

PROSPECTS OF MINIMUM SEEDING RATES  
OF SUGAR BEETS FOR ELIMINATION OF HAND THINNING

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INTRODUCTION

The major problem confronting growers and processors of sugar beets at the present time and for many years past, is how to obtain by mechanical means satisfactorily thinned stands of beets, free of weeds. Elimination of the burden and the stigma of "stoop" labor is paramount if the industry is to be healthy and prosperous in a modern, competitive world.

Mechanical methods used heretofore have consisted chiefly of planting sufficient seed to provide a much greater stand than was actually desired for a plant population to produce the crop. The excess plants then were cut out, either by running a cultivator, equipped with knives and/or duckfeet, at right angles to the direction of the row; or by use of a "down the row" machine such as the "Dixie" beet thinner. The latter machine makes use of revolving knives to cut out the excess plants. Various schemes and modifications of machines have been and are being used with varying degrees of success. Essentially all such devices, regardless of type or modification, can do only one thing - cut a pre-determined space of the row and leave a portion, as a "block", containing the untouched beets. Unfortunately, no machine yet has been able to distinguish between beets and weeds. Neither is it able to leave by anything more than chance, those lone plants that would serve to close some of the long "skips" always present in machine thinned or blocked fields.

Limited information tends to support the theory that if placement of the seed, germination, and emergence of the seedling can be controlled, it would be possible to plant the desired amount of seed and eliminate all hand work beyond hoeing to control weeds. As yet, hoeing will need to be done. Elimination of weeds is not within the scope of the immediate discussion since it will be more adequately covered by other parts of the program of this meeting.

The general trend of growers on their own initiative, since the introduction of segmented seed, has been toward lower seeding rates.

EXPERIMENTAL RESULTS AND DISCUSSION

In 1945, after making plantings at various rates and with various types of seed, the question arose: Can segmented seed be distributed with enough precision with present drills to require no hand thinning? Then, can germination and emergence be controlled adequately to insure getting the planted seed to a growing plant? On July 18, 1945, a planting was made with the John Deere #18 drill equipped with small, smooth tubes, 72-hole

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plates, 12-tooth gear, seeding approximately 2# per acre. The plot was irrigated for germination. A second trial was made in August, 1945, after examining the stands obtained in the July planting. Irrigation for germination was necessary in the August planting. Because of the lateness of the dates of planting no attempt was made to collect data on yield. The stand counts are presented in table 1.

Table I. Germination Stand Data for 1945 Plantings with Low Seeding Rates

| Date of Planting | Seeds Per Foot | Germ. (a)       |  | Total Beets Per 100 Ft. | Percent (b) |                   |
|------------------|----------------|-----------------|--|-------------------------|-------------|-------------------|
|                  |                | Stand - Percent |  |                         | Stand       | Single Beet Hills |
| July             | 3-4            | 10.5            |  | 146                     | 126         | 84                |
| August           | 3-4            | 13.8            |  | 204                     | 110         | 62                |

(a) Inches containing beets in 100".

(b) Beet-containing blocks per 100'.

The seed used was the same as the general issue to growers in the area. It had the following characteristics: Segmented, size 7-10/64; germination, 70 percent; single-germ units, 53 percent. It is evident from the foregoing table that a poorer distribution of seed was obtained in the August planting, averaging almost two beets per foot.

In 1946, The Beet Sugar Development Foundation, in cooperative tests with beet processors and state experiment stations, studied low rate of seeding, unthinned, compared with average rate of seeding thinned with long-handled hoe. The Great Western Sugar Company conducted three such cooperative tests, located at Billings, Montana, Longmont, Colorado, and Windsor, Colorado. At Billings stands obtained for the 2-pound planting were about double the desired population, and it was necessary to reduce stands by means of the long-handled hoe to satisfy the grower. At each of the other locations, conditions were such that stands could be carried to completion according to plan. Table 2 gives the germination stand data for each of the three locations: Billings, Montana, Longmont and Windsor, Colorado.

Table 2. Germination Stand Data, "Supplementary Test," 1946. Cooperative with The Beet Sugar Development Foundation Summary for Three Locations: Billings, Montana, Longmont, Colorado, and Windsor, Colo.

| Treatment                  | Beets per 100' |      |      | Plant Population (Beets per Acre) |       |        | Percent Potential Germ. |      |      |
|----------------------------|----------------|------|------|-----------------------------------|-------|--------|-------------------------|------|------|
|                            | Blgs.          | Lmt. | Wsr. | Blgs.                             | Lmt.  | Wsr.   | Blgs.                   | Lmt. | Wsr. |
| 1. 3-4 seed pieces per ft. | 243            | 85   | 384  | 57737                             | 22216 | 100362 | 81                      | 19   | 87   |
| 2. 6-8 seed pieces per ft. | 403            | 168  | 683  | 95752                             | 43908 | 178509 | 68                      | 19   | 78   |

Of the three locations, Windsor was the only one receiving irrigation for germination. This accounts for the unusually high percent of potential for that location. At Billings, germination conditions were good without

supplemental irrigation. An extremely dry spring was experienced at Longmont which accounts for the small number of beets emerging at that location. The conditions affecting germination then become controlling factors in obtaining stands and the question becomes, "How well and to what extent can these factors be controlled?" Temperature and moisture at planting time are determinants. Temperatures may slow down or speed up the process, but customarily are within an acceptable range for the initiation of plant growth. Soil moisture, in many areas, cannot be completely controlled. This is especially true for all areas not having adequate supply of early irrigation water and those beet growing areas in the region of the Great Lakes where natural precipitation is depended upon for production of the crop.

In southern Montana and northern Wyoming (Big Horn Basin area) plentiful water for irrigation is available at an early season as well as through the summer. The common practice for the Wyoming area is to irrigate for germination as annual precipitation averages only about 7 inches per year. Under such conditions of irrigation, the soil moisture factor can be controlled almost 100 percent. With anything near precision placement of the seed, then, it should be unnecessary to do anything beyond a hoeing job for removal of weeds. An occasional beet plant or "double" can at the same time be removed and enhance the stand characteristics. Extra beet plants in this theory constitute "weeds" since they cost time and effort in their removal.

The authors are fully aware of the many other ills and plagues which beset the beet crop from the time the seed is placed in the soil. Seedling diseases may cause loss of stand before emergence or afterward, but new and modern fungicides are reducing such losses; insect enemies may attack seedlings, but DDT and other new insecticides are giving remarkable control; wind and freezing are as likely to destroy both heavy and low seedings. Other field crops all suffer from enemies of a similar nature, yet they are planted only in the amount desired to produce plants.

At Longmont an additional planting was made for study of the effect of "delayed" thinning in the comparison "no thinning versus long-handled-hoe thinning." The differences between dates of thinning was based on the number of leaves; i.e., 4 leaves versus 8 leaves. At Billings, two additional treatments were added: (1) whole seed graded 7-10/64", planted 6-8 seed pieces per foot; (2) whole ungraded seed at 15 pounds per acre. The latter are for time comparisons and need not be considered here. Final evidence of the harvest data from these three locations are enlightening and are given in table 3.

Table 3. Summarized Harvest Results for Three Locations

| <u>Longmont, Colorado</u>   | <u>Marketable</u> |              |               |               | <u>Non-</u>       |
|---|-------------------|--------------|---------------|---------------|-------------------|
|   | <u>Tons</u>       | <u>%</u>     | <u>Pounds</u> | <u>No.</u>    | <u>Marketable</u> |
| <u>Treatment</u>  | <u>Beets</u>      | <u>Sugar</u> | <u>Sugar</u>  | <u>Beets</u>  | <u>Beets</u>      |
|   | <u>per A.</u>     | <u>Sugar</u> | <u>per A.</u> | <u>per A.</u> | <u>per A.</u>     |
| 1. Seeding rate, 3 seed portions per foot. No thinning.                               | 19.11             | 10.15        | 3879          | 19174         | 52                |
| 2. Seeding rate, 6-8 seed portions per foot. Long-handled hoe thinning, 4-leaf stage. | 19.40             | 10.51        | 4078          | 21000         | 52                |
| General Mean  | 19.25             | 10.33        | 3978          | 20087         | 52                |
| CV (%)  | 18.75             | 11.81        | 22.17         | -             | -                 |
| Sm in % of General Mean   | 2.71              | 3.15         | 3.20          | -             | -                 |
| LSD 5% pt.  | *                 | *            | *             | -             | -                 |
| LSD 1% pt.  | *                 | *            | *             | -             | -                 |
| 3. Seeding rate, 3 seed portions per foot. No thinning.                               | 20.14             | 12.54        | 5051          | 18102         | -                 |
| 4. Seeding rate 6-8 seed portions per foot. Long-handled hoe thinning, 8-leaf stage.  | 19.39             | 13.05        | 5061          | 24794         | 44                |
| General Mean  | 19.76             | 12.79        | 5056          | 21448         | 22                |
| CV (%)  | 19.72             | 10.16        | 22.15         | -             | -                 |
| Sm in % of General Mean   | 2.57              | 2.45         | 2.88          | -             | -                 |
| LSD 5% pt.  | *                 | *            | *             | -             | -                 |
| LSD 1% pt.  | *                 | *            | *             | -             | -                 |
| <u>Windsor, Colorado</u>  |                   |              |               |               |                   |
| 1. Seeding rate, 3 seed portions per foot. No thinning.                               | 13.24             | 13.67        | 3620          | 44721         | 4791(a)           |
| 2. Seeding rate, 6-8 seed portions per foot. Long-handled hoe thinning, 4-leaf stage. | 16.51             | 13.55        | 4474          | 25496         | 174               |
| General Mean  | 14.87             | 13.61        | 4047          | 35108         | -                 |
| CV (%)  | 21.37             | 10.21        | 23.65         | -             | -                 |
| Sm in % of General Mean   | 3.97              | 2.63         | 4.39          | -             | -                 |
| LSD 5% pt.  | 1.71              | *            | 511           | -             | -                 |
| LSD 1% pt.  | 2.31              | *            | 693           | -             | -                 |
| <u>Billings, Montana</u>  |                   |              |               |               |                   |
| 1. Segmented seed, 3 seed portions per foot.  | 24.63             | 17.2         | 8481          | 26433         | -                 |
| 2. Segmented seed, 6-8 seed portions per foot.  | 24.44             | 16.9         | 8277          | 27423         | -                 |
| 3. Whole seed, graded 7-10/64" 6-8 seed portions per foot.                            | 24.41             | 17.4         | 8490          | 25800         | -                 |
| 4. 15# whole, ungraded seed per acre  | 25.29             | 17.5         | 8833          | 25245         | -                 |
| General Mean  | 24.69             | 17.24        | 8520          | 26225         | -                 |
| CV (%)  | 3.83              | 2.28         | 5.63          | -             | -                 |
| Sm in % of General Mean   | 1.56              | .93          | 2.30          | -             | -                 |
| LSD 5% pt.  | *                 | .48          | *             | -             | -                 |
| LSD 1% pt.  | *                 | *            | *             | -             | -                 |

\* No significant differences  
(a Wt. of unmarketable beets for treatment 1 at Windsor-0.18 T/A.

As was previously indicated, Treatment 1 (the low seeding rate) at Billings was thinned with the long-handled hoe. The only advantage, therefore, for this treatment was in the saving of labor for thinning since the plots planted to the low rate of seeding consumed only 5.4 man hours per acre to hoe thin as compared with 6.3 man hours for the heavier rate. It is interesting to note that a very good yield, which was equal to that for the heavier rate of seeding, was obtained from planting only 3 seed portions per foot at Longmont where the germination stand was only 19 percent of potential. The fact that delayed thinning at Longmont caused no loss in yield is indicative of lack of any crowding of the plants prior to thinning. The difference in sugar percent between early and delayed thinning at Longmont is believed to have been caused entirely by soil heterogeneity. Treatments 1 and 2 were not randomized with treatments 3 and 4. The significant loss in yield at Windsor for the non-thinned treatment is explained by the wide difference in population of plants per acre. The stand figure given in table 3 of 44721 beets per acre represents the harvested roots. Actual germination stand was 100362 beets per acre, or more than twice the harvested stand, even though no thinning was done. Non-marketables, as harvested, account for only a fraction of the difference in number of roots, and as indicated at the bottom of the table, only .18 tons per acre. Apparently, a considerable number of the seedlings were unable to survive the competition, while others may have been too small to harvest.

After the failure of the 1946 no-thinning test at Billings due to "too good" stands, a planting was made at one-half the rate prescribed for the previous test. Since the available drill could not be reduced to plant 1 pound per acre by means of gears, plates were made from blanks, with 36 holes instead of the conventional 72 (J.D. #13). This rate of seeding was compared with a slightly higher rate, thinned by means of the long-handled hoe. In addition, whole seed graded, 7-10/64" was compared at the low rate of seeding unthinned. Stand counts are given in table 4 and yield data as table 5.

Table 4. Germination Stand Data, Minimum Seeding - Billings, Montana, 1946

| <u>Treatment</u>                  | <u>Seed Units<br/>per Foot</u> | <u>Beets per 100<br/>Ft. of Row</u> | <u>Percent<br/>Double<br/>Plant Hills</u> | <u>Percent<br/>Potential<br/>Germination</u> |
|-----------------------------------|--------------------------------|-------------------------------------|---|--|
| 1. Whole seed, graded<br>7-10/64" | 1-2                            | 130                                 | 15  | 87   |
| 2. Segmented seed                 | 1-2                            | 157                                 | 18  | 91   |
| 3. Segmented seed                 | 2-3                            | 216                                 | 18  | 94   |

Table 5. Minimum Seeding Study, Billings, 1946

| Treatment   | Tons   | %     | Pounds      | Beets per |
|---|--------|-------|-------------|-----------|
|   | Beets  |       | Gross Sugar |           |
|   | per A. | Sugar | Per A.      |           |
| 1. Whole seed, graded 7-10/64"<br>1.5 seeds per foot. Hoëing<br>only. No beets removed. | 12.82  | 16.3  | 4179        | 132       |
| 2. Segmented seed. 1.5 seeds per<br>foot. Hoëing only. No beets<br>removed.             | 12.17  | 16.7  | 4065        | 147       |
| 3. Segmented seed. 2.3 seeds per<br>foot. Long-handled-hoe<br>Thinned.                  | 11.58  | 16.2  | 3752        | 102       |

Planted May 21, 1946. No irrigation for germination, but irrigated in seedling stage.  
Harvested October 17, 1946.

Actually, the stands in treatments 1 and 2 above (tables 4 and 5) could have been improved at hoeing time, but labor was specifically instructed for the purpose of the experiment not to remove any beets. This procedure required somewhat more time than the treatment where beets were removed as the weeds were hoed.

The differences cannot be held as significant since replication was absent; but field uniformity was excellent. The plot was not irrigated for germination, but was irrigated in the seedling stage. It was planted late - May 21.

In a test at Greeley, Colorado,\* designed to test distribution obtained by closure of plate cells in various patterns, two treatments of low seeding rate, unthinned, were compared with a slightly higher rate, hand thinned. Harvest data from this test are given in table 6.

Table 6. Summary of Results, Light Seeding Rates with Plate Cells Closed in Various Patterns, Greeley, Colorado - 1946

| Treatment                                      | Seed Units<br>per Foot | Lbs. Seed<br>Per Acre | Harvest Data           |            |                       |
|--|------------------------|-----------------------|------------------------|------------|-----------------------|
|  |                        |                       | Tons Beets<br>per Acre | %<br>Sugar | Beets per<br>100' Row |
| 1. 3 cells closed and 3<br>open, hand thinned. | 3.27                   | 1.77                  | 13.99                  | 15.84      | 72                    |
| 2. 4 cells closed and 2<br>open, not thinned.  | 1.97                   | 1.06                  | 11.64                  | 16.14      | 106                   |
| 3. 2 cells closed and 1<br>open, not thinned.  | 2.52                   | 1.36                  | 13.34                  | 16.08      | 104                   |

The observer's comment is worthy of note: "It is questionable whether reported yield differences are significant. The fact that yields are almost the same and that there is a 50 percent saving of labor with treatments 2 and 3 over treatment 1 is an interesting observation and one worthy of further study."

\* Conducted by Howard Rienks, Fieldman, The Great Western Sugar Company, and G. W. Howard, Engineer, The Beet Sugar Development Foundation

SUMMARY

All the information bearing on the subject of low seeding rates with no hand thinning is admittedly very preliminary in nature. Nevertheless, it is sufficient to encourage further study, especially in those areas where soil moisture levels are very stable or can be controlled by irrigation at germinating time.