Some Effects of Preharvest Foliage Sprays of Maleic Hydrazide on the Sugar Content and Storage Losses of Sugar Beets[1]

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Preliminary experiments (8)[3] have indicated that a preharvest foliage spray of 2,500 parts per million of maleic hydrazide reduces the loss of sucrose in sugar beets stored for processing. In these initial tests spray concentrations ranging from 500 to 5,000 parts per million applied at intervals between six weeks and 48 hours of harvest produced no noticeable effects on the plants growing in the field. Furthermore, the chemical, irrespective of dosage or time of application, did not influence yield or beet size or reduce the percentage of sucrose in the beets at harvest time. Sugar beets harvested from plants which had received a 150-200 gallon per acre spray application of 2,500 parts per million of maleic hydrazide two weeks or more before harvest and subsequently placed in storage held at various temperatures were noted to be free of sprout and root growth while control lots sprouted profusely.

Others have reported that maleic hydrazide exerts a controlling influence on carbohydrate metabolism and accumulation in several plants (1, 4, 5, 7) . The recent paper by Naylor (6) interestingly provides data showing a 13-fold increase in the sucrose content of seedling maize tops following treatment with maleic hydrazide. Thus, it became of interest to investigate more thoroughly the possible effects this substance may have upon sucrose accumulation in the sugar beet, as well as possible reduction of losses of sucrose during storage.

Table 1.—The Effects of Preharvest Foliage Sprays of Maleic Hydrazide on the Sucrose Content of Sugar Beets.

Treatments		Percent Sucrose	
Spray	Storage	At Harvest	After 30 Days Storage
Maleic hydrazide as MH-30, Sept. 7	Not ventilated or washed	18.15	17.57
Maleic hydrazide as MH-X22, Sept. 20	Not ventilated or washed	17.89	17.21
Maleic hydrazide as MH-Na, Sept. 20	Not ventilated or washed	17.65	17.40
Maleic hydrazide as MH-30, Sept. 28	Not ventilated or washed	17.76	17.08
Control (no treatment)	Ventilated and washed	17.17	16.72
Control (no treatment)	Ventilated and not washed	16.79	16.44
Control (no treatment)	Not ventilated or washed	16.54	15.78
Least differences necessary for significance between treatments—	5% level	0.48	0.66
	1% level	0.64	0.88

[1] Journal Article 1,325 from the Michigan Agricultural Experiment Station

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[3] Numbers in parentheses refer to literature cited.

Experimental Procedure

One-acre randomized field plots of sugar beets, grown on a productive mineral soil, were sprayed at various dates prior to harvest with 2,500 parts per million of maleic hydrazide of several formulations[4] (Table 1). For each acre plot approximately 200 gallons of spray was applied at 300 pounds pressure, sufficient to wet the leaves to run-off. Triton B1956[5] was used as a wetting agent with the MH-30 formulation at the rate of one pint to 100 gallons of water. Beets were mechanically harvested and topped October 16 to 18. In agreement with previous studies (8), yield estimates showed no influence of any of the treatments on the tonnage of beets harvested.

Table 2.—Effects of Preharvest Foliage Sprays of Maleic Hydrazide on Storage Losses of Sugar Beets.

Treatments		Percent Loss of Original After 30 Days Storage		
Spray	Storage	Weight of Beets	Sucrose Content	Total Sucrose
Maleic hydrazide as MH-30, Sept. 7	Not ventilated or washed	11.7	3.2	14.6
Maleic hydrazide as MH-X22, Sept. 20	Not ventilated or washed	13.3	3.8	16.6
Maleic hydrazide as MH-Na, Sept. 20	Not ventilated or washed	7.9	1.4	9.2
Maleic hydrazide as MH-30, Sept. 28	Not ventilated or washed	10.9	3.8	14.3
Controls (no treatment)	Ventilated and washed	12.9	2.6	15.2
Controls (no treatment)	Ventilated and not washed	12.6	2.1	14.5
Controls (no treatment)	Not ventilated or washed	9.8	4.6	14.0

Approximately five tons of beets were sampled from each of the treated and control plots. After duplicate weighings they were placed in especially designed experimental bin storages in an open shed and subjected to the various storage treatments listed in Tables 1 and 2. The design of the bins with facilities and procedures for ventilation, in the bins which were ventilated, have been described by Hansen (3). As the bins were filled, 10 random selected beet samples for sucrose analyses were taken at six-inch depth intervals. On November 15 to 17, after 30 days of storage, when the bins were unloaded, care was again taken to select beets for sucrose analyses from the same levels and locations where the original samples were taken.

Comparative temperature patterns in each of the storage bins were obtained by means of copper constantan thermocouples and an eight-point electronic recording potentiometer (Brown), connected to a stepping switch arrangement so that 48 readings could be taken consecutively. Temperatures characteristic of the location of each thermocouple were recorded automatically at three-hour intervals. Each bin had 16 thermocouples placed in

[4] MH-30, a water soluble diethanolamine salt containing 30 percent maleic hydrazide. MH-X22, a water soluble diethanolamine salt of maleic hydrazide containing a wetting and sticking agent. MH-Na, the sodium salt of maleic hydrazide containing a wetting and sticking agent.

[5] Rohm and Haas, Philadelphia, Pa.

four layers 12 inches apart, starting 12 inches from the bottom. Two thermocouples in each layer were placed into the center of beets and the other two recorded the air temperatures in the interstices.

Beets for each bin were accurately weighed immediately before binning and again at the conclusion of the experiment. The total weight losses combined with the initial and final percentages of sucrose in the beets provided an accurate record of the storage losses of sugar.

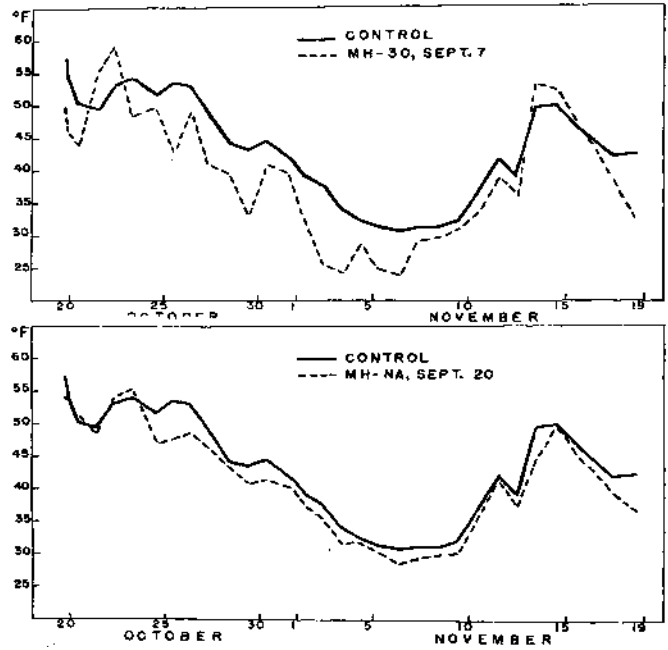

Figure 1. The effects of a preharvest foliage spray of maleic hydrazide (2,500 ppm.) on average daily storage bin temperatures of sugar beets. Top, comparison of bin temperatures of beets harvested from a non-treated (control) plot and one sprayed with the diethanolamine salt of maleic hydrazide on September 7; bottom, comparison of bin temperatures of beets harvested from a non-treated (control) plot and one sprayed with the sodium salt of maleic hydrazide on September 20.

Results

Sugar analyses (Table 1) following harvest suggest that maleic hydrazide applied as a preharvest foliage spray in the three formulations on the dates listed significantly increased the sucrose content of sugar beets. Differences in sucrose composition approach a 10 percent increase.

In Table 2, comparative net storage losses of sucrose resulting from the maleic hydrazide treatments and the various storage conditions are presented. Both loss in weight and changes (decreases) in sucrose composition of the beets are considered. Little significance can be attached to any of the differences with the possible exception of the sodium salt formulation (MH-Na) applied September 20. Beets harvested from plants sprayed with this chemical showed a considerable reduction in total sugar loss apparent in changes in both weight and composition during storage. The data for this particular treatment, as well as the records of the average daily temperatures prevailing in treated and control bins, are similar to results already reported (8) .

Tabulations of average daily temperatures prevailing in each bin for the duration of the storage tests gave, in general, lower values for bins containing beets harvested from plots treated with maleic hydrazide. In these tests neither washing the beets nor ventilating the bins altered the temperatures. The comparative temperature patterns of the control (not ventilated or washed) bin, and those found in bins of beets harvested from plots treated with MH-30 on September 7, and the sodium salt or maleic hydrazide on September 20, are illustrated (Figure 1). A ten-day interval of continuous below freezing outdoor temperatures in early November followed by unseasonably high temperatures necessitated an untimely termination of the experiment and likely contributed to the nature of the results obtained in the storage tests.

The several experiments conducted to date concerned with the various effects of preharvest foliage sprays of maleic hydrazide on sucrose accumulation in sugar beets before harvest and the losses of sucrose in storage piles prior to processing, as well as possible influences on top-root ratios (2) , suggest interesting possibilities and the need for further detailed investigations of the effects of this unique plant growth regulator on sugar beet metabolism.

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