Effect of Seedstalk Removal on Sucrose Production in Bolting Sugarbeets[1]

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Introduction

Cooler-than-normal temperatures during December 1974 to February 1975 caused higher-than-normal bolting in Imperial Valley sugarbeets (*Beta vulgaris* L.). The sugarbeets were fall-planted for spring and early summer harvest. Among individual fields, bolting varied from negligible to over 50%. Removal of the seedstalks above the crown whorl leaves seemed in order to prevent seed from maturing and being dispersed as weed seed in subsequent crops.

Unpublished results of researchers in other Southwestern areas with fall-planted sugarbeets suggested that the percent sucrose was lower in roots of topped bolting sugarbeets than in nontopped ones. With fall-harvested sugarbeets, Johnson and Kidman (1)[3] reported an increase in root weight and total sucrose, but no effect on percent sucrose, when seedstalks were removed in July. In their study, seedlings from seed planted in February and March were subjected to unfavorably cool temperatures in April and parts of March and May. Nelson and Deming (2) reported a lower percent sucrose and total sucrose yield from topping fall-harvested sugarbeets in August.

We conducted experiments in three fields in 1975 and two fields in 1976 to determine the effect on weight, percent sucrose, and total sucrose of harvested roots when seedstalks were removed from bolting sugarbeets. Germination of seed from the bolting sugarbeets in four of the fields was also tested.

Methods and Materials

Fields were selected on the basis of a high bolter incidence and harvest scheduled in July. Pertinent cultural data for the five fields are shown in Table 1.

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[3]Numbers in parentheses refer to literature cited.

Table 1.—Cultivars, plant rows per bed, planting dates, date of seedstalk removal, harvest date, and estimated bolter incidence for five sugarbeet fields.

Field No.	Cultivar	Rows Per Bed†	Planting Date	Seedstalk Removal Date	Harvesting Date	Percent Bolter Incidence
			D/M/Y	*D/M/Y*	*D/M/Y*	
1	USH 10	double	09/09/74	13/06/75	26/06/75	30-40
2	USH 9	single	12/10/74	16/06/75	22&23/07/75	10-20
3	USH 10	double	10/10/74	27/06/75	23/07/75	10-15
4	USH 10	single	06/09/75	03/06/76	01/07/76	<5
5	USH 10	double	14/09/75	02/06/76	22/07/76	5-10

†Single-row beds were 76 to 86 cm between centers and double-row beds were 101 to 106 cm between centers.

In 1975, bolter incidence varied from negligible to 40%. Seedstalk development was relatively advanced before we detected the problem and selected the fields. In the selected fields, fruiting stages varied from nearly mature seed on the oldest seedstalks to immature flowers on all seedstalks. Terminal irrigations to all fields had been applied between June 1 and 6. Although all fields had been scheduled for a July harvest at the time of selection, field no. 1 was rescheduled subsequently for a late June harvest.

In 1976, bolter incidence was relatively low, varying from negligible to 10%. Fields with the highest bolter incidence had been planted to sugarbeets during the previous year, and many of the bolters in these fields were suspected to have originated from seed produced by previous bolters. Field no. 5 had been planted previously to sugarbeets whereas field no. 4 had not. In both fields, seedstalks were relatively young at topping and the earliest flowers on about half the seedstalks were unopened. Irrigations were continued until 2 or 3 weeks before root harvest.

Seedstalks were removed above the leaf height of the nonbolting sugarbeets, between 25 and 40 cm above the ground. In fields No. 1 and 2, all seedstalks were topped for 10 to 15 m in two adjacent rows at three locations in each field. At harvest, 30 roots were harvested from topped sugarbeets in these rows and from nontopped sugarbeets in two adjacent rows. We harvested roots from as much row length as necessary to obtain 30 roots, discarding rotten roots and those smaller than 5 cm in diameter. In fields No. 3, 4, and 5, we tagged 30 successive bolters on an individual bed at five, five, and four locations, respectively. Beginning at one end of each row, we topped the seedstalks or left them untopped at random, until we selected 15 topped and nontopped bolters. Rotten roots were discarded at harvest. At harvest, seed was collected from the nontopped bolters in fields No. 1, 2, 4, and 5.

Each sample of 15 or 30 roots was analyzed separately. Weight and percent sucrose of the cleaned roots were determined and total sucrose yield was calculated. Percent sucrose was determined with a polarimeter. Average germination of cleaned seed was determined on paper in petri dishes at 20 to 30°C with four replicates of 100 seeds each from each location within fields Nos. 1, 2, 4, and 5.

Results, Discussion, and Conclusions

Data in Table 2 indicated that seedstalk removal decreased the percent sucrose slightly but did not affect total sucrose yield. Although root weight was more variable than percent sucrose or total sucrose, root weight was greater in topped than nontopped bolting sugarbeets, except in field no. 5. In field no. 5, between four and

Table 2.—Average weight, sucrose percent, total sucrose, and NO_3^--N rating† of harvested roots from topped or nontopped bolting sugarbeets, and after 14 days, average seed germination from nontopped bolting sugarbeets.

Field no.	Root Weight	Percent Sucrose	Total Sucrose	NO_3^--N Rating†	Seed Germination
	kg	%	*g*		%
1. topped	0.95	14.8	142	3.0	‡
nontopped	0.91	16.5	148	2.2	83
p*	0.65	0.10	0.70	‡	‡
2. topped	1.50	15.5	230	3.0	‡
nontopped	1.35	16.7	224	3.0	79
p*	0.55	0.15	0.85	‡	‡
3. topped	1.08	15.5	166	2.2	‡
nontopped	1.00	17.4	174	1.8	‡
p*	0.15	0.01	> 0.90	‡	‡
4. topped	1.86	14.3	266	1.0	‡
nontopped	1.66	15.6	258	1.4	43
p*	0.15	0.005	> 0.90	‡	‡
5. topped	0.87	11.9	105	2.0	‡
nontopped	0.86	13.9	119	1.8	53
p*	> 0.90	0.02	0.40	‡	‡

*Probability that sample means are not different by t-test.
†Rating based on a scale of 1 (no color) to 5 (maximum color) with the diphenylamine test.
‡Not applicable or not determined.

six roots in each sample were relatively large and the remaining roots were very small. The large roots were suspected to have originated from planted seed, and the small roots from seed produced by bolting sugarbeets during the previous year. The relatively high bolter incidence in field no. 5, as compared with less than 5% incidence in neighboring fields (which had not been planted to sugarbeets during the previous year), also suggested that many of the bolting sugarbeets originated from seed produced by bolters during the previous year. All roots had a low nitrate content rating. A large percent of seed from the nontopped bolting sugarbeets germinated. Seedstalk did not regrow in any of the fields. Root rot incidence was not related to seedstalk removal and was less than 5%, except in field no. 2.

Sugarbeet seedlings can be a serious problem in subsequent crops, especially sugarbeets, since seed germination from the nontopped bolting sugarbeets is relatively high. Low temperatures would induce seedstalks more readily in these seedlings than in those from planted seed, as we suspected as having occurred in field no. 5. Incorporating complete sterility into commercial sugarbeet cultivars would be an alternative solution, since this would eliminate seedlings in subsequent crops.

We present this data to aid agronomists in their recommendations to farmers, although further detailed studies are needed. Farmers would note the lower percent sucrose in roots from topped bolters, as compared with nontopped bolters, but they probably would not recognize a higher root weight and similar total sucrose. Whether the farmer should remove seedstalks from bolting sugarbeets depends on several factors, including the bolting incidence, scheduled harvesting date, topping cost, and difficulty and cost for controlling unwanted sugarbeet seedlings in subsequent crops.

Acknowledgement

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Literature Cited

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