PLANT POPULATION, ROW SPACING, AND HERBICIDE EFFECTS ON WEEDS AND YIELD IN SUGARBEETS

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ABSTRACT

Today's agricultural economy dictates that producers fine-tune their farming practices to maximize yields and minimize production costs. To help identify practices that might benefit sugarbeet producers, the University of Wyoming conducted a two year study on the impact that row spacing, sugarbeet population and herbicide treatments had on weed control and sugarbeet yield. The study was conducted on a Mitchell sandy loam soil at the University of Wyoming Agricultural Experiment Station at Torrington, WY with glyphosate tolerant sugarbeet. The experiment was conducted as a split plot with three to six replications. Main plots were three sugarbeet row spacings and subplots a factorial arrangement of five plant populations and weed management level (2 applications of glyphosate at 0.42, and 0.84 kg ha-1, 4 micro-rate applications of desmedipham-phenmedipham plus triflusulfuron plus clopyralid and methylated seed oil (MSO) at 90 + 4.5 + 25 g ha-1 + 1.5% v/v, 3 applications of a conventional rate of desmedipham-phenmedipham-ethofumesate at 290, initially, and 370 g ai ha-1, subsequently, a hand weeded and a weedy check plot. Both years the 38 cm row spacing produced the highest yields, least weeds and highest sucrose. Weed control and yields were best in the hand weeded and 2 glyphosate application treatments.

INTRODUCTION

Currently sugarbeets are grown in 56 or 76 cm rows in Wyoming. Producers are looking for ways to improve profits with increasing operating costs. The best way to improve profits for producers would be to increase yields of their crops. Research has shown that yields of sugarbeets can be increased with narrow row spacings less than 76 cm (Hills 1972, Cattanach & Schroeder 1979, Fornstrom & Jackson 1983, and Stebbing *et. al.* 2000). Studies conducted in Wyoming showed that yields could be increased by 3.4 Mg/ha when sugarbeets were grown in 56 cm rows compared to 76 cm rows (Fornstrom & Jackson 1983). In western Nebraska, in a two year study, 46 cm rows provided the highest yields in one year while there were no differences between row spacings in the second year (Stebbing *et. al.* 2000). A summary of 31 studies conducted in the Red River valley showed that when row spacings were reduced to 46 to 56 cm from 69 to 76 cm sugar production was increased by 660 kg/ha (Cattanach & Schroeder 1979).

Several studies have shown that low sugarbeet populations at harvest have a greater effect on sugarbeet yield than high populations at harvest (Fornstom, 1980). In Wyoming it was determined that optimal harvest population was

57,500 plants/ha. If populations were reduced from this level yields declined rapidly while increasing the population above 57,500 plants/ha reduced yields slightly (Fornstrom & Jackson, 1983).

Weeds continue to be a significant problem for sugarbeet growers and herbicide resistant weeds, in particular ALS resistant kochia, are a serious problem in several sugarbeet producing areas in the United States. Herbicide tolerant sugarbeets would help solve some of these weed problem; however, it would not be a magic bullet. Cultural practices need to be incorporated into a production plan to help manage herbicide resistance in weeds. One cultural practice that would aid in controlling problem weeds is reducing the sugarbeet row spacing to allow the crop to be more competitive with the weeds.

To date there is little information available for growing sugarbeets in row spacings of less than 56 cm, especially in Wyoming.

MATERIALS AND METHODS

Studies were conducted in 2001 and 2002 at the Torrington Research and Extension Center to determine the effect of row spacing, plant population and herbicide treatment on sugarbeet yield and weed growth. Two studies were conducted. The first study investigated the effect of row spacing and plant population and on sugarbeet yield. The row spacings were 38, 56 and 76 cm rows while the seeded populations ranged from 49,420 to 296,520 seeds per hectare. A second experiment studied the effect of row spacing and herbicide treatment on sugarbeet yield and weed growth. Both studies were conducted with Roundup Ready sugarbeets (HM 1605 RR). The herbicide treatments included: 2 applications of glyphosate at 0.42, and 0.84 kg ha-1, 4 micro-rate applications of desmedipham-phenmedipham plus triflusulfuron plus clopyralid and methylated seed oil (MSO) at 90 + 4.5 + 25 g ha-1 + 1.5% v/v, 3 applications of a conventional rate of desmedipham-phenmedipham-ethofumesate at 290, initially, and 370 g ai ha-1, subsequently, a hand weeded and a weedy check plot. The row spacing and population studies were kept weed free in order to determine the effect row spacing and population had on sugarbeet yield.

Weed control ratings along with weed biomass samples were collected to determine how row spacing impacted weeds. In addition light readings were taken when plants in each row spacing closed the row to understand how this affected light penetration through the sugarbeet canopy. The plots were hand harvested each year and processed by Western Sugar Company, Gering, Nebraska. All data was analyzed using analysis of variance with SAS. Means separation was determined using alpha = 0.05.

RESULTS

Final sugarbeet populations were generally lower than the seeded populations both years (Table 1). In 2001 there were disease problems in the field which resulted in a significant stand decline. Final population had minimal effect on yields especially at the higher population (Table 2). Yields tended to decline

slightly past populations of 100,000 plants/ha. Yields deceased rapidly for populations below 65,000 plants/ha.

Yields were increased by 12 to 17% in 38 cm rows compared to 56 and 76 cm rows respectively (Table 3). These studies confirmed results obtained previously with 56 cm rows out yielding 76 cm rows by 3.8 Mg ha^{-1}. Sugar content decreased as row spacing decreased while sugar lost to molasses increased with decreasing row spacing. This was not unexpected since these parameters are related to sugarbeet size. In narrow rows sugarbeets tend to be more uniform and larger in size since plants are spread out within a row giving them more room to grow. As beet size increases sugar percentage decreases while the level of impurities (SLM) increase. While these parameters result in lower overall levels of recoverable sucrose in narrower rows the amount of sucrose produced per acre is still increased.

Weed biomass is greatly reduced by switching production to narrow rows (Table 3). The main reason for the reduced weed growth in narrow rows is that they close the row earlier than the wider rows and eliminate light from getting through the sugarbeet canopy that can be used by weeds for growth (Figure 1). The 38 cm rows closed 2 to 4 weeks earlier than the 56 or 76 cm rows. Glyphosate applied at 0.84 kg ha^{-1} provided the best weed control, while the conventional program and glyphosate at 0.42 kg ha^{-1} provided slightly less but similar control. The micro-rate system was slightly less effective than the conventional program. All herbicide treatments provided weed control equal to or better than that currently achieved commercially. Visual weed control did not appear to be affected by row spacing.

The crop stand that provided highest yield was 91,000 plants per hectare and this was consistent across row spacings. When the population was increased above this level, yields either remained constant or decreased slightly.

Table 1. Seeded and final populations of sugarbeets in 2001 and 2002.

Seeded	Final Population	
Population	2001	2002
(seeds/ha)	(------plants/ha-----)	
49,420	------	66,495
98,840	36,358	110,508
148,260	------	138,015
197,680	65,061	162,891
247,100	------	186,810
296,520	98,069	------
LSD	3959	

Table 2. Effect of plant population on sugarbeet yield parameters.

Population	Yield	Sugar	SLM[1]	Sucrose
(plants/ha)	(Mg/ha)	(%)	(%)	(Kg/ha)
36,358	44.95	13.10	1.80	5239
65,788	76.40	14.18	1.74	9662
104,289	78.50	13.69	1.75	9593
138,015	72.23	14.67	1.66	9426
162,891	73.24	14.09	1.64	9085
186,810	70.50	14.61	1.62	9093
LSD	11.47	NS	NS	1610

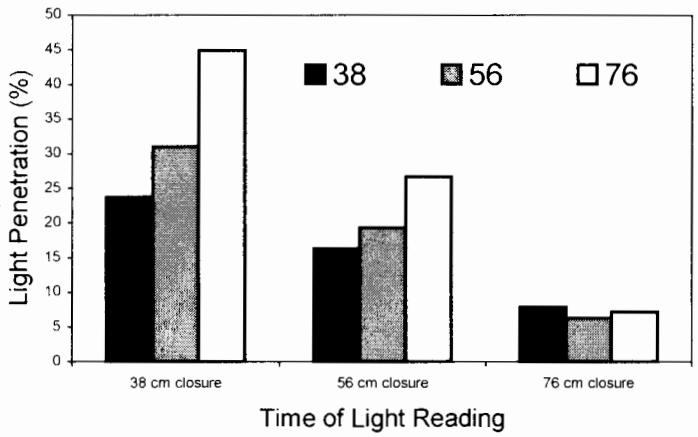
[1] *Sugar loss to molasses*

Table 3. Effect of row spacing on sugarbeet yield parameters and weed biomass.

Spacing	Yield	Sugar	SLM[1]	Sucrose	Weed Biomass
(cm)	(Mg/ha)	(%)	(%)	(Kg/ha)	(Mg/ha)
38	79.15	13.94	1.73	9729	3.54
56	70.75	14.10	1.69	8926	4.44
76	67.36	14.27	1.67	8626	7.55
LSD	6.62	NS	NS	929	2.71

[1] *Sugar loss to molasses*

Figure 1. Effect of row spacing on light penetration through the sugarbeet canopy during the growing season.



CONCLUSIONS

These studies indicate that growers may be able to switch to 38 cm rows while increasing yields and reducing the impact of weeds. Yields in 38 cm rows are greatly increased compared to either 56 or 76 cm rows. In areas that have problems with ALS resistant kochia, 38 cm row production may provide an integrated approach for control of this weed. There are planters available commercially with the capability of planting sugarbeets and other crops in 38 cm rows. A limited number of sugarbeet harvesters are becoming available that could harvest sugarbeets in 38 cm rows. A second option for harvest of sugarbeets in 38 cm rows would be to make two passes through the field with a 76 cm harvester. The next step in this research will be to conduct larger scale trials to determine the economic feasibility for Wyoming producers.

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