

## EFFECT OF PLANT POPULATION AND PLANTING DATE ON SUGAR PRODUCTION – 2 YR SUMMARY

Joseph F. Giles, and Norman R. Cattanaach

Associate Professor and Research Specialist  
Department of Soil Science, North Dakota State University**Introduction**

Plant populations of 150 to 175 plants per 100 ft of 22-inch row are recommended at the six-leaf growth stage for early seeded sugarbeet to maximize sugar production in the Red River Valley of Minnesota and North Dakota. Most of the research on which this recommendation is based was conducted during the late 1970's and early 1980's and is reported in the Sugarbeet Research and Extension Reports. Some of the studies evaluated the effect date of planting and plant population had on sugarbeet yield and quality. Limited data evaluating the date of planting has been collected in recent years. This study was conducted in 2002 and 2003 and included two planting dates using two varieties of sugarbeet, a tonnage variety and a sugar variety.

**Materials and Methods**

Field experiment was established on Bearden silty clay loam (Fine-silty, mixed, super active, frigid, Aeric Calcicquoll) on the Kirk Watt farm at Glyndon, MN. Each planting date was arranged in a randomized complete block design with three replications. Individual treatment plots measured 11 feet wide and 30 feet long. Soil nitrogen levels were adjusted with fertilizer to approximately 130 lbs/acre of available residual soil test plus added fertilizer N.

Sugarbeet, Seedex Thunder and Beta 6447, was planted in early May and late May each year with a John Deere MaxEmerge 2. Sugarbeet was placed 1.25 inches deep with 3.5-inch in-row spacing. A 22-inch row spacing was used. Counter was surfaced band applied at 11.9 lbs/a and incorporated with chain at planting. Post emergence herbicides, cultivation and hand labor was used as needed for weed control. Two applications each of Eminent and Super Tin were applied for Cercospora leafspot control.

Sugarbeet populations of 75, 100, 125, 150, 175, and 200 plants per 100 feet of row were established with hand thinning at the four-leaf stage on each planting date.

Sugarbeet were harvested in late September. The middle two rows of each 6 row plot were harvested. Yield determinations were made and quality analysis performed at American Crystal Sugar Quality Tare Lab, East Grand Forks, MN.

**Results and Discussion**

The yield data indicate a population of at least 100 plants per 100 feet of row is needed to maximize sugar production of these sugarbeet varieties regardless of planting date (Tables [1-12](#)). The significant increases in recoverable sugar per acre occurred with plant populations of 150 plants in the early planting with the sugar variety, Beta 6447 ([Table 3](#)), while a plant population of 175 produced the most sugar in the early planting of Seedex Thunder ([Table 9](#)) and 100 plants per 100 feet of row produced the most sugar in the late planting ([Table 12](#)). Very little difference between plant populations occurred in the late planting of Beta 6447 ([Table 6](#)). A plant population of 75 plants per 100 feet of row in the early planting of Beta 6447 ([Table 2](#)) produced more recoverable sugar than any late plant population ([Table 6](#)). However, a plant population of 100 was needed in the early planting of Seedex Thunder ([Table 9](#)) to compare to recoverable sugar production of any late plant population over 100([Table 12](#)).

Recoverable sugar production averaged across planting date and variety was significantly increased as plant population was established at greater than 100 plants per 100 feet of row (Tables [13-15](#)). A non-significant decrease in root yield, recoverable sugar per acre and per ton resulted as plant population reached 200. This decrease may be due to the larger decrease in harvestable roots as a percentage of the established plant population.

The early planting significantly increased the root yield and recoverable sugar per acre as compared to the later planting each year (Tables [16-17](#)). These differences in 2002 are lower than normally expected and are related to the usually slow plant growth resulting from the below normal temperatures experienced during May of that year. These conditions may have also contributed to a decreased effect of variety averaged over plant population and planting date (Tables [18-19](#)).

**Table 1. Effect of planting date (May 2) and population of Beta 6447 on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population, Glyndon, MN, 2002.**

---

LOSS TO	RECOVERABLE	REC	HARVEST
---------	-------------	-----	---------

POPULATION (plants /A)	ROOT YIELD Tons/A	SUCROSE Percent	MOLASSES Percent	SUGAR Lbs/Acre	SUGAR Lbs/T	BEETS /100 FT
17820 (75)	20.4	16.14	2.11	5751	280.4	72
23760 (100)	22.2	16.30	2.23	6241	281.6	89
29700 (125)	21.6	17.48	1.97	6704	310.3	116
35640 (150)	21.7	17.00	1.90	6550	301.9	125
41580 (175)	21.1	16.83	1.84	6336	299.8	145
47520 (200)	18.3	15.65	2.26	4978	267.7	127
LSD (.05)	3.4	1.09	ns	1274	27.3	

**Table 2. Effect of planting date (April 29) and population of Beta 6447 on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population, Glyndon, MN, 2003.**

POPULATION (plants /A)	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT
17820 (75)	23.2	17.34	1.50	7384	317.0	78
23760 (100)	25.4	18.10	1.40	8486	335.0	97
29700 (125)	26.2	17.00	1.44	8149	310.0	116
35640 (150)	27.0	17.54	1.30	8785	325.4	137
41580 (175)	27.0	17.30	1.32	8585	319.0	158
47520 (200)	24.6	17.20	1.31	7813	318.0	163
LSD (.05)	3.3	ns	0.19	1310	ns	10

**Table 3. Effect of planting date (early) and population of Beta 6447 on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population, Glyndon, MN, 2002-2003.**

POPULATION (plants /A)	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT
17820 (75)	21.3	16.71	1.80	6400	298.1	74
23760 (100)	23.3	17.21	1.77	7239	308.8	92
29700 (125)	23.5	17.06	1.71	7245	307.0	114
35640 (150)	24.1	17.20	1.59	7542	312.3	130
41580 (175)	23.8	16.97	1.59	7337	307.7	151
47520 (200)	21.2	16.43	1.76	6314	293.4	146

**Table 4. Effect of planting date (May 30) and population of Beta 6447 on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population, Glyndon, MN, 2002-2003.**

POPULATION (plants /A)	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT
17820 (75)		16.45	2.09	5302	287.1	75
23760 (100)	19.9	16.36	2.37	5553	279.8	94
29700 (125)	19.1	16.59	2.08	5546	290.3	115
35640 (150)	18.6	15.89	2.31	5046	271.6	123
41580 (175)	18.7	15.95	2.26	5128	273.8	157
47520 (200)	18.6	16.99	2.03	5573	299.3	146
LSD (.05)	ns	ns	.27	ns	27.4	

**Table 5. Effect of planting date (May 28) and population of Beta 6447 on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population, Glyndon, MN, 2003.**

POPULATION (plants /A)	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT
17820 (75)	20.9	17.00	1.41	6502	311.3	78
23760 (100)	20.0	17.92	1.30	6688	333.4	100
29700 (125)	21.3	16.84	1.33	6581	310.2	118
35640 (150)	20.1	17.50	1.40	6489	322.1	132
41580 (175)	20.8	16.30	1.20	6295	302.2	142
47520 (200)	20.6	17.10	1.22	6545	318.0	170
LSD (.05)	ns	1.45	0.22	ns	29.2	14

**Table 6. Effect of planting date (late) and population of Beta 6447 on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population, Glyndon, MN, 2002-2003.**

POPULATION (plants /A)	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT
17820 (75)	19.7	16.61	1.75	5878	297.2	75
23760 (100)	19.8	17.12	1.78	6091	306.7	97
29700 (125)	20.2	16.60	1.70	6028	298.0	116
35640 (150)	19.4	16.66	1.82	5761	296.7	128
41580 (175)	19.8	16.01	1.69	5685	286.3	148
47520 (200)	19.7	16.92	1.61	6019	306.0	159

**Table 7. Effect of planting date (May 2) and population of Seedex Thunder on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population, Glyndon, MN, 2002.**

POPULATION (plants /A)	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT
17820 (75)	17.2	15.33	2.35	4485	259.6	68
23760 (100)	20.9	15.52	2.30	5526	264.3	93
29700 (125)	22.6	15.68	2.20	6096	269.5	124
35640 (150)	21.5	16.42	2.32	6053	281.9	119
41580 (175)	23.2	16.76	1.93	6871	296.6	157
47520 (200)	21.2	15.85	2.10	5826	275.0	167
LSD (.05)	2.9	1.22	.37	887	29.1	

**Table 8. Effect of planting date (April 29) and population of Seedex Thunder on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population, Glyndon, MN, 2003.**

POPULATION (plants /A)	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT
17820 (75)	27.0	17.10	1.51	8292	311.1	77
23760 (100)	27.0	17.32	1.41	8454	319.0	99
29700 (125)	30.0	17.24	1.50	9457	316.0	123
35640 (150)	30.0	16.30	1.50	8851	296.2	138
41580 (175)	30.0	17.00	1.31	9367	312.2	160

47520	(200)	27.3	17.00	1.30	8478	309.4	172
LSD (.05)		2.1	0.94	ns	1014	21.3	14

**Table 9. Effect of planting date (early) and population of Seedex Thunder on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population, Glyndon, MN, 2002-2003.**

POPULATION (plants /A)	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT	
17820	(75)	22.0	16.15	1.93	6348	284.5	73
23760	(100)	23.4	16.38	1.84	6887	290.8	97
29700	(125)	26.2	16.41	1.84	7703	291.3	124
35640	(150)	25.6	16.18	1.90	7339	285.5	130
41580	(175)	26.4	16.68	1.64	7984	301.0	159
47520	(200)	24.0	16.20	1.70	7029	290.1	169

**Table 10. Effect of planting date (May 30) and population of Seedex Thunder on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population, Glyndon, MN, 2002.**

POPULATION (plants /A)	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT	
17820	(75)	17.0	14.95	2.52	4250	248.5	69
23760	(100)	21.3	16.69	2.03	6245	293.2	98
29700	(125)	21.4	15.86	2.37	5800	269.8	134
35640	(150)	19.5	16.27	2.29	5456	279.5	136
41580	(175)	21.1	16.50	2.16	6034	286.9	160
47520	(200)	21.2	16.41	2.02	6101	287.7	166
LSD (.05)	ns	.94	.25	1413	22.8		

**Table 11. Effect of planting date (May 28) and population of Seedex Thunder on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population, Glyndon, MN, 2003.**

POPULATION (plants /A)	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT	
17820	(75)	19.5	16.50	1.40	5880	302.1	76
23760	(100)	22.0	17.35	1.33	6959	320.3	97
29700	(125)	22.1	17.12	1.30	6991	317.0	130
35640	(150)	23.0	16.52	1.24	7027	306.0	137
41580	(175)	22.0	17.00	1.20	6743	308.0	156
47520	(200)	23.0	16.50	1.30	6930	304.0	173
LSD (.05)	2.6	0.7	0.17	750	15.6	13	

**Table 12. Effect of planting date (late) and population of Seedex Thunder on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population, Glyndon, MN, 2002-2003.**

LOSS TO	RECOVERABLE	REC	HARVEST
---------	-------------	-----	---------

POPULATION (plants /A)	ROOT YIELD Tons/A	SUCROSE Percent	MOLASSES Percent	SUGAR Lbs/Acre	SUGAR Lbs/T	BEETS /100 FT
17820 (75)	18.5	15.78	1.94	5151	276.7	74
23760 (100)	21.6	17.02	1.70	6623	306.3	98
29700 (125)	21.8	16.53	1.82	6450	294.2	132
35640 (150)	21.5	16.36	1.76	6323	292.0	137
41580 (175)	21.5	16.50	1.67	6409	296.5	157
47520 (200)	22.2	16.40	1.67	6544	294.5	170

**Table 13. Effect of population over variety and planting date on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population, Glyndon, MN, 2002.**

POPULATION (plants /A)	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT
17820 (75)	18.3	15.72	2.27	4947	268.9	71
23760 (100)	21.1	16.22	2.23	5891	279.7	94
29700 (125)	21.2	16.41	2.16	6036	285.0	122
35640 (150)	20.3	16.39	2.21	5776	283.7	126
41580 (175)	21.0	16.51	2.05	6092	289.3	155
47520 (200)	19.8	16.23	2.10	5620	282.4	151
LSD (.05)	1.7	.63	.19	617	15.4	

**Table 14. Effect of population over variety and planting date on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population, Glyndon, MN, 2003.**

POPULATION (plants /A)	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT
17820 (75)	22.6	17.0	1.5	7015	310.4	77
23760 (100)	23.4	17.7	1.3	7647	326.7	98
29700 (125)	24.9	17.0	1.4	7794	313.1	122
35640 (150)	25.0	17.0	1.3	7788	312.3	136
41580 (175)	24.9	16.8	1.3	7748	310.3	154
47520 (200)	23.9	16.9	1.3	7742	312.1	169
LSD (.05)	1.0	.56	.11	431	12.0	7.4

**Table 15. Effect of population over variety and planting date on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population, Glyndon, MN, 2002-2003.**

POPULATION (plants /A)	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT
17820 (75)	20.4	16.31	1.86	5944	289.2	74
23760 (100)	22.1	16.93	1.77	6710	303.2	96
29700 (125)	22.9	16.65	1.77	6857	297.6	122
35640 (150)	22.6	16.60	1.77	6741	296.6	131
41580 (175)	22.9	16.54	1.65	6854	297.9	154
47520 (200)	21.7	16.48	1.69	6477	296.0	161

**Table 16. Effect of planting date over population and variety on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population, Glyndon, MN, 2002.**

PLANTING DATE	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT
May 2	21.0	16.25	2.13	5951	282.3	117
May 30	19.6	16.24	2.21	5503	280.6	123
LSD (.05)	1.0	ns	.ns	387	ns	ns

**Table 17. Effect of planting date over population and variety on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population, Glyndon, MN, 2003.**

PLANTING DATE	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT
April 29	27.0	17.2	1.4	8508	315.6	127
May 28	21.2	16.9	1.3	6636	312.8	126
LSD (.05)	2.2	ns	0.6	878	ns	ns

**Table 18. Effect of variety over population and planting date on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population, Glyndon, MN, 2002.**

VARIETY	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT
Beta 6447	19.9	16.47	2.12	5726	287.0	115
Seedex Thunder	20.7	16.02	2.22	5729	276.1	124
LSD (.05)	ns	.36	ns	ns	8.8	ns

**Table 19. Effect of variety over population and planting date on root yields, sucrose percentage, sucrose loss to molasses, recoverable sugar production, and harvest population, Glyndon, MN, 2003.**

VARIETY	ROOT YIELD Tons/A	SUCROSE Percent	LOSS TO MOLASSES Percent	RECOVERABLE SUGAR Lbs/Acre	REC SUGAR Lbs/T	HARVEST BEETS /100 FT
Beta 6447	23.1	17.2	1.3	7359	318.4	124
Seedex Thunder	25.1	16.8	1.3	7786	310.0	128
LSD (.05)	1.3	ns	ns	392	ns	ns