Sugar Beet Spacing Trials

about 33,000 beet plants per acre most nearly maintained maximum sugar beet production in Imperial Valley tests

John E. Swift

Sugar beet population studies were carried on in the Imperial Valley during the 1948 and 1949 seasons to establish the optimum plant population—either by row spacing or plant spacing in the rows.

Trials were set up to run on individual farms and on plantings of different row widths. To gain desired population levels nearly uniform stands of beets were selected and were then thinned to various distances. Each replication of a population series was of such size to be just under a full truck load when harvested.

In the first—the 1947–1948—tests fields were selected which had single row plantings on 32- and 34-inch centered beds and a double row planting on a 42-inch centered bed.

An area—as uniform as possible—was selected and each replication of a plant spacing covered three beds for each single row planting and two beds for each double row planting. The fields varied in length from 1,000 to 1,200 feet.

Plant populations were obtained by hand thinning—with short handled hoes—consecutive rows to a given distance. The spacings used between plants were 4, 6, 8, 10, 12 and 16 inches. Each spacing was replicated in four blocks.

Populations on these plots were determined by making three counts in each row of each plot. The first count was made from 100 to 200 feet in from the edge of the field, the second count was made in the center of the field and the third count was made 100 to 200 feet in from the end of the field. Each area counted was 100 feet long and all plants in this area were counted. The final average from all counts for 100 feet of row was used for computing the total number of plants per acre and the actual spacing between plants.

From the figures obtained it was computed that one replication of the plot had 36,684 plants per acre and the distance between the plants was 5.07 inches. In this particular series the original attempt was to obtain plants spaced four inches apart.

In the 1947–1948 series of tests there was one test on single row 32-inch centered beds, two tests on single row 34-inch centered beds and one test on double row 42-inch centered beds.

In the second—the 1948–1949—series of tests the season began with one test on 26-inch single row beds, one test on single row 30-inch beds, one test on single row 32-inch beds, one test on single row 34-inch beds, one test on single row 36-inch beds and one test on double row 42-inch beds.

This report covers the results of both years and a total of six tests carried out on six different ranches.

Harvesting of the single row plots was done by a one-row harvester. The double row plots were harvested by hand crews. Each three or four rows of a replication were loaded into one truck and sent in for weighing.

All operations were handled the same as for commercial acreages of sugar beets except for a special sampling of roots for sugar content determination. The results from this sugar determination were compared to the sample taken by the sugar company at the dump and were found to be very little different in any case.

Populations ranged in these tests from 47,916 plants per acre on one replication of the attempted four-inch spacing on the 42-inch double row beets down to 9,309 plants on one replication of 16-inch spacing in the 34-inch single row planting.

Spacings between the plants ranged from 4.48 inches apart on one attempted four-inch planting on single row beets up to 18.59 inches apart on one 16-inch spacing in the double row planting.

For the most part actual spacings of the plants for attempted distances from eight inches on up stayed within one half to three fourths of an inch of the attempted spacing distance. The four- and six-inch attempted spacings varied from one to two inches wider than desired.

Average Yield of Sugar for Various Spacing Distance

Attempted spacing in inches	Ranch number and yield in tons of sugar per acre 1	2	3	4	5	6	Average of all ranches
4"	3.77	4.20	3.74	3.67	3.30	3.82	3.75
6"	3.34	3.81	3.59	3.84	3.17	3.62	3.56
8"	3.52	3.91	3.63	3.89	3.27	3.39	3.60
10"	3.38	3.71	3.63	3.50	3.03	3.44	3.44
12"	3.39	3.73	3.42	3.40	3.04	3.29	3.37
16"	2.85	3.38	3.26	3.06	3.58	3.16	3.21

.22 tons for significance at 19–1

Average Yield for Various Spacing Distances

Attempted spacing in inches	Ranch number and yield in tons per acre 1	2	3	4	5	6	Average of all ranches
4"	23.3	23.7	19.6	22.7	18.7	20.9	21.5
6"	20.9	21.3	18.8	22.6	18.0	19.4	20.2
8"	22.1	21.8	20.3	22.8	18.2	18.9	20.7
10"	21.5	21.1	20.0	21.9	17.4	18.9	20.1
12"	22.4	21.5	18.4	21.7	17.7	18.3	20.0
16"	18.6	20.0	18.4	19.9	15.2	17.5	18.2

.803 tons for significance at 19–1

All replications were kept separate and yield in tons per acre, were computed. The sugar percentage of all replications in a series of spacings were averaged, as was the tonnage per acre, and from this the average yield in tons of sugar per acre for a group of spacings calculated.

In all tests except one there was a greater yield in sugar per acre where the plant population was the highest. The difference between the four-, six-, and eight-inch spacing groups was not significant; the four-inch grouping was significantly better than the 10-, 12- and 16-inch groups at the 5% level, and the 16-inch spacing was significantly poorer than all other spacings except the 12-inch group.

The significance of the four-inch spacings over the others indicates strongly that a refinement of technique and grouping by populations instead of thinning distances will bring out that populations around 30–35,000 beets per acre will give better yields in sugar per acre. This analysis covered all populations in a thinning grouping and thereby allowed a large variation in population and yields.

The table in columns two and three illustrates the difference in yields in sugar of the various spacing groups.

There was very little difference in the

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Protein Intake of Laying Hens

two levels of protein in diet for laying hens compared in tests in southern California

A. T. Dietz

Hens in individual cages laid as well on a medium protein intake as on a diet with a high protein intake level during a six-month test on two ranches in the Pomona area.

Many southern California poultrymen using individual cage housing followed the practice of feeding 17% to 19% protein all mash rations and some poultrymen consistently fed rations containing 20% or more protein.

With two co-operating poultrymen a test was set up to make a comparison between rations containing about 16% and 19% protein. All conditions, including housing, age of birds and sources of stock, were as near the same for birds on each ration and on each ranch as was possible.

A total of 292 hens was used on each ration on the two ranches. On one ranch a two-row cage house of 448 4½-months-old White Leghorn pullets was used. Two small houses of 68 Rock-Leghorn Cross layers of different ages were used on the other ranch. Care was taken in this case to see that about equal numbers of birds of each of the several hatches were placed in each house.

The rations were compared for about six months, beginning early in June and ending early in December of 1949.

These rations were set up to utilize the ingredients which were readily available and economical in price at the time the test was started. Neither were considered as ideal rations for all time, but both should be examined periodically and changed to utilize low-cost ingredients.

Rations Used in the Test

	17% Medium	20% High
Barley	400	350
Milo	500	400
Corn	300	300
Fish meal (65%)	50	50
Meat meal (55%)	50	100
Soybean meal	200	300
Alfalfa meal	150	150
Wheat bran	300	300
Limestone	40	40
Shell, coarse. Fed in mash	40	40
Bone meal	20	10
Salt, iodized	10	10
D. act. Animal sterol	1	1
Fermentation by-product (2,000 mg. ribo. per pound)	1	1
Manganese sulfate	½	½
Total pounds	2062.5	2052.5
Total protein (calculated)	16.4%	19.24%
Total protein (actual)*	17.6%	20.1%
Per cent calcium	2.35	2.39
Per cent phosphorus	.82	.84
Vitamin A, I.U. per pound	5553	5581
Vitamin D A.O.A. C. per pound	440	442
Riboflavin mg. per pound	2.22	2.32

*Chemical analysis of four samples of each of the rations was made by the State feed laboratory. The samples were taken from the supply on the ranches during the last three months of the test.

The average egg production during the test period was 131.8 eggs per hen on the medium protein ration compared with 124.5 per hen for the high protein ration.

Culling and mortality were not widely different but the total of those that died and were culled was higher on the high protein ration on both ranches.

Feed consumption per bird was practically the same on both rations.

Feed cost was 18¢ per hundredweight higher for the high protein ration. Since feed cost was less and egg production was higher on the low protein ration, the feed cost per dozen eggs was lower by 2¢ as an average of the two ranches.

Care must be taken in drawing definite conclusions from a test of this type because it was conducted only in one area and under only two types of management and sources of stock. Different areas, different management, or different stock might give different results.

The results of this test have influenced many poultrymen in the Pomona area to change to a lower protein ration rather than to one with a higher protein level.

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Data from the Pomona Protein Intake Test

	Cooperator No. 1		Cooperator No. 2		Av. both ranches	
	Medium	High	Medium	High	Medium	High
Days of test	184	184	183	183		
Total number of hens	224	224	68.7	68.7		
Average number eggs laid per hen	123.6	119.6	139.9	129.4	131.8	124.5
Number died	18	15	1	0		
Number culled	32	44	14	16		
Number died and culled	50	59	15	16		
Average feed cost per cwt. (dollars)	3.95	4.13	3.82	4.00	3.89	4.07
Average feed cost per bird (dollars)	1.86	1.98	1.92	2.02	1.89	2.00
Average pounds feed consumed per hen	47.1	47.8	50.1	50.5	48.6	49.2
Feed cost per dozen eggs (cents)	18.1	19.9	16.4	18.7	17.3	19.3

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per cent sugar between most of the plant spacing groups except that the closer spacings were usually slightly higher than the others, but this was not a significant difference. The extreme spacings of 16 inches did show a difference in sugar content in that all cases but two the average per cent sugar of all replications of the 16-inch spacings was lower than any of the other plant spacings in these tests. The yield in tons of sugar per acre of the 16-inch spacings was also lower than any of the other spacing groups.

The populations in the given spacing groups varied considerably depending upon the row width, ranch and the adherence to the distance set. The greatest variations were in the four- and six-inch groupings. The other groupings were all nearly uniform under similar conditions.

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SOIL

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the loss of moisture below the surface layer.

At four of the locations small plots were sterilized with sodium borate to prevent the growth of vegetation and soil samples were taken over a five-year period. The results show that the losses of moisture were confined largely to the surface foot of soil. The difference between the soil-moisture content on the sterilized plots and that on the covered ones was striking. The moisture-content curves for the sterilized plots are almost horizontal for the five-year period whereas in the covered ones all of the available moisture was exhausted by midsummer.

Runoff

A plot year consists of one pair of plots for one year. For instance, in the Button Canyon plots there is one pair of plots for seven years; while for the Madera plots there are two pairs for two years. The compilation is for a total of 68 plot years.

The average runoff for all the plots is only about 7% of the rainfall, indicating high rates of infiltration. It has been said that chamise vegetation occupies sites where the soils have been damaged by burning implying that their infiltration capacities have been affected adversely. Since chamise occupies so much of the brush lands of the state, particular attention has been paid to it, and a number of chamise plots have been included in the experiments.

The runoff from the burned Button Canyon plot which is in a chamise area averaged only 0.17% of the rainfall. The chamise plots in Monterey County had only 0.4% of the rainfall in runoff, and the Ono chamise plots had a runoff of 14% of the rainfall.

There are 35 plot years where the runoff was greater from the burned areas than from the unburned, and 33 years when the unburned had the greater runoff. In most cases the differences between runoff under burned and unburned conditions are small.

The difference may seem large in a few cases—for example, the Oregon Oaks plots. For three years the average runoff from the covered plots was 0.04 inch as compared to 1.50 for the burned, a difference of about 37 times. Upon reversing the treatment for the next three years when the plot which previously had been vegetated was burned each year, the newly burned plot had only 0.01 inch runoff against 0.31 from the unburned—a difference of 31 times.

Another example is the Diamond Range plots. Here, when the runoff for four years averaged 1.19 inches for the unburned and 2.25 from the burned, there was a difference of about 1.9 times, but upon reversal the runoff from the unburned exceeded that from the burned by 1.92 times.

It is apparent that the differences in runoff are not significant but arise from variations in soil between the adjacent plots. There is also another factor which must be considered—the surprisingly large amount of water intercepted by the vegetation on the unburned plots—which means that much larger quantities of water were received by the soil on the burned areas than the unburned.

The interception was measured by the difference in catch of rain in the standard rain gauges exposed in the open on the burned plots and that in trough gauges placed under the vegetation in the covered plots. The average yearly amount of rain intercepted for the 68 plot years is 4.05 inches. The mean rainfall for all of the plots was 20.09 inches so that the interception was 20.11% on the average. Some of this water was evaporated from the leaves and some reached the ground by running down the stems of the plants, but the amounts are not known.

Erosion

The amount of erosion is small. The yearly average for the 71 plot years is 8.2 pounds for the unburned and 9.3 pounds for the burned plots. Converted to depth and using an average value for soil density these figures are 0.00049 for the unburned and 0.00056 for the burned. One pound of eroded material is about 0.00006 inch in depth.

There are 32 plot years where the erosion is greater from the unburned areas and 26 plot years where it is greatest from the burned areas. In 13 plot years there are equal amounts from the unburned and burned plots. The largest difference is for the Holland plots with an average annual erosion of 0.4 pounds for the unburned and 8.3 for the burned, or 21 times more erosion from the burned, but the actual difference is very small. In inches depth it amounts to only 0.0004 inch and upon reversal of the treatments the unburned had 0.8 and the burned 0.3 pound eroded.

The moisture properties of the soil in these experiments have not been adversely altered by burning. Runoff and erosion have not been accelerated in the areas where these experiments were conducted, and consequently burning should not be condemned at least for these localities.

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The yield in net tons per acre from all tests showed that a significant difference at 19 to one odds was obtained on all four-inch spacing over all others and that the yield of the 16-inch spacings was significantly poorer than all others. The spacing groups from six to 12 inches were not significantly different.

The table in columns one and two on page 6 shows the average yields of the various spacings attempted in these field studies.

The yield table shows that the attempted four-inch spacing regardless of the population is significantly better than all others and the 16-inch spacings are significantly poorer than all others. Also it is shown that there is no significant difference between any of the other spacings.

These differences are based on groupings and not on actual populations; of course, the closer spacings give the higher population. The four-inch spacings ranged from 47,000 plants per acre down to 21,000 plants per acre. These were the extremes. The average number of plants in all four-inch spacings were 34,968 plants per acre.

An analysis of this shows a significant difference at the 5% level between populations of 34,000 or more beets per acre—which were obtained in the four-inch spacings—over all other spacings. It was thought that possibly the inclusion of the 42-inch double row planting and one 34-inch single row planting which had high populations and a low yield might have a noticeable effect on these results. A second analysis was run excluding these two ranches and the average population of the four-inch spacing was reduced to 31,158 plants per acre. This made the significance of the four-inch spacing more pronounced than in the first analysis at the 5% level. This, of course, does not show that any given population is better than any other, but does point out that where the higher populations were obtained better yields resulted.

A closer study of the individual replications indicates a more uniform yield at the higher or population levels of 29–34,000 beets per acre. The other spacing groups gave some high yields but there are both high and low yields in these groups whereas in the higher populations, the yields are all in the same range.

It is believed under the conditions in Imperial Valley that if populations of around 33,000 beets per acre can be maintained more nearly maximum yields would be attained. This can be done by calculating on the basis of row width what plant spacing will give this population.

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