Effect of Multiple Pesticide Treatments on Sugarbeet Yield and Quality

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INTRODUCTION

Manual labor for controlling weeds in sugarbeets (*Beta vulgaris* L.) is being replaced by widespread use of herbicides. Dexter et al. (6) reported that most sugarbeet growers used more than one herbicide to control weeds in addition to other pesticides to control insects or diseases.

Smith and Schweizer (10) noted a cultivar by herbicide interaction for injury from herbicides early in the growing season; however, most cultivars recovered by final harvest. Smith et al. (11) reported that inbred sugarbeet populations were more susceptible to herbicide injury than commercial cultivars. Dexter and Kern (5) reported herbicide by cultivar interactions using higher than recommended EPTC (S-ethyl dipropylthiocarbamate) rates.

Dolzhikova et al. (7) and Kovrigo and Gruzdev (8) reported that multiple herbicides did not affect the yield or quality of sugarbeets. Smith and Schweizer (10) observed no effect on sucrose content or purity averaged over all cultivars and herbicides.

Blickenstaff et al. (2) reported that aldicarb [2-methyl-2-(methylthio)propionaldehyde-o-(methylcarbomyl)

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oxime] was the most effective registered insecticide for control of sugarbeet root maggot, *Tetanops myopeaformis* (von Roder). Abivardi and Altman (1) reported that a combination of aldicarb and cycloate (S-ethyl N-ethylithiocyclohexane carbamate) reduced growth of two sugarbeet cultivars.

In most sugarbeet production areas, roots are stored in large unprotected piles after harvest prior to processing. Respiration causes substantial losses of sucrose during storage (12). Schroeder et al. (9) reported that certain herbicides, which were not registered for use on sugarbeets, caused increased storage losses.

Our objectives were to determine the effect of multiple pesticide applications on sugarbeet yield and quality components at harvest and on sucrose losses during post-harvest storage of three commercial sugarbeet cultivars. Preliminary data (5) indicated that the cultivars selected had a differential response to EPTC.

MATERIALS AND METHODS

Three commercial cultivars, 'ACH-14', 'Mono-Hy R1', and 'Hilleshog 833', were planted in a randomized complete block design experiment with six replications at Moorhead, MN, and Fargo, ND, in 1980 and eight replications at Fargo, ND, in 1981. Pesticide treatments were the main plots and cultivars the subplots. Subplots were 7.5 m long and four rows 56 cm apart. EPTC was applied at 2.8 kg ai/ha in 160 L/ha of water and preplant incorporated with a rototiller operated 10 cm deep. Aldicarb was applied as granules at 1.7 kg ai/ha in a 6 cm band over the row during planting. Seed was planted 4 cm deep in early May of both years. Desmedipham [ethyl m-hydroxy-carbanilate carbanilate(ester)], was broadcast at 1.1 kg ai/ha in 160 L/ha of water at 276 k Pa when the sugarbeet plants had two to four true leaves. Each pesticide was used alone and in all possible combinations for a total of 8 treatments including a control. Sugarbeets in all plots were thinned and maintained weed free by hand weeding after the desmedipham application.

The center two rows of each plot were harvested in early October. The Moorhead, MN, location was harvested with a mechanical lifter in 1980 and the Fargo, ND, location was harvested manually both years. The roots were washed, weighed, and divided into two subsamples. One subsample was analyzed for sucrose and purity using standard procedures. The other subsample was placed in a perforated plastic bag and stored at 5 C and near 100% relative humidity for 120 days. After storage, the roots were analyzed for sucrose and purity and the data was corrected for weight loss during storage. The data from each experiment were analyzed separately and combined over experiments.

RESULTS AND DISCUSSION

Analysis of data from individual locations indicated that cultivars differed in yield at harvest and in quality components at harvest and after storage (data not presented). These cultivar yield and quality differences were expected (5). The pesticide treatments caused no consistent effect and interactions among cultivars and pesticides were not consistently significant at all individual locations before or after storage. Some of the main effects, that is response to pesticides, and interactions between pesticides and cultivars were significant at harvest but not after storage and vice versa. Yield and quality components differed among locations before and after storage. Growing conditions were more favorable in 1981 than in 1980. Cercospora leaf spot (*Cercospora beticola* Sacc.) was more prevalent on the plots in 1980 than in 1981. Storage losses were higher for the Moorhead location than Fargo in 1980 which was probably in part due to the mechanical harvesting at the Moorhead location (4). Also, Cercospora leaf spot was more prevalent at the Moorhead location and may have influenced storage losses.

Cultivars differed for yield and quality before and after storage averaged over all locations (Table 1). Sugarbeet yield was higher with an EPTC treatment than without it, perhaps due to improved early season weed con-

Table 1. Effect of cultivars and pesticides on sugarbeet yield and on quality both at harvest and after 120 days storage at 5 C and near 100% relative humidity.[a]

Variable	Yield	Sucrose		Purity		Extractable sucrose		
		Harvest	Storage	Harvest	Storage	Harvest	Stroage	Loss
	(Mg/ha)	---------- % ----------				---- (kg/Mg) ----		(%)
Cultivars								
ACH-14	33.4	15.7	14.8	93.2	92.9	136	126	7.4
GW-R1	38.5	14.6	13.6	93.0	92.3	125	115	8.0
H-833	38.3	14.6	13.5	92.2	91.2	122	111	9.0
LSD 0.05	1.6	0.3	0.3	0.5	0.5	4	4	
EPTC								
Absent	36.1	15.0	13.9	92.8	92.2	128	117	8.6
Present	37.4	15.0	14.0	92.8	92.2	128	117	8.6
LSD 0.05	0.6	NS	NS	NS	NS	NS	NS	
(Desmedipham)								
Absent	36.5	15.0	14.0	92.9	92.2	128	117	8.6
Present	37.0	15.0	14.0	92.7	92.1	127	117	7.9
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	
Aldicarb								
Absent	36.3	14.9	14.0	92.7	92.0	127	117	7.8
Present	37.2	15.0	14.0	92.9	92.3	128	118	7.8
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	

[a]Values represent averages of studies conducted in 1980 and 1981.

trol. Desmedipham or aldicarb did not affect yield or quality components at harvest or after storage. The cultivar by pesticide interaction was not significant for any of the quality components (data not shown). Thus, any differences in yield or quality of the sugarbeet cultivars were independent of the pesticides.

A significant location by cultivar interaction occurred for yield but not for any of the quality components before or after storage (data not shown). Campbell and Kern (3) found that cultivars differed in genetic potential to respond to favorable environments. Yield of Mono-Hy R1 and Hilleshog 833 cultivars were 48 and 81% higher, respectively, at the Fargo location in 1981 compared to the Moorhead location in 1980.

Our data indicate that cultivars with the lowest recoverable sucrose per ton at harvest had the highest losses of sucrose during storage (Table 1). Also, the data indicate that the use of approved pesticides, at recommended rates, alone or in combination did not reduce yield or quality at harvest nor cause an increase in storage losses of sucrose during post-harvest storage. These findings support the data of Dolzkikova et al. (7) and Kovrigo and Gruzdev (8) for yield and quality at harvest. The data in part supports Smith and Schweizer (10) who reported that cultivars were not affected at harvest, but some were affected early in the growing season by multiple herbicides. However, we are the first to report that post-harvest losses of sucrose are not affected by usage of multiple pesticides during the growing season.

SUMMARY

The effect of EPTC, desmedipham and aldicarb alone and in all combinations on yield and quality of three commercial sugarbeet cultivars at harvest and on sucrose losses during storage were determined at two locations in 1980 and one location in 1981. Cultivars differed significantly in yield and quality at harvest and after storage both years. Pesticides did not consistently affect sugarbeet quality at harvest or after storage. No significant in-

teractions occurred between cultivars and pesticides. Cultivars with the lowest quality at harvest had the highest losses of sucrose during storage.

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