time all plots were handled at the same time. In the cross-blocked areas some blocks were trimmed down a little if they were thick with plants.

There was considerable watergrass in these plots. When the plots were thinned the labor removed all watergrass from the rows. This was not done in the cross-blocked plots until they were hoed. The grass was quite large at this time and it was difficult to remove it from the blocks.

It appears that under the conditions of this test cross-blocking on 20-inch centers caused a significant decrease in yields of beets per acre. This is contrary to results obtained in other sections. Further tests in the Woodland area are to be carried on in an effort to find if the results obtained this year are reliable.

Cross-Cultivation of Sugar Beets

« R. J. TINGLEY[1]

The original intention of this work was to compare the practice of cross-cultivating beets on 20-inch centers with conventional hand thinning on a practical field basis. This practice should not be confused with cross-blocking or other mechanical means of performing the blocking of beets in the row, as a part of the hand-thinning operation.

The theory on which this practice is based is: If the cross-cultivating is done in such a maimer as to leave approximately the same population of beets per unit of row[7] or acre, the final yield will approximate that ordinarily secured under conventional hand-thinning methods.

Advantages of Method

The general use of this method was first conceived under conditions of a plentiful labor supply and low beet prices, with the idea in mind of reducing the costs of production sufficiently to provide a fair profit to the growler with existing low returns. This cultural method may now be more important as an actual labor-saving practice, particularly to reduce the number of workers needed and to enable the grower to handle comparatively large acreages satisfactorily, even if all planting has to be done in a short period of time. It is now apparent that by cross-cultivating sugar beets, any grower can properly cultivate his entire acreage and reduce the number of beets in the row in time so that there is no shock or delayed growth which

[1]Holly Sugar Corporation, Hamilton City, Calif.

usually occurs following the conventional-thinning operation. Under any conditions, excepting the most favorable, the soil can be more completely cultivated and the number of beets and weeds reduced in the entire field much sooner in the growing period than by waiting for a small crew of thinners to complete a normal-thinning job. This advantage alone may more than offset any disadvantage of several beets growing within a hill.

The experience gained during the last 2 years certainly proves that the practice of cross-cultivating should not be attempted as a poor farming practice or a means whereby a crop can be grow'n without careful work and supervision. This program can only be successfully carried out when it is preceded by careful seedbed preparation work, good seeding, and accurate cultivation both with the rows and across them, and the proper timing of each operation.

Discussion of Experiment

The experimental data herein presented was all accumulated on the Holly Sugar Corporation Ranch at Hamilton City, California, in cooperation with its tenant, C. F. Haines. During 1940, he cross-cultivated 293 acres and thinned 475 acres. During 1941, his entire planting of 750 acres was cross-cultivated and handled in this manner with a very small number of men as compared with hand thinning.

The general practice followed by Mr. Haines after the beets were up was to cultivate carefully with the rows with a set of discs and knives, and then roll with a Western Land Roller. This operation was followed within a few days by cross-cultivating with the same tools on a cultivator equipped with a disc-marker. A remarkably accurate job of spacing the rows had been done with a good operator using a 6-row cultivator on a small rubber-tired tractor.

All of the cultivating was done with the cultivator tools set on 20-inch centers and the width of the spacing for the hill was determined in each field by the stand and soil conditions. The discs were usually set to leave from 3 to 5 Inches un-cut in the row. Mr. Haines has attempted to regulate this width to leave at least 90 percent of the hills with 1 or more beets In them. Tt is possible that good even stands secured with some type of single-seed planting equipment may be cultivated to leave even a higher percentage of hills with plants in them.

After the first cross-cultivating, it has been the general practice to cultivate them at least once more with the row, and once more across the rows before they are hoed. This provides very complete soil tillage and destroys all of the weeds except in the hills. This practice is bound to conserve moisture and produce the maximum beet growth possible during a period which might not, by customary hand thinning, have produced much root development.

The hoeing operation is done with long-handled hoes and the men work back and forth across the field rather than in the direction the beets were originally planted, so they can readily see the number and spacing of the beets in the hill. By careful work these men have been able to reduce the number of beets in each hill to from 1 to 5 without any finger work.

Tn actual practice during 1940, this operation cost from $1.55 to $4.37 per acre with men being paid 35 cents per hour. On about 125 acres one additional hoeing was performed at a total average cost of $4.35 per acre compared to 168 acres which were hoed but once at a cost of $4.37 per acre. These amounts constituted the total hand-labor cost up to harvest.

In 1940, 3 plots were laid out in 3 different fields just after the first hoeing was completed. They were located in what appeared to be average conditions existing in each field and were 4 rows wide and 100 hills long, so that there were 1,200 hills included in the data secured. A careful count of the number of beets at that time showed that an average of 2.86 beets were left in each hill. At harvest time there was an average of 2.39 beets in each hill with the following distribution :

1 beet	2 beets	3 beets	4 beets	5 beets or more	Blanks
20.2 percent	26.9 percent	17.7 percent	10.3 percent	4.4 percent	20.5 percent

The 1,200 hills would represent 2,000 feet of continuous row. A total of 2,827 beets or 141 per 100 feet of row were counted following the first hoeing, and 2,283 beets or 114 per 100 feet were harvested.

Figure 1 shows the average weight of each beet and the total weight of beets per hill for the 1,200 hills weighed in 1940. The actual yield of the 293 acres cross-cultivated was 16.38 tons per acre and the 475 acres hand-thinned produced only 13.73 tons per acre. However, there were no direct comparisons between the two methods except that all of the cultural practices were carried on by the same men and equipment, and in the same general manner in both cases. This illustrates the fact that, while the size of the individual roots decreases as their number in each hill increases, the total weight of marketable beets remains about the same with 2, 3 or 4 beets growing in hills 20 inches apart in a row, and their weight will be greater than that of an individual beet in 20-inch spacing.

In 1941, the plots were not laid out at hoeing time so that there is no information available on the number of beets left per hill and stand. The weight and distribution data are calculated from 6 different double rows 100 hills long, representing 1,200 hills, which were

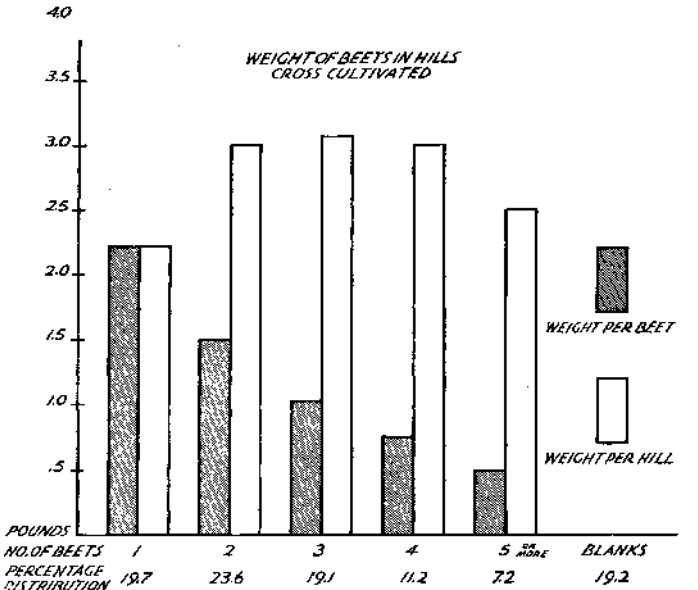

Figure 1.

selected at random during harvest. There were 123 beets per 100 feet of row in this 2,000 feet, with the following distribution:

1 beet	2 beets	3 beets	4 beets	5 beets or more	Blanks
19.7 percent	23.6 percent	19.1 percent	1.12 percent	7.2 percent	19.2 percent

Figure 2 shows the average weight of each beet and the total weight of beets per hill in this trial. The results in 1941 correspond fairly closely to the previous year.

The cost of hoeing in 1941 was considerably higher than in 1940 due to several factors: (1) The rate per hour was increased to 40 cents; (2) a poorer class of labor was available; (3) the later season and more frequent irrigations caused more weeds. The actual results on about 400 acres hoed once, and 350 acres hoed twice show a total cost for hand labor up to harvest of $7.38 per acre. Hand thinning and hoeing two times under comparable seasonal, soil and weed

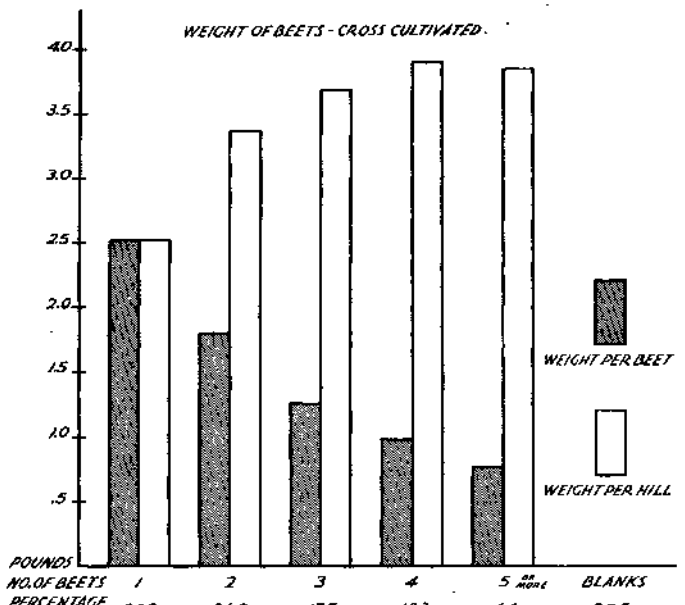

Figure 2.

conditions would probably have cost $8.00 per acre for thinning, and about $6.00 per acre for hoeing.

Summary

The general conclusions drawn from the experience with these specific plots, which were studied in considerable detail, and the more than 1,000 acres of field practice on 1he Hamilton City Ranch in 3 940 and 1941, as well as several other growers' results on smaller acreages, may be summarized as follows:

1. Any beet grower who has sufficient equipment and experience to grow a good crop under conventional hand-thinning methods can cross-cultivate his beets and produce a satisfactory crop at a substantial cash saving, and materially reduce the number and skill of the hand laborers required.

2. The general field practices need to be carefully and accurately done to secure good results.

3. The hoeing job should reduce the number of beets per hill to leave 2 to 4 plants.

4. The cross-cultivating, particularly if it includes deep chiseling, will definitely improve the penetration of irrigation water in tight soils.

5. Cross cultivation completed early will improve soil moisture by creating a more complete mulch, and will save moisture and soil fertility by preventing the early, heavy growth of the beets which are not needed, and weeds which are otherwise left in the row until thinning is done.

It is expected that there will be a substantial increase in the sugar-beet acreage handled by the cross-cultivating method in the Hamilton City District in 1942 with the view of reducing labor problems and costs.

Methods and Equipment for Fertilizing Row Crops

R. A. JONES[1]

There are three distinct methods of fertilizing row crops: (1) Broadcasting before planting, (2) fertilization at planting time, and (3) side-dressing after the crop is planted.

With the first method, the fertilizer is usually applied to the soil just prior to planting. A combination grain and fertilizer drill is the implement most commonly used, since with this implement the fertilizer can be drilled into the soil at any desired depth. Other implements, such as fertilizer-broadcasting machines manufactured by all implement companies, end-gate lime and fertilizer spreaders, and home-made cylinder spreaders such as the water-tank spreader, can be used to distribute the fertilizer evenly over the soil. With the broadcasting equipment, the fertilizer is usually distributed just prior to final preparation of the seedbed, as through preparation of the seedbed, the fertilizer becomes mixed with the top soil.

Advantages of Broadcast Method

The broadcast method of fertilization has a number of advantages: (1) It permits the use of heavier applications of fertilizer at planting time without the danger of seed germination injury; (2)

[1] Anaconda Sales Company.