The Effects of Maleic Hydrazide and 2,4-D on Sugar Beet Growth and Sugar Content in Certain Field Experiments

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Previous work by Mikkelsen, et al. (2)[2] on organic soils of the Sacramento-San Joaquin Delta area of California has indicated that the yield and sucrose content of sugar beets can be favorably affected by growth regulators. Sucrose percentage and sugar yield per acre of treated beets have been increased. Under certain conditions root yields have also been increased. Erickson and Price (1) and Mikkelsen et al. (2) have presented data showing maleic hydrazide to be influential in hastening maturity, as indicated by increased root/top ratios. The physiological maturity of the beets, concentration of the growth regulator and the time of harvest influence the intensity of the responses obtained (2). Other tests have indicated that 2,4-D may temporarily induce higher sugar percentages. Such effects were observed to be of a short time duration.[3] Rasmussen (3) has shown that carbohydrates reserves are depleted under the influence of applications of this regulant.

This experiment was designed to evaluate the effects of maleic hydrazide and 2,4-D on sucrose accumulation and yield of sugar beets as influenced by the time lapse between treatment applications and harvest dates.

Table 1.—The Average Effect of Maleic Hydrazide and 2,4-D Treatments on Sucrose Content of Sugar Beets at Three Harvest Dates.

Treatments	Sucrose Content (percent) Harvest Dates 9/25/51	10/16/51	11/6/51	Ave. Treatment Effect
Check	12.1	13.5	13.9	13.1
MH (0.3%)	13.4	14.1	14.7	14.1
2,4-D (0.025%)	12.9	12.9	12.1	12.3
Ave. Time Effect	12.5	13.5	13.6	

L.S.D. (0.05) Dates and Treatments — 0.51
C.V. = 5.2%

Experimental Procedure

A commercial sugar beet planting, variety U. S. 22, on peaty muck of the Venice soil series, San Joaquin County, California, was used in this experiment. This site was selected because it is located in an area which has historically produced sugar beets of high yield, but relatively low sugar content. The sugar beets in the experimental plots were representative of the area, of uniform stand and appeared to be growing rapidly.

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[2] Numbers in parentheses refer to literature cited.
[3] R. S. Baskett—Unpublished data.

The experimental design consisted of completely randomized blocks, with three treatments, three dates of harvest and five replications. Each plot consisted of six 60-foot rows. Maleic hydrazide was applied as a foliar spray, at a concentration of 0.3 percent of active ingredient.[4] "Dreft," a commercial detergent, at a concentration of 0.05 percent, was used as a spreader in the maleic hydrazide mixture. The sodium salt of 2,4-D was applied at a concentration of 0.025 percent. These concentrations were used because previous work had indicated that they were near the optimum rates. Both materials were applied with knapsack sprayers, at the rate of 50 gallons an acre. This rate of application gave good coverage of the foliar parts. The original applications were made on September 4, 1951. The center 50 feet of the four middle rows were harvested for yield determinations. Four representative samples, each containing approximately 20 beets, were then taken from each plot for sugar and tare determinations.[5]

Results and Discussion

The effects of maleic hydrazide and 2,4-D on the sugar content of beets at 21-day harvest intervals are presented in Table 1. The maleic hydrazide treatment significantly increased the sugar content as compared with the untreated beets at all harvest dates. Its maximum effect was expressed 21

Table 2—Average Effect of Maleic Hydrazide and 2,4-D Treatments on Sugar Beet Yields at Three Harvest Dates.

Treatments	Yields (tons per acre) Harvest Dates 9/25/51	10/16/51	11/6/51	Ave. Treatment Effect
Check	15.3	16.6	15.9	16.3
MH (0.3%)	15.9	15.4	16.0	15.8
2,4-D (0.025%)	16.5	16.2	18.6	17.1
Ave. Time Effect	15.9	16.0	17.2	

L.S.D. (0.05) Dates and Treatments — 1.02
C.V. = 8.4%

days after treatment, when the average sucrose increase over the check plots was 1.3 percent. This represents a 9.8 percent increase in sucrose content. Two,4-D treatments had a depressive effect on sucrose accumulation. This effect was not observed at the first harvest date, but at successive harvests the average sucrose content was reduced as compared to the checks. At the last harvest date a lowering of 1.8 percent occurred in beets from the 2,4-D-treated plots as compared to those of the check. There was no significant interaction between time and any treatment under the conditions of this experiment, even though the 2,4-D-treated beets appeared to decline in sugar content with time when compared to the check and the maleic hydrazide treated beets.

The average treatment effects of 2,4-D and maleic hydrazide on yield were not significantly different from the check as shown in Table 2. Beets

[4] Maleic hydrazide, as the diethanolamine formulation, was supplied by the Naugatuck Chemical Division, U. S. Rubber Company.

[5] Sucrose analyses were made by the Holly Sugar Corporation, at its Tracy, California, plant.

treated with 2,4-D gave significantly higher yields than those treated with maleic hydrazide. The greatest yield increase of beets sprayed with 2,4-D occurred between the second and third harvest dates, which corresponded to a period when the same beets appeared to decline in sucrose percentage.

Measurements of sugar yield per acre do not indicate an average increase of any one treatment over another, as shown in Table 3. Sugar yield determinations were not as accurate as those for percent of sucrose and yield because of the greater variability associated with this factor. A more

Table 3.—The Average Effect of Maleic Hydrazide and 2,4-D Treatments on the Sucrose Yield of Beets at Three Harvest Dates.

Treatments	Sucrose Yield (tons per acre) Harvest Dates 9/25/51	10/16/51	11/6/51	Ave. Treatment Effect
Check	1.93	2.21	2.30	2.12
MH (0.3%)	2.13	2.15	2.34	2.21
2,4-D (0.025%)	1.96	2.07	2.22	2.08
Ave. Time Effect	1.97	2.15	2.29	

L.S.D. (0.05) Dates and Treatments — 0.18
C.V. = 11.2%

critical examination of the data indicated, however, that maleic hydrazide-treated beets consistently produced more sucrose than the check at the first harvest date. This effect was not evident at subsequent harvests. Therefore, an analysis of variance was made on the data of the first harvest date from the maleic hydrazide treated and check plots. This material is found in Table 4. This analysis indicated that maleic hydrazide probably significantly increased the yield of sugar at three weeks after its application. A need is suggested for more work with maleic hydrazide, using shorter preharvest application intervals.

As compared to the check, 2,4-D treatments had no significant effect on the average sugar yield per acre.

Table 4.—The Effect of Maleic Hydrazide on Sucrose Yield of Beets at the First Harvest Date.

Treatment	Sucrose Yield (tons per acre) Harvest Dates I	II	III	IV	V	Ave. Treatment Effect
O	1.70	1.78	1.98	2.03	1.67	1.83
MH	1.82	2.05	2.08	2.24	2.44	2.13

L.S.D. (0.05) 0.29

Summary

Foliar sprays containing 0.3 percent maleic hydrazide and 0.025 percent 2,4-D were compared as to their effects on sugar beet growth and sucrose accumulation at three dates of harvest.

Maleic hydrazide applications increased the percentage of sucrose of sugar beets, but did not influence root yields under the conditions of this experiment. The largest increase in sugar percentage was measured during the first 21-day interval after treatment. The sugar yield per acre of the beets sprayed with maleic hydrazide exceeded that of the check at only the first harvest date, or 21 days after applications.

Two,4-D treatments significantly decreased the average sugar content, but had no significant effect on the total yield as compared to the untreated beets. The yield of beets treated with 2,4-D was higher than those treated with maleic hydrazide but it was not significantly higher than average yield of the checks.

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