

INDEPENDENCE WILL DOUBLE IN POPULATION IN 5 YEARS

(Continued from Page One.)

irrigation studies have been given considerable attention, but the first important work on the irrigation of beets was done by Widsoe and his associates. According to Bulletin 80, published in 1902, sugar beets had a greater percentage of moisture in the soil when they were first irrigated (about the middle of June than any of the other common crops grown.) The relative proportions of the constituents of the plant were not found to be affected to any noticeable extent by irrigation although there was a tendency for the plants receiving most water to contain the highest percentages of sucrose and a higher purity. On a gravity loam land received 20 to 27 inches of water the beet yield was greater than with more or less, and the lower quantity was best. The highest yield of dry matter to the acre, and for such pound of water applied, was from the plot receiving 20.17 inches of water in five equal irrigations, the smallest being with 17.78 inches in eight irrigations. Better yields were obtained by making the larger applications early in the season than during the later period. A trial of one year showed flooding to be better than furrow irrigation. Between twenty and twenty-five inches of water yielded beets with highest sugar content.

Bullitin 115 indicates that for the early season, beets exhaust the soil moisture less thoroughly and rapidly than the cereals and alfalfa, but more than potatoes. Beets needed their first irrigation when the soil contained more moisture than with the other crops. The water was used faster during August than during July or September. At the time of harvest, beets had exhausted the soil more thoroughly of water than oats, corn or potatoes.

Field experiments reported in Bullitin 116 indicate a general increase in dry matter with increased applications of water up to 50 inches. The yield of dry matter for each inch of water decreased as the total water during the season increased. In pounds of water for a pound of dry matter there was an increase from 569 for 15.25 inches of water to 1,186 for 60.25 inches. Nearly three times as large a yield of dry matter would be produced when 30 inches were spread over four acres as when it was applied to one acre.

Bullitin 117 shows sugar beets to gain nearly five tons to the acre when the amount of water was increased from five to ten inches, but when more than ten inches were given there was little increase in tonnage. An acre of land with 30 inches of water applied produced 2.82 tons and when spread over six acres the same quantity of water gave a total yield of 82.68 tons.

Results given in Bulletin 118 definitely indicated that part of the yield of sugar beets was due to the water applied prior to the irrigation season, although such irrigations were not nearly so valuable as those added later. The percentage of well-shaped beets was higher when the water was applied at the usual times. Water added about a month after planting had distinctive value in determining a high yield. It was very important that the applications be regulated to keep the soil uniformly moist during July and August. September irrigations had little value, less than two inches during this month being ample where the amount had been sufficient the two previous months.

With ordinary quantities of water to be applied, almost without exception, the greater the number of irrigations, using the same quantity of water, the larger the yields. It is believed that with fifteen inches of water, four irrigations are sufficient and three would be nearly as good. Applying five inches every other week during the irrigation season appeared to be the best practice. Although it is seldom wise to have more than two-week intervals between irrigations, the frequency of applications may be decreased as the total water applied throughout the season is increased.

Bullitin 119 shows a tendency from the earliest to the latest date of harvesting, for a decrease in the proportion of leaves as the quantity of irrigation water increased. Although the water in the whole plant and the leaves decreased as the water applied decreased, the moisture in the roots remained practically constant for each period irrespective of the quantity of water used.

Bullitin 120 brings out the facts that although there was only a slight increase in the percentage sucrose with the water applied up to 35 inches, the percentage of carbohydrates increased quite steadily with increased quantities of water used. The application of 50 inches in every case decreased the sucrose content. The percentage purity was lowest with the smallest of water and highest with intermediate applications up to 20 inches. The per cent sucrose and purity were higher in October than in September.

Description of the Experiment

The experimental work reported in the bulletin was conducted on the Greenville Experiment Farm two miles north of Logan, Utah. The soil, which is a well-drained uniform clay loam to great depth, has been described in detail in Utah Station Bulletin No. 115. The land was manured every year and was plowed in the fall except one year when fall at rains made it necessary to wait till spring. The land was planted alternately to beets and potatoes. The soil will hold about 22 per cent of moisture as a maximum under field conditions. The plots were 30 by seven-foot space between the plots.

The water was measured by means of a Coppoletti weir and taken to the land in wooden flumes, where it was added to the beets by the flooding method. All the water was retained on the plots by banks around the edges. To a number of plots water was added each week during the growing season, but the time of applying water to, most of the plots depended on the stage of development of the plants.

The sugar beet plant was divided into four stages as follows: First, just before thinning time; second, four weeks after thinning; third, when the beets averaged two inches in diameter; and fourth: when the beets were nearly—but not quite—ripe.

A five-inch irrigation was used as a standard at these stages. An application of this amount was given at each stage, at each two stages, at each three stages, and to all four stages, thus giving quite a number of different combinations. It is possible, therefore, from the results obtained to determine which stages are best when either one, two, or three irrigations are used.

In the weekly irrigations one plot received one inch, another 2 1/2 inches, another 5 inches, and another 7 1/2 inches of water each week during the regular irrigation season.

The experiment was begun in 1912 and carried through 1912, 1914, 1915, and 1916, giving five years results. Conditions during these years were made as uniform as possible in every respect. The record of precipitation during the first four years is given in Utah Station Bulletin No. 146. It averaged nearly 18 inches a year.

Certainly the most important consideration in connection with irrigation, from the farmer's point of view, is its effect on the yield of the crop. Where beets are sold on a sliding scale the farmer is also interested in the per cent sugar contained; the sugar factory is always much interested in this item.

The yield of both roots and tops is reported, the quantity of tops being of very much less interest than that of roots; yet the tops do have a decided value as a fertilizer when plowed under and as feed for stock. The yield of tops is expressed as tons of wilted to the acre.

In reporting these experiments, the results are separated into two divisions; (1) those from the plots receiving regular weekly irrigations, and (2) those from plots receiving water only at certain periods in the growth of the plants.

Figure 5 shows the five-year average yield of beets and tops on plots receiving no water, 1 inch weekly, 2 1/2 inches weekly, 5 inches weekly, and 7 1/2 inches weekly. It will be noted that the highest yield was obtained with one inch weekly, or an average total of 12.8 inches for the entire year. That receiving 2 1/2 inches weekly, or 32 inches during the year, gave only slightly less yield; but where 5 inches and 7 1/2 inches of water were applied weekly the yield was decidedly reduced. With the larger amount the yield was almost exactly the same as it was where no irrigation water was applied. The yield of tops bore about the same general relationship as the roots, except that with high water proportionately more tops to roots were produced than where no water was applied.

Figure 6 shows the average yield of roots and tops on plots receiving five-inch irrigations at various stages in the growth of beets. The lowest yield was obtained where the land was irrigated after the seed was planted and before it came up. The yield with this treatment was decidedly less than it was where no water was given.

Comparing the various periods where but one five-inch irrigation was given, it will be seen that the third period, when the beets averaged two inches in diameter, was the most favorable; the last period, when the beets were nearly ripe, was the least favorable. The second period was decidedly more favorable than the first. It will be further noted that the yield of tops was greatest with the very late irrigation. This means that the farmer by looking



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at his beet field will likely be deceived into thinking that the very late irrigation is increasing his yield much more than it really is.

Upon the examining the plots receiving two, three and four irrigations, the value of irrigation water during the third stage is very evident. The highest yield was received where a total of 15 inches were applied. It will be remembered that in the weekly irrigations a higher yield was obtained for 12.8 inches than for 32 inches.

It seems, therefore, that the total requirements of sugar beets for irrigation water are not large, but the period of application is important.

.Size and Shape of Beets.

The average weight of beets under the different treatments show that the size of beets follows closely the relationships that have already been pointed out for yield. This was to be expected since the stand on all plots was practically the same in the spring and yield was largely, but not entirely, an expression of size. The size of beets irrigated only at the fourth stage was proportionately less than the yield would indicate.

The length of beets shows that where 7 1/2 inches of water were given each week the length of beets averaged very slightly less than those receiving no water. The longest beets on the weekly irrigations were produced by one inch of water each week, but the differences due to the treatments were very slight. Five inches of water applied at any period made the beets longer than those that were not irrigated. The longest beets were those irrigated at the first three stages. The very late irrigation had but little effect in lengthening the beets.

There is a popular idea among farmers that the first irrigation should be delayed just as long as possible in order to induce the beets to go deeply into the soil in order to increase length, some even allow their beets to be positively injured by drought before applying water. The results reported here, which represent many thousands of careful measurements during five years, show the old idea is largely a fallacy.

In the ordinary good beet soil that is well drained an irrigation does not decrease the depth of penetration of beets; it rather assists them to go deeper. Of course this does not contradict the well-known fact that beets are likely to be shorter on a soil that is absolutely water-logged. This condition to a slight extent has already been pointed out where a total of 96 inches of water were applied.

In view of these experiments, it seems folly to let beets suffer for want of water and be permanently injured in order to get them to root deeply.

The percentage of forked beets is shown to bear very little consistent relationship to the amount of water or the time of its irrigation. In the weekly irrigation tests the beets that were not irrigated had the largest number of forked roots while in the plots that had water applied at different periods the plot receiving water at the first stage only had the least number of forked roots. The greatest number was on plots, irrigated early and late. The differences, therefore, are not consistent and the idea that any method of irrigation greatly increases the tendency toward forkedness seems unwarranted.

Summary.

- 1 In the bulletin results of five years' experiments on the irrigation of sugar beets are reported.
- 2 When the beets were watered each week during the growing season, one inch of water weekly gave a higher yield than did more than this quantity
- 3 When but one irrigation was given it was most effective when applied

at the time the beets averaged about two inches in diameter.

4 Irrigating the land after the seed was planted and before the plants were up reduced the yield below that where no irrigation water was applied.

5 The least desirable time to apply water after the plants had begun to grow was just before the beets were ripe.

6 When the water was applied at the proper time, two or three irrigations of five inches each gave practically as good results as where more water was used.

7 Proportionately more tops were produced by the high and the late irrigations than by the opposite conditions.

8 The percentage sugar and the purity were higher in the irrigated than in the non-irrigated beets, except where the irrigation water was added late.

9 The highest percentages of sugar resulted from irrigated water applied when the beets were about two inches in diameter.

10 Contrary to popular opinion, the length of beets was not increased by delaying the time of applying the first irrigation.

11 The percentage of forked beets bore no consistent relationship to the amount of irrigation water applied.

12 Irrigation water affected the average size of beets in practically the same manner that it affected the total yield.

13 Sugar beets do not require large quantities of irrigation water if they are sensitive to the time it is given.



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