Gibberellic Acid as a Growth Accelerator on Sugar Beets

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Gibberellic acid (GA) has been shown, by Marth and Mitchell (1, 2)[2] and Wittwer and Bukovac (3, 4) to promote seed germination and accelerate the subsequent growth and development of seedling plants. Since early emergence and rapid initial growth of sugar beets are frequently important in reducing the latter losses due to damping-off organisms and nematodes, it appeared desirable to evaluate the effectiveness of GA on sugar beets in the seedling stage. It also appeared possible that GA would have some effect on sugar production due to probable changes in leaf size or shape. The experiment reported here was designed to provide information on these questions.

Materials and Methods

US 56/2 was the seed variety used for this experiment. The seed had been decorticated and treated with Phygon and Lindane. The plants were grown in used shortening cans, 10 inches in diameter by 12 inches deep, filled with No. 2 grade vermiculite.

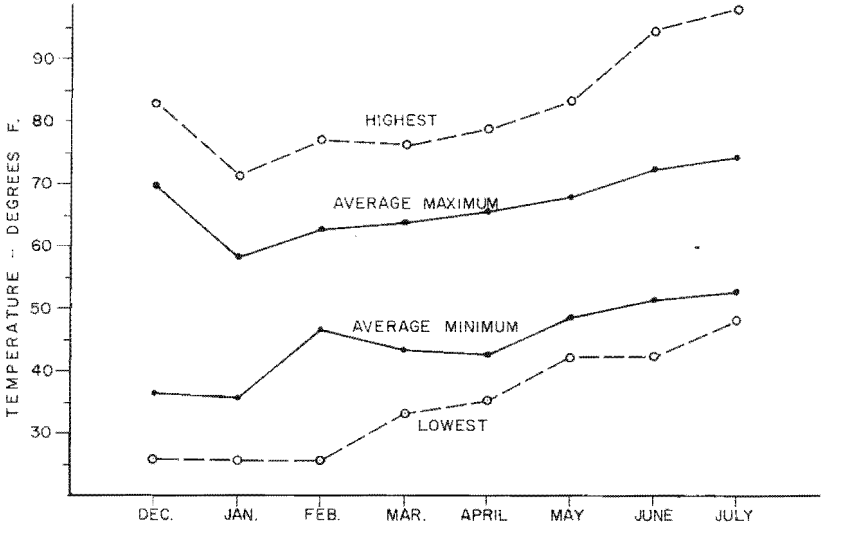

Figure 1.—Temperatures for the growing period of 1957.

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[2] Numbers in parentheses refer to literature cited.

On December 11, 1956, 20 seeds were planted per pot, evenly spaced in a circle, midway between the center and edge, 3/4 inch deep. After emergence, the plants were thinned periodically until only 2 plants remained in each pot. Forty such pots were set out in a 10 by 4 randomized pattern 20 to 24 inches apart under natural environmental conditions.

The graph in Figure 1, constructed from data obtained from the U. S. Weather Bureau at Santa Maria, California, shows no radical departure between highest or lowest, or between average maximum and average minimum temperature for the growing period. Pots were turned and re-randomized every 30 days. Hoagland's No. 1 solution (5) was applied daily in sufficient quantities so that solution dripped from holes punched in bottom of cans for 10 to 15 minutes after applying.

After the first root and foliar GA applications were made in January, 1957, the nitrogen level of the solution was doubled to avoid any possibility of spindly growth due to nitrogen deficiency which might have resulted from growth promotive effects of the GA. NO_3-N content of the beet petioles was determined from samples collected periodically. Six weeks prior to harvest, on July 12-15, 1957, the nitrogen level of the solution was reduced and the NO_3-N content of the petioles dropped slightly below the critical level of 1000 p.p.m. This procedure, as outlined by Ulrich (6), was used to obtain as high a sucrose content as possible.

The GA used in this experiment was obtained from two sources. The potassium salt of gibberellic acid called "Gibrel" by Merck & Company and gibberellic acid, as such, from Eli Lilly & Company.[3] The 40 pots had previously been randomly divided into four groups of 10 each. Three different GA treatments were applied to three of the groups while the fourth was left as the untreated control. Treatments were as follows:

A. **Seed treatment:** Prior to planting, the seed was soaked for 48 hours in an aqueous solution of 10 p.p.m. of GA. No further applications of GA were made to this group.

B. **Root treatment.** When the plants had reached the four-leaf stage, GA was injected into the vermiculite as a root application. Five ml. of a 100 p.p.m. solution was injected one inch away from the plant and one and three-quarter inches deep in the vermiculite. Two injections per plant (on opposite sides) equivalent to 1000 micrograms per plant were used per application. Four such

[3] The donation of sufficient quantities of Gibberellic acid for this experiment by Eli Lilly & Company, and Merck & Company, is hereby gratefully acknowledged.

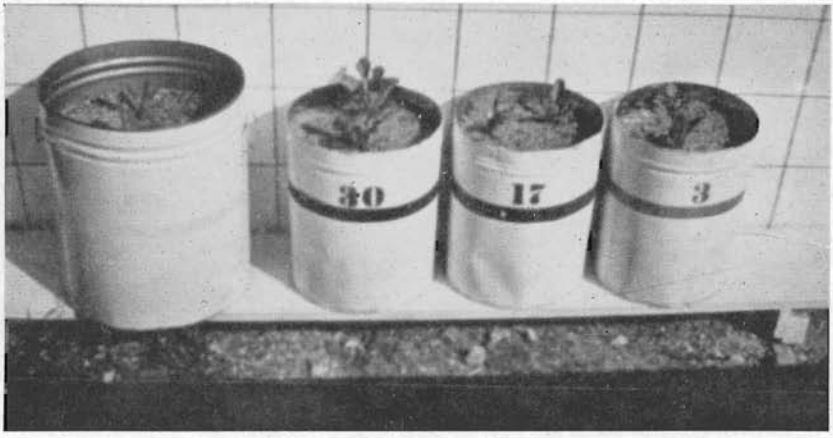

Figure 2.—February 21, 1957, 70 days after planting date.

applications, approximately 30 days apart, were made during the early part of the growing season, from January 16, 1957, to April 25, 1957.

C. **Foliar treatment.** Foliar applications were made at the rate of 0.3 ml. of a 100 p.p.m. GA solution (30 micrograms per plant per application) in the center of the leaf rossette. Four such applications were made on the same time schedule as the root treatment.

D. **Untreated control group.**

Due to the relatively small population involved, root weight, sucrose, top weight, height of tops, and leaf count were all determined on individual-plant basis.

Experimental Results

Emergence of the seedlings was about the same for all of the plants. No significant difference could be detected between the seed treated group and the others. By January 10, 1957, 30 days after planting, all of the plants in the seed treated group were in the four-leaf stage. Six days later the remainder of the plants, none of which had been treated with GA, began to show four-leaf development. All pots had been periodically thinned, until at this stage, only two plants per pot remained. On January 16, 1957, the first root and foliar applications were made.

As shown in Figure 2, the seed treated plants (No. 30) were maintaining their lead 70 days after planting and 30 days after first application of GA to other plants.

Figure 3.—March 18, 1957, 95 days after planting date.

Figure 4.—April 24, 1957, 135 days after planting date.

On March 18, 1957, Figure 3, 95 days after planting, the seed treated plants still showed a significant difference in top growth. By April 24, 1957, 135 days after planting, Figure 4, this initial growth advantage had leveled out and the root treated plants (No. 39) showed a marked growth acceleration. The foliar treated plants (No. 17) showed very little, if any, response. In all probability the amounts of GA applied to this group were too small. As more than one-half of the growing season had elapsed, no change was made in the amount of GA applied to the leaves.

During the earlier part of this experiment there was some doubt as to whether translocation of the GA through the root system would take place. By May 25, 1957, Figure 5, it was quite obvious that this had occurred. All of the plants receiving the root treatment showed elongation of petioles and much larger

leaves, lighter green in color than the control plants. This unusual top growth is characteristic of a plants response to GA.

Table 1 shows there is no significant difference in sucrose content or root weight between any of the treated groups and the control. The significant difference is in the top weight and top height.

Figure 5.—May 25, 1957, 162 days after planting date and 30 days after fourth application of gibberellic acid.

Table 1.—Yield Data for the Three Methods of Gibberellic Acid Application.

Treatment	Sugar Percent	Root Weight Pounds	Top Weight Pounds	Top Height Inches	Leaves Number
Soil injection	15.89	3.54	3.40	24.7	157
Seed	16.17	3.20	2.00	16.7	139
Leaf	16.80	3.02	1.84	18.9	95
Control	16.01	3.35	2.02	18.3	114
F-Value	1.54	1.31	9.46	18.70	2.11
L.S.D. 5%	N.S.	N.S.	0.69	2.3	N.S.

Required F-value at the 5% level, 2.92; 1% level, 4.68

Summary

1. Three concentrations and three methods of applying GA were used. Seeds were treated only once in a 10 p.p.m. solution. Roots had 1000 micrograms per plant applied, and foliar

treatment was at the rate of 30 micrograms per plant. Both root and foliar applications were made four times during the growing season.

2. Seed treated plants showed accelerated early growth.

3. Root treated plants showed translocation of GA from root to tops resulting in a green top weight nearly equal to the root weight.

4. No response was noted in the foliar treated group.

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