INFLUENCE OF PLANT POPULATION ON SUGARBEET PRODUCTION

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INTRODUCTION

Achieving optimum plant population with uniform stands is the foundation in establishing the potential for high yield and quality of sugarbeet. For high tonnage, increasing plant population has potential to increase the sugar content, the opposite trend is true for high sugar content. Optimizing plant population will help growers to optimize plant population based on the cultivar selection. Research objectives were to determine changes in root yield and sugar content with the selection of plant population for high tonnage and high sugar cultivars, and determine the interactions between cultivar selection, and plant population on sugarbeet root yield and quality.

Table 1. Initial soil nutrient concentration and basic soil physical-chemical properties

Site	**Ada, MN**	**Prosper, ND**
Textural Class	Sandy Clay Loam	Silty Clay Loam
pH	7.6	6.7
NO_3-N 0-2 ft (lb ac^{-1})	49	48
Olsen P (ppm)	4	60
K (ppm)	48	495
OM (%)	3.07	3.3

METHODS

Field study was conducted at two sites, Ada, MN and Prosper, ND. For both sites, previous crop was soybean. The experiment was laid out in factorial RCBD which included six population density, 75, 125, 175, 225, 250, and 275 plants per 100 ft, and two cultivars, high tonnage (Beta seed) and high sugar (Crystal). Individual treatment plots measured 11 feet wide and 30 feet long. Recommended NPK fertilizers were applied based on the soil test values (Table 1) in the form of urea, MAP and MOP. At Ada, 81 lb of N, 55 lb of P_2O_5 and 90 lb of K_2O ac^{-1}, were applied. At Prosper, we only applied nitrogen due to high soil test values for phosphorus and potassium. Plots were planted in thick to achieve the highest population of 275 plants per 100 ft. Due to lack of rain, emergence was not uniform at both locations. After emergence, we conducted a stand count and thinned plots to achieve stand density of 175 plants per 100 ft. At harvest, we did another set of stand count. Middle two rows of each plot were harvested to determine the root yield and sugar concentration was analyzed by American Crystal Tare Lab in East Grand Forks, MN. Due to uneven emergence, results were represented as changes in recoverable sugar yield with range of stand density.

RESULTS AND DISCUSSION

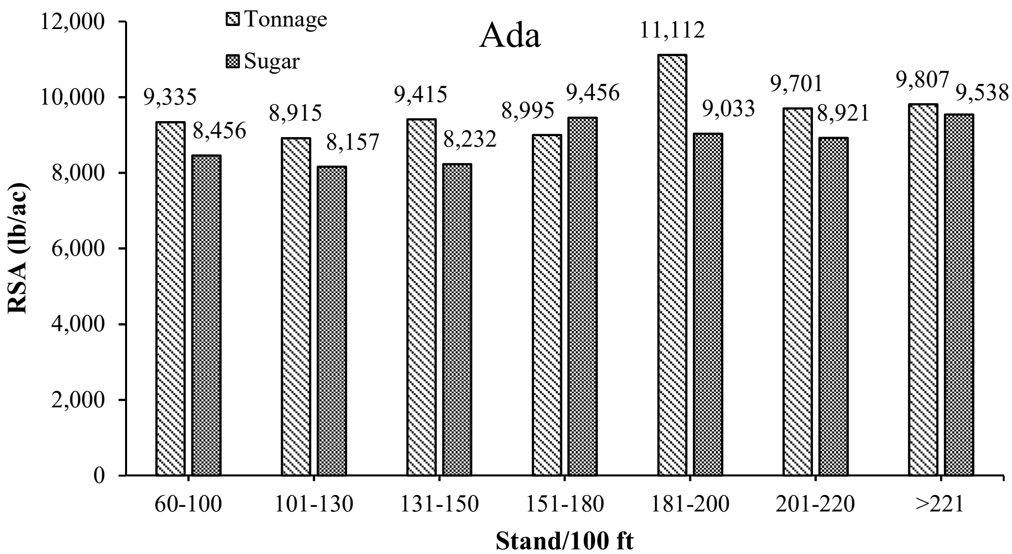
Due to lack of rainfall at planting, stand emergence was irregular. Stand density of middle two rows at harvest was presented in Table 2. For high tonnage cultivar, the highest average root yield was 32.0 ton/ac with stand density at harvest with population of 178 plant/100 ft at Ada, and 31.1 ton/ac with population of 160 plant/100 ft at Prosper, highest sugar concentration was 16.5% at Ada and 15.4% at Prosper. Sugar concentration did not show any response to plant population. Recoverable sugar yield also optimized at plant population of 181-200 plant per 100 ft at both sites (Fig. 1). For high sugar cultivar, highest root yield was 28.1 ton/ac and 29.2 ton/ac and highest sugar concentration was 17.7% and 17.1% at Ada and Prosper, respectively. For high sugar cultivar, recoverable sugar yield was optimized at greater than 221 plant per 100 ft at Ada and at 151-180 plant per 100 ft at Prosper.

CONCLUSION

This trial showed that for high tonnage, root yield and recoverable sugar yield were optimized at 200 plant per 100 ft; but for high sugar, plant population density could be increased to 220 plants per 100 ft depending on site. This experiment needs to be continued to validate results under consistent plant population and other soil characteristics.

Table 2. Average final stand density (plant/60 ft), root yield (t/ac), and sugar concentration (%) in response to plant density and cultivar type conducted at Ada, MN and Prosper, ND during 2020

Density /100 ft	Cultivar	Density at harvest	Root yield (t/ac)	Sugar%	Density at harvest	Root yield (t/ac)	Sugar%
			Ada			Prosper	
75	**Tonnage**	46 (3)	29.3 (3.8)	16.9 (0.3)	71 (27)	28.5 (7.3)	15.1 (0.3)
125		77 (7)	31.1(3.9)	16.4 (0.2)	96 (15)	31.1 (1.2)	15.2 (0.9)
175		107(5)	32.0 (2.1)	16.5 (0.3)	63 (26)	23.5 (6.0)	15.3 (0.8)
225		129 (20)	31.6 (2.4)	16.3 (0.6)	81 (20)	28.2 (3.1)	15.0 (1.0)
250		122 (26)	28.9 (2.3)	16.1 (0.2)	78 (18)	26.5(6.8)	15.4 (0.7)
275		126 (14)	30.3 (5.3)	16.5 (0.3)	95 (32)	30.6 (6.7)	15.2 (0.7)
75	**Sugar**	47 (5)	26.4 (2.2)	17.7 (0.3)	78 (25)	25.9 (2.2)	17.1 (0.8)
125		67 (8)	23.6 (2.2)	17.5 (0.3)	73 (33)	28.4 (1.4)	16.7 (0.8)
175		99 (11)	27.2 (2.6)	17.4 (0.7)	101 (20)	26.8 (5.0)	17.0 (0.5)
225		130 (4)	27.9 (1.7)	17.5 (0.2)	88 (23)	28.8 (2.0)	16.4 (0.9)
250		118 (9)	25.6 (1.8)	17.6 (0.8)	88 (29)	29.2 (1.1)	16.7 (0.5)
275		106 (14)	28.1 (2.4)	17.7 (0.4)	113 (15)	28.2 (2.2)	16.7 (0.9)



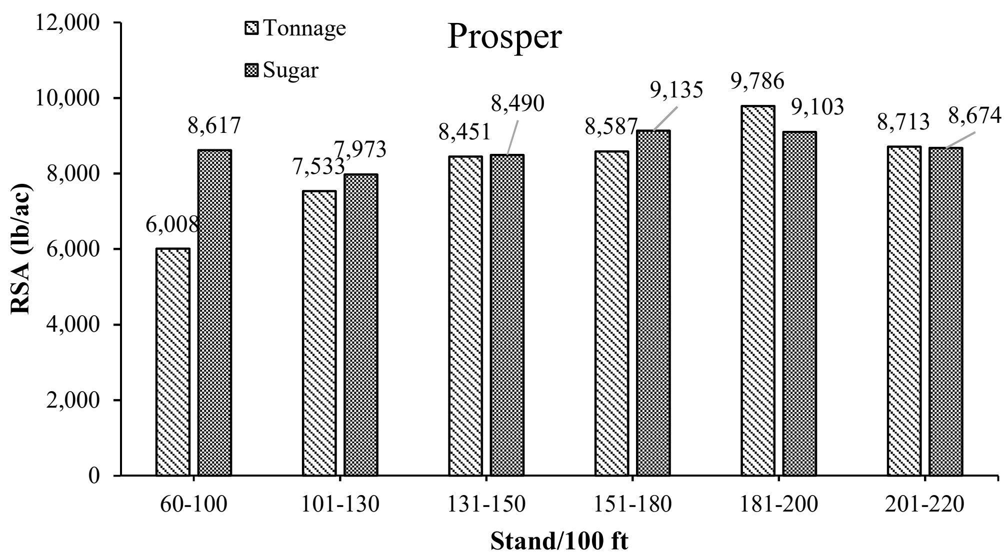


Figure 1. Changes in recoverable sugar yield (lb/ac) due to a range of stand density of high tonnage and sugar cultivars at Ada, MN and Prosper, ND during 2020 growing season