Results of a Fertilizer Starter Test in Alberta

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The length of the growing period in any given year has a great effect on the yield of sugarbeets produced in Alberta. Harvest dates are decided upon on the basis of factory operation and are relatively constant, while seasonal conditions prevailing in the spring may vary considerably from year to year.

Fear of killing frosts and the frequently-observed slow growth of early plantings too often discourage the general early start of field operations even in favorable years. Practices that may stimulate early seedling growth can be of great practical value.

Review of Literature

Dubetz (2)[2] in Alberta reported on the effects of fertilizers and osmotic pressure on germination of sugarbeet seed, proving that solutions of osmotic pressure exceeding 6 atmospheres significantly inhibited germination.

Johnson (3) in Colorado found that early plant growth can be stimulated by small, inexpensive applications of fertilizer at planting time, thus enabling the seedlings to withstand disease and weather hazards during this critical period. He reported greater responses to phosphate than to nitrogens and suggested that too heavy applications may have toxic rather than beneficial effects.

Schmehl (5) in Colorado compared the phosphate responses of beets planted in a treated and rototilled band 4″ wide and 4″ deep with those of beets receiving phosphates from a concentrated band 4″ deep and 4″ to the side of the row. The uptake of phosphorus initially higher for the rototilled treatment, became lower later in the season suggesting a transfer of root activity to different soil zones.

Larson (4) in Montana recommended that phosphate be placed close to the seed for early season uptake and throughout deeper and constantly moist soil layers for later availability. His experimental data show clearly the yield advantages of broadcasting and plowing P_2O_5 in the fall over banded spring applications. Furthermore, remarkable "starter" effects resulted from additional application of phosphate with the seed. These results were essentially confirmed by Schmehl and others.

Afanasiev (1) reported on early vigor of beets resulting from satisfactory nutrient balances, which reduced the incidence of "black root" disease.

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[2] Numbers in parentheses refer to literature cited.

Comparisons between side-dressed applications of treble superphosphate and liquid phosphoric acid (7) have shown these two sources of P_2O_5 to be approximately equivalent.

Materials and Methods

A factorial experiment including three factors at two levels was conducted during the spring of 1968 at Taber, Alberta. Objective of the test was to observe the occurrence of "starter effects" from liquid fertilizer application to sugarbeet seed at planting time.

Factors and their levels were as follows:

Planting Dates	d_0	April 17
	d_1	May 3
Nitrogen	n_0	-----
	n_1	9¼ lb/acre
P_2O_5	p_0	-----
	p_1	10½ lb/acre

The resulting 8-treatment combinations were replicated eight times. The design was of a randomized block type. Stand records were gathered on June 20 by counting the number of seedlings in 80 feet of row per plot and by weighing the seedlings to measure their vigor.

Both N and P_2O_5 were applied as solutions directly over the seed at planting time through calibrated orifices. The N solution was a commercial 28-0-0 preparation, and the 30% liquid phosphoric acid for the experiment was made available by a fertilizer manufacturing firm.

An experimental applicator was assembled capable of metering two solutions independently of each other or simultaneously. Compressed nitrogen gas was used as a source of pressure.

The 1967 fall sampling of the 13-acre field on which the test was located gave a nitrogen reading of approximately 80 lb/acre and a P_2O_5 level of 40 lb/acre. Commercial fertilizer had been broadcast and plowed under during the 1967 summer.

The phenoldisulfonic acid method was used for the N test; a modified Bray method for P, using 0.03N NH_4F and 0.03N H_2SO_4 as extractants, and vanadate - molybdate for color development. K was extracted using 1N NH_4AC.

Solution fertilizers were chosen as a most practical way of reducing rates well below the levels of standard fertilizer applications.

The weights of early and late seedlings were in a 1 to 2.5 ratio. Contributions to the sum of squares of data considerably different in size may detract from the validity of the analysis of variance. However, in this instance, the analysis of variance of the raw data for seedling weights was not different from the analysis of their logarithms.

Results

Stand evaluation produced two sets of data: numbers of seedlings per plot and average seedling weights. Averages for each of the 8-treatment combinations are given in Table 1.

Table 1.—Stand evaluation. Treatment averages for 80 ft rows.

Two-way tables.

Seedling numbers

	d_0	d_1	
n_0	114	166	140
n_1	83	122	103
p_0	99	150	125
p_1	99	138	118
	99	144	
	n_0	n_1	
p_0	147	102	125
p_1	133	103	118
	140	103	

L.S.D. 5% 8.4 seedlings
L.S.D. 1% 11.1 seedlings

Seedling weights in oz.

	d_0	d_1	
n_0	1.65	.64	1.15
n_1	1.66	.63	1.15
p_0	1.24	.55	.89
p_1	2.08	.72	1.40
	1.66	.63	
	n_0	n_1	
p_0	.90	.88	.89
p_1	1.39	1.41	1.40
	1.15	1.15	

L.S.D. 5% 0.132 ozs/sdl.
L.S.D. 1% 0.176 ozs/sdl.

Seedling counts were significantly higher for the late planting date. 30.1% of the seeds planted on April 17 and 47.4% of those planted on May 3 produced surviving seedlings at the date of evaluation. Average seedling weights were respectively 1.66 and 0.63 oz per plant, significantly in favor of the early planting.

Nitrogen at the level of 9¼ lb/acre reduced seedling numbers from 140 to 103. This significant loss in numbers was not compensated by increased seedling vigor. P_2O_5 did not significantly alter seedling counts, although resulting in a highly significant increase in their weights from .89 to 1.40 oz per plant. The significant DxP interaction for the seedling weight data pointed out a more marked response to P_2O_5 at the earlier than at the later planting date.

Discussion

Frost reduced the stand density for the early planting date more severely than for the later one. However, the earlier seedlings, particularly those receiving phosphate, were far more vigorous than the later ones.

The amount of 28-0-0 N solution applied with the seed supplied approximately 10 lb/acre of nitrogen. This amount is equivalent in quantity, although not in chemical form, to the amounts of N provided by 100 lb/acre of 11-48-0 placed with the seed. The depressing effects on germination agree with Dubetz's results, and under the conditions of this test were not compensated by gains in vigor.

In contrast to nitrogen responses, 10 lb/acre of P_2O_5 supplied as phosphoric acid gave growth stimulation, particularly evident in the earlier plantings. The amounts of P_2O_5 used in the test approach 1/5 of those supplied by a 100 lb/acre application of 11-48-0.

Summary and Conclusions

The results of this test indicate that on land well supplied with nutrients, small amounts of phosphoric acid applied with the seed may produce a considerable increase in vigor of seedlings particularly noticeable in early planted fields.

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