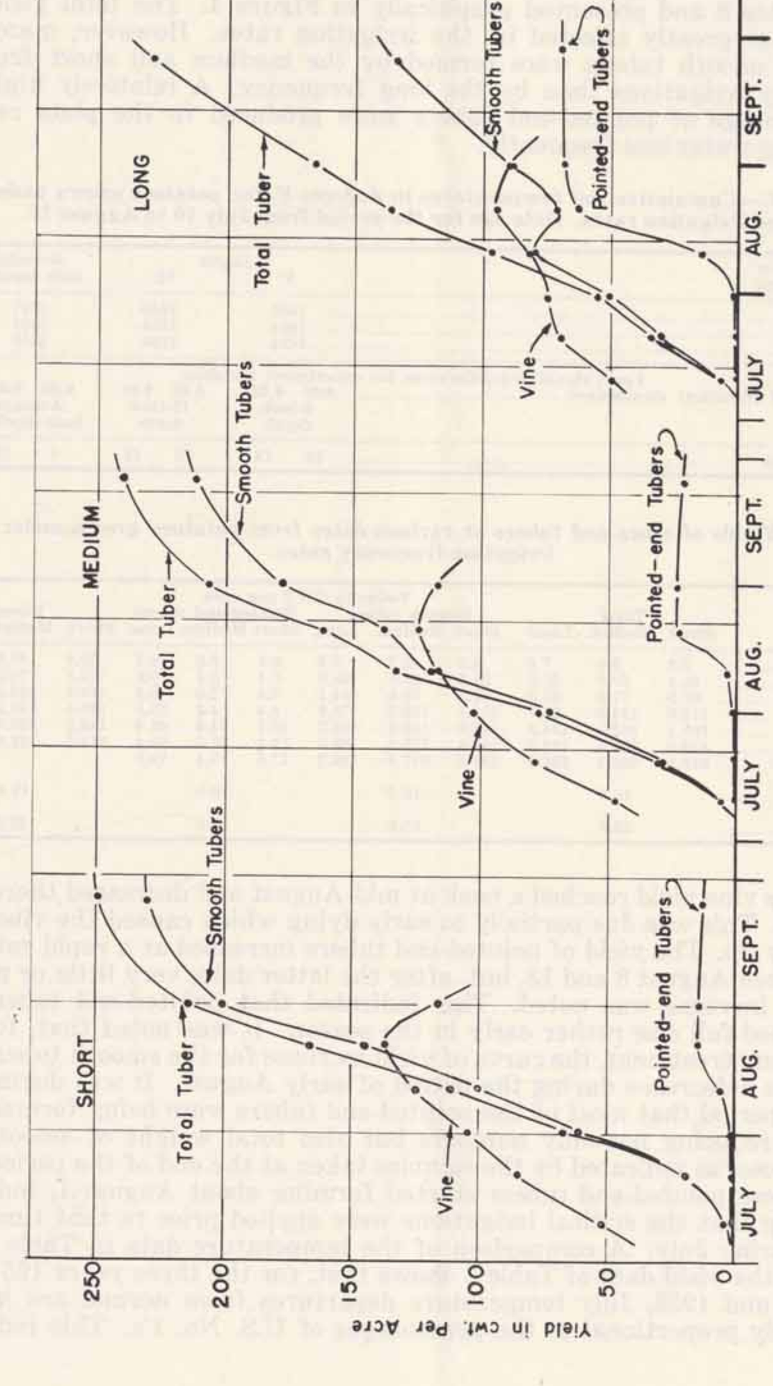

Figure 4.—Rate of tuber and vine development of potatoes grown under three irrigation frequencies.

The data on rate of development of tubers and vines are tabulated in Table 8 and presented graphically in Figure 4. The total yield was not greatly affected by the irrigation rates. However, many more smooth tubers were formed by the medium and short frequency irrigations than by the long frequency. A relatively high percentage of pointed-end tubers were produced in the plots receiving water less frequently.

Table 7.—Cumulative soil temperatures in degrees F. for potatoes grown under three irrigation rates. Data are for the period from July 10 to August 15.

Frequency Treatment	Depth 6"		Depth 12"		Average both depths	
Short	1392		1249		1321	
Medium	1404		1259		1331	
Long	1424		1286		1355	
Least significant differences for experiment variables						
Level of statistical significance	0.05	0.01	0.05	0.01	0.05	0.01
	6-inch depth		12-inch depth		Average both depths	
Irrigation	13	18	13	18	9	12

Table 8.—Yields of vines and tubers at various dates from potatoes grown under three irrigation frequency rates.

	Yields in CWT per acre											
	Total			Smooth tubers			Pointed-end tubers			Vines		
	Short	Medium	Long	Short	Medium	Long	Short	Medium	Long	Short	Medium	Long
9 July	3.3	5.8	7.6	3.2	5.7	7.4	0.0	0.0	0.1	51.9	47.8	50.3
19 July	21.1	30.8	30.2	20.2	29.0	28.8	0.1	0.1	0.8	75.3	79.7	73.5
29 July	67.2	77.8	55.6	62.8	73.9	54.1	0.5	1.0	0.2	104.3	102.2	76.3
8 August	112.8	134.6	97.7	101.7	123.3	79.9	4.4	4 2	15.5	126.4	122.8	84.2
18 August	165.4	162.1	136.3	143.9	132 2	66.7	15.7	24.4	65 0	142.7	130.7	96.7
28 August	219.0	207.4	168.8	196.9	177.2	89.5	12.2	22.0	70.4	118.2	122.3	90.1
25 September	249.1	242.4	230.9	231.0	217.4	139.2	11.3	17.4	74.0			
LSD (0.05)		16.8			19.0			10.0			17.4	
(0.01)		22.3			25.2			13.5			23.0	

The vine yield reached a peak at mid-August and decreased thereafter. This was due partially to early dying which caused the vines to dry up. The yield of pointed-end tubers increased at a rapid rate between August 8 and 18, but, after the latter date, very little or no yield increase was noted. This indicated that pointed-end tubers reached full size rather early in the season. It was noted that, for the long treatment, the curve of yield increase for the smooth tubers shows a decrease during the period of early August. It was during that period that most of the pointed-end tubers were being formed, thus reducing not only numbers but also total weight of smooth potatoes, as indicated by the samples taken at the end of the period.

These pointed-end tubers started forming about August 1, indicating that the critical irrigations were applied prior to that time, or during July. A comparison of the temperature data in Table 1 with the yield data of Table 3 shows that, for the three years 1951, 1952 and 1953, July temperature departures from normal are inversely proportional to the percentages of U.S. No. 1's. This indicates a definite correlation between soil temperatures and yield of good quality potatoes for this type of tuber.

Sprinkler Versus Furrow Method

A comparison of the data from the sprinkler and furrow plots of 1951 and 1952 demonstrated that the sprinkler method saved a considerable amount of water over the furrow method. The numbers of irrigations and amounts of water applied during the years 1951

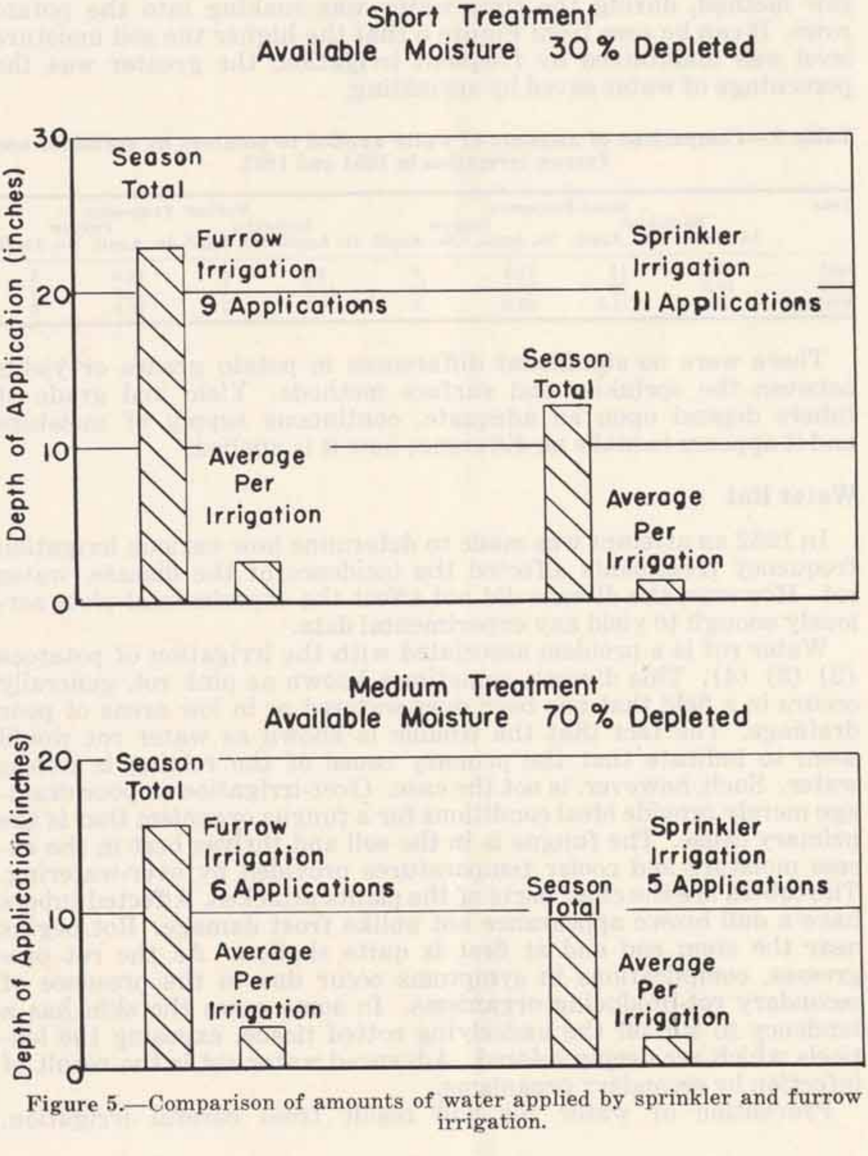

Figure 5.—Comparison of amounts of water applied by sprinkler and furrow irrigation.

and 1952, necessary to maintain the short and medium frequency treatments, are tabulated in Table 9 and the average values for two years shown graphically in Figure 5. For the data plotted in the figure, the greatest contrast appeared in the short frequency treatment where a total of 22.8 inches was applied on the furrow irrigation plots but only 12.4 inches was required for the sprinkler plots. The difference was accounted for by the fact that the water applied to the surface by sprinkling was nearly all effective, while a great deal was wasted to deep percolation and surface runoff with the furrow method, during the time water was soaking into the potato rows. It can be seen from Figure 5 that the higher the soil moisture level was maintained by frequent irrigation, the greater was the percentage of water saved by sprinkling.

Table 9.—Comparison of amounts of water applied to potatoes by sprinkler and furrow irrigation in 1951 and 1952.

Year	Short Frequency				Medium Frequency			
	Sprinkler		Furrow		Sprinkler		Furrow	
	In Appli.	No. Appli.	In. Appli.	No. Appli.	In. Appli.	No. Appli.	In. Appli.	No. Appli.
1951	11.4	11	17.5	8	8.5	5	12.0	5
1952	13.3	12	28.1	10	10.0	5	19.2	7
Average	12.4	11.5	22.8	9	9.3	5	15.6	6

There were no significant differences in potato grades or yields between the sprinkler and surface methods. Yield and grade of tubers depend upon an adequate, continuous supply of moisture and it appears to make no difference how it is applied.

Water Rot

In 1952 an attempt was made to determine how various irrigation frequency treatments affected the incidence of the disease, water rot. However, the disease did not affect the experimental plots seriously enough to yield any experimental data.

Water rot is a problem associated with the irrigation of potatoes (2) (3) (4). This disease, sometimes known as pink rot, generally occurs in a field that has been over-watered or in low areas of poor drainage. The fact that the trouble is known as water rot would seem to indicate that the primary cause of the rotting is excess water. Such, however, is not the case. Over-irrigation or poor drainage merely provide ideal conditions for a fungus organism that is the primary cause. The fungus is in the soil and thrives best in the excess moisture and cooler temperatures provided by over-watering. The tubers are the chief parts of the plants attacked. Affected tubers have a dull brown appearance not unlike frost damage. Rot begins near the stem end and at first is quite shallow. As the rot progresses, complications in symptoms occur due to the presence of secondary rot-producing organisms. In some cases the skin has a tendency to slip off the underlying rotted tissue, exposing the lenticels which are deeply colored. Advanced water rot is the result of infection by secondary organisms.

Prevention of water rot will result from careful irrigation, in which care is taken to prevent waterlogging of the soil. Fields should be leveled to remove low, poorly drained areas and irrigation "runs" should not be too long. Crops should be rotated so that potatoes do not follow potatoes. If tubers with water rot are found in fields, care should be taken not to place rotted tubers in storage.

Summary

The effect of irrigation rate on yield and quality of Russet Burbank potatoes was measured over a 3-year period. Three soil moisture levels were maintained. The available soil moisture was kept above 70 percent in one treatment, 30 percent in another, and near the wilting point in the third. In addition, a comparison was made between the sprinkler and furrow methods of applying water to potatoes.

The results are summarized as follows:

1. The consumptive use of water by potatoes was related to the amount of moisture in the soil available for transpiration and evaporation. Higher soil moistures resulted in greater consumptive use.
2. Frequent irrigations, applied every 5 or 6 days during the hottest part of the season, were required to maintain the available moisture above 70 percent. The irrigation interval was extended to 10 or 11 days during the latter, cooler part of the growing season.
3. Application of water only when plants showed drought symptoms caused a great many pointed-end tubers to be formed, and at the same time, greatly reduced the yield of U.S. No. 1 tubers.
4. Neither frequency of irrigation nor total water applied had a significant effect on the total potato yield.
5. Knobby and undersized tubers are evidently caused by seasonal factors and by withholding the first irrigation. Irrigation frequency alone had no effect on the amount of knobby or undersized tubers.
6 Allowing the soil moisture to drop to the lower levels between irrigations resulted in lower starch content.
7. Irrigation rate had no effect on the disease Verticillium Wilt (early dying) other than to delay onset of the disease if the first irrigation was delayed.
8. No benefit was derived by heavy soaking until the potato row was wet to the surface. Continuing irrigation only until the soil was wet across the row at the seed-piece depth required less water and produced potatoes of equal quality.
9. Higher soil temperatures resulted in greater numbers of pointed-end tubers. Cooler soil temperatures were maintained by applying water more frequently.

10. The yield of knobby tubers was not correlated with soil temperatures.

11. Pointed-end tubers were formed in early August when the potatoes were from 1-2 ounces in size.

12. Sprinkler irrigation of potatoes resulted in a saving of water over the furrow method of 54 percent in the short frequency plots and 60 percent in the medium treatment. The sprinkler method did not, however, produce tubers of a better grade or in a greater quantity than were produced by the furrow method.

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