EFFECT OF SODIUM CHLORIDE APPLICATION ON SUGARBEET PRODUCTION-1998

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Introduction

The objective of this research is to evaluate the effect of fall and spring applications of sodium chloride and slow release sodium chloride on sugarbeet production.

Materials and Methods

Field experiments were established on a Fargo silty clay (Fine, smectic, frigid, Typic Epiaquert) north of the airport at Fargo, North Dakota, a Wheatville silt loam (Coarse-silty over clayey, frigid Aeric Calciaquoll) at the Northwest Experiment Station near Crookston, MN and a Bearden silt loam (Fine-silty, frigid Aeric Haplaquoll) near Glyndon, MN during the fall of 1997. Following small grain harvest, chisel plowing to the depth of 6-8 inches was conducted to establish a conventional seedbed. The experiment was arranged in a randomized complete block design with six replications. Individual treatment plots measured 11 feet wide and 30 to 35 feet long. In October, five sodium chloride treatments were applied and incorporated with a field cultivator and included a zero-NaCl control. Three treatments consisted of broadcasting granular NaCl at rates of 100, 200, or 400 lb. NaCl a^{-1}, while the other treatment consisted of applying 200 lb. NaCl a^{-1} as sulfur coated material. Prior to seedbed preparation with an Alloway Seedbedder in the spring, the same four NaCl treatments were applied.

Sugarbeet (Beta 3712) were planted on May 2, April 27 and April 23, at Fargo, Glyndon and Crookston respectively with a John Deere 71 Flex or a MaxEmerge 2. Due to a drying seedbed following planting, the Fargo location was replanted on May 23. Sugarbeet was placed 1.25 inches deep with 5-inch in-row spacing at Fargo, and Glyndon and a 2-inch spacing at Crookston. Counter 15G at a rate of 11.9 lb./acre was applied in a 3-inch band over the seed row. A 22-inch row spacing was used. Stand counts were taken on May 22 at Crookston and June 2 at Fargo and Glyndon. Sugarbeets were thinned to a 150 beet per 100 feet of row at Crookston at the four-leaf stage. Post emergence herbicides, cultivation and hand labor were used as needed for weed control at all locations.

Unusual rainfall occurring during May and June resulted in severe root rot at the Fargo and Glyndon locations and reduced the harvested replications Fargo to five.

Sugarbeet were harvested during the last full week of 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:

Sugarbeet plant emergence was not significantly affected by sodium chloride applications at any of the locations (Table 1). The large decrease in plant number with the slow release spring application may be due the large amount of precipitation leaching the other treatments below the seed germination zone of the soil profile and bring a higher concentration of salt into the soil solution prior to the replanting date. Due to the frequency and amount of rainfall during the month of May only one plant count was possible which was after most of the seedlings had emerged.

Other parameters measured at harvest time (Tables 2-9) were not affected by sodium chloride applications, except at the Fargo location where all sodium chloride treatments applied in the fall or in the spring significantly reduced recoverable sugar per ton from that of the check and the 200 pound fall slow release treatment, and the 400 pound spring and 200

pound spring slow release treatments increased the potassium content of the harvested roots. The decrease in yield and sugar production at the Fargo location resulted from the replanting on May 23. This was following the almost 6 inches of rainfall during the early part of May. There was a large increase in recoverable sugar per acre with 400 pound spring application at Crookston

Acknowledgments

Appreciation is expressed to Cargill, Inc. and the Sugarbeet Research and Education Board of Minnesota and North Dakota for grant funds, American Crystal Sugar for sugarbeet quality analysis, and the cooperation of Kevin and Brad Nelson, farmer cooperators.

Table 1. Effect of sodium chloride application on sugarbeet plant establishment (plants per 100 feet) at Crookston, Fargo and Glyndon, 1998.

Treatment	Crookston	Fargo	Glyndon
Check	267	122	211
Fall 100	309	114	211
Fall 200	289	102	211
Fall 200Slow	273	125	209
Fall 400	290	109	214
Spring 100	292	128	215
Spring 200	289	106	208
Spring 200Slow	258	86	211
Spring 400	281	115	209
LSD (.05)	NS	NS	NS

Table 2. Effect of sodium chloride application on recoverable sugar production, pounds per acre at Crookston, Fargo and Glyndon, 1998.

Treatment	Crookston	Fargo	Glyndon
Check	7299	4218	6764
Fall 100	7347	3943	7308
Fall 200	7325	3869	7145
Fall 200Slow	7511	4743	7207
Fall 400	7378	4371	7120
Spring 100	7601	4372	7002
Spring 200	7120	4321	7385
Spring 200Slow	7370	4168	6633
Spring 400	8174	4339	6713
LSD (.05)	NS	NS	NS

Table 3. Effect of sodium chloride application on recoverable sugar production, pounds per ton at Crookston, Fargo and Glyndon, 1998.

Treatment	Crookston	Fargo	Glyndon
Check	308	274	270
Fall 100	319	247	285
Fall 200	314	242	283
Fall 200Slow	308	256	280
Fall 400	320	253	284
Spring 100	311	239	283
Spring 200	313	245	287
Spring 200Slow	313	244	274
Spring 400	340	248	272
LSD (.05)	NS	19	NS

Table 4. Effect of sodium chloride application on sugarbeet root yield, tons per acre at Crookston, Fargo and Glyndon, 1998.

Treatment	Crookston	Fargo	Glyndon
Check	24.1	15.6	25.5
Fall 100	23.4	16.3	25.9
Fall 200	23.7	16.3	25.7
Fall 200Slow	24.9	18.9	26.1
Fall 400	23.5	17.7	25.5
Spring 100	24.9	18.7	25.1
Spring 200	23.2	18.0	26.2
Spring 200Slow	24.0	17.5	24.7
Spring 400	24.5	18.0	25.2
LSD (.05)	NS	NS	NS

Table 5. Effect of sodium chloride application on sodium content (ppm) of sugarbeet roots at Crookston, Fargo and Glyndon, 1998.

Treatment	Crookston	Fargo	Glyndon
Check	591	708	625
Fall 100	630	918	543
Fall 200	659	922	601
Fall 200Slow	711	920	565
Fall 400	569	863	547
Spring 100	703	955	480
Spring 200	587	853	549
Spring 200Slow	559	946	577
Spring 400	457	771	660
LSD (.05)	NS	NS	NS

Table 6. Effect of sodium chloride application on potassium content (ppm) of sugarbeet roots at Crookston, Fargo and Glyndon, 1998.

Treatment	Crookston	Fargo	Glyndon
Check	1506	1998	1784
Fall 100	1728	2058	1743
Fall 200	1586	2233	1830
Fall 200Slow	1696	2005	1835
Fall 400	1622	2147	1933
Spring 100	1622	2017	1879
Spring 200	1648	2197	1877
Spring 200Slow	1686	2382	1861
Spring 400	1740	2333	1860
LSD (.05)	NS	265	NS

Table 7. Effect of sodium chloride application on sucrose percentage of sugarbeet roots at Crookston, Fargo and Glyndon, 1998.

Treatment	Crookston	Fargo	Glyndon
Check	17.2	15.7	15.3
Fall 100	17.8	14.8	16.0
Fall 200	17.6	14.5	16.0
Fall 200Slow	17.3	15.2	15.8
Fall 400	17.9	15.4	16.0
Spring 100	17.5	14.4	15.9
Spring 200	17.5	14.7	16.1
Spring 200Slow	17.5	14.7	15.6

Spring 400	18.7	14.9	15.5
LSD (.05)	NS	NS	NS

Table 8. Effect of sodium chloride application on loss to molasses (percent) in sugarbeet roots at Crookston, Fargo and Glyndon, 1998.

Treatment	Crookston	Fargo	Glyndon
Check	1.8	2.1	1.9
Fall 100	1.9	2.4	1.7
Fall 200	1.9	2.5	1.8
Fall 200Slow	1.9	2.5	1.7
Fall 400	1.9	2.5	1.8
Spring 100	2.0	2.4	1.8
Spring 200	1.9	2.4	1.8
Spring 200Slow	1.8	2.6	1.8
Spring 400	1.7	2.4	1.9
LSD (.05)	NS	NS	NS

Table 9. Effect of sodium chloride application on amino nitrogen content (ppm) of sugarbeets at Crookston, Fargo and Glyndon, 1998.

Treatment	Crookston	Fargo	Glyndon
Check	742	834	715
Fall 100	747	1011	663
Fall 200	771	978	699
Fall 200Slow	774	1017	650
Fall 400	814	1018	698
Spring 100	812	989	679
Spring 200	783	931	675
Spring 200Slow	760	1061	710
Spring 400	673	951	691
LSD (.05)	NS	NS	NS

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The objective of this research is to evaluate the effect of fall and spring applications of sodium chloride and slow release sodium chloride on sugarbeet production.

Procedure:

Field experiments were established on a Fargo silty clay (Fine, smectic, frigid, Typic Epiaquert) north of the airport at Fargo, North Dakota, a Wheatville silt loam (Coarse-silty over clayey, frigid Aeric Calciaquoll) at the Northwest Experiment Station near Crookston, MN and a Fargo silty clay-Bearden silt loam (Fine-silty, frigid Aeric Haplaquoll) near Glyndon, MN during the fall of 1996. Following small grain harvest, chisel plowing to the depth of 6-8 inches was conducted to establish a conventional seedbed. The experiment was arranged in a randomized complete block design with six replications. Individual treatment plots measured 11 feet wide and 30 to 35 feet long. In October, five sodium chloride treatments were applied and incorporated with a field cultivator and included a zero-NaCl control. Three treatments consisted of broadcasting granular NaCl at rates of 100, 200, or 400 lb. NaCl a^{-1}, while the other treatment consisted of applying 200 lb. NaCl a^{-1} as sulfur coated material. Prior to seedbed preparation with an Alloway Seedbedder in the spring, the same four NaCl treatments were applied.

Sugarbeet (Beta 3712) were planted on May 2, May 6, and May 12 at Crookston, Glyndon and Fargo, respectively with a John Deere 71 Flex or MaxEmerge 2 planter. Sugarbeet was placed 1.25 inches deep with 5-inch in-row spacing at Fargo, and Glyndon and a 2-inch spacing at Crookston. Counter 15G at a rate of 11.9 lb./acre was applied in a 3-inch band over the planted seed. A 22-inch row spacing was used. Stand counts were taken on May 27 and June 3 at Fargo, May 20 and30 at Crookston, and May 19, 21, and 28 at Glyndon. Counts were made in the rows to be harvested in the fall. Sugarbeets were thinned to a 150 beet per 100 feet of row at Crookston at the four-leaf stage. Post emergence herbicides, cultivation and hand labor were used as needed for weed control at all locations.

Root maggot infestation during the month of July at the Glyndon site, resulted in the abandonment of the three replications on the Bearden silt loam soil prior to harvest.

Sugarbeet were harvested during the last week of 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:

Sugarbeet plant emergence was not affected by sodium chloride applications on the heavy clay soil at the Fargo location (Table 1). A comparison of these early season counts with those taken at harvest shows very little decrease in stand during the growing season at this location. The spring 400 sodium chloride application significantly reduced plant numbers in two of the three stand counts taken at the Glyndon location (Table 2). Harvest population numbers show total emergence had not occurred at the time the last stand count was taken. The 200 pound fall sulfur coated and spring applications significantly decreased plant numbers on the first counting date at this location. Likewise, the spring application of 100 and 400 pound applications were significantly less on the first plant count at the Crookston location (Table 3).

Results averaged across the three locations show a slight, however, nonsignificant increase in recoverable sugar per acre (Table 4) with a spring application of 100 and 400 pounds of sodium chloride. Results were not consistent across all locations. With the root maggot damage occurring at the Glyndon site, the data is somewhat more variable significantly different than the conventional product.

Other parameters measured at harvest time (Tables 5-13) were not affected by sodium chloride applications, except at the Glyndon location where 400 pounds applied in the fall or in the spring significantly reduce sucrose percentage from the fall sulfur coated application. A harvest population count was not made at the Crookston location.

Acknowledgments

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Table 1. Effect of sodium chloride application on sugarbeet plant establishment (plants per 100 feet) at Fargo, 1997.

Treatment	May 27	June 3
Check	19	130
Fall 100	27	137
Fall 200	20	137
Fall 200S	24	124
Fall 400	16	121
Spring 100	24	127
Spring 200	19	124
Spring 200S	25	136
Spring 400	31	135
LSD (.05)	NS	NS

Table 2. Effect of sodium chloride application on sugarbeet plant establishment (plants per 100 feet) at Glyndon, 1997.

Treatment	May 19	May 21	May 28
Check	39 abc	87	143 a
Fall 100	45 a	98	156 a
Fall 200	37 abc	86	146 a
Fall 200S	28 bcd	82	136 ab
Fall 400	40 ab	92	140 a
Spring 100	46 a	98	155 a
Spring 200	26 cd	75	136 ab
Spring 200S	40 ab	92	152 a
Spring 400	21 d	67	115 b

Means within columns followed by common letter are not significantly different by Duncan's New Multiple range test at P=0.05.

Table 3. Effect of sodium chloride application on sugarbeet plant establishment (plants per 100 feet) at Crookston, 1997.

Treatment	May 20	May 30
Check	594 a	778
Fall 100	518 ab	671
Fall 200	559 ab	709
Fall 200S	501 abc	695
Falls 400	601 a	747
Spring 100	476 bc	674
Spring 200	499 abc	720
Spring 200S	518 ab	704
Spring 400	398 c	649

Means within columns followed by common letter are not significantly different by Duncan's New Multiple range test at P=0.05.

Table 4. Effect of sodium chloride application on recoverable sugar production, pounds per acre at Crookston, Fargo and Glyndon, 1997.

Treatment	Crookston	Fargo	Glyndon	Mean
Check	7028	5954	4673	6090
Fall 100	6814	5997	6420	6371
Fall 200	7165	5484	5991	5939
Fall 200S	7039	5838	6933	6286
Fall 400	7485	5733	5243	6299
Spring 100	7353	6200	6995	6568
Spring 200	6795	5799	5712	6143
Spring 200S	6896	5690	6340	6015
Spring 400	7433	6269	6418	6592
LSD (.05)	NS	NS	NS	NS

Table 5. Effect of sodium chloride application on recoverable sugar production, pounds per ton at Crookston, Fargo and Glyndon, 1997.

Treatment	Crookston	Fargo	Glyndon	Mean
Check	300	264	289	282
Fall 100	295	269	305	286
Fall 200	307	254	295	279
Fall 200S	297	273	317	286
Fall 400	308	260	277	281
Spring 100	303	274	308	287
Spring 200	301	272	281	284
Spring 200S	299	264	306	281
Spring 400	312	265	283	286
LSD (.05)	NS	NS	NS	NS

Table 6. Effect of sodium chloride application on sugarbeet root yield, tons per acre at Crookston, Fargo and Glyndon, 1997.

Treatment	Crookston	Fargo	Glyndon	Mean
Check	23.5	22.4	16.2	21.5
Fall 100	23.1	22.2	21.0	22.2
Fall 200	23.4	21.6	20.4	21.1
Fall 200S	23.7	21.3	21.9	21.8
Fall 400	24.2	22.1	18.9	22.2
Spring 100	24.2	22.6	22.6	22.7

Spring 200	22.5	21.3	20.3	21.5
Spring 200S	23.1	21.4	20.3	21.1
Spring 400	23.8	23.7	22.7	23.0
LSD (.05)	NS	NS	NS	NS

Table 7. Effect of sodium chloride application on sodium content (ppm) of sugarbeet roots at Crookston, Fargo and Glyndon, 1997.

Treatment	Crookston	Fargo	Glyndon	Mean
Check	467	783	482	605
Fall 100	509	777	444	612
Fall 200	449	904	395	635
Fall 200S	547	746	314	622
Fall 400	489	875	614	677
Spring 100	475	737	342	600
Spring 200	517	735	510	611
Spring 200S	520	724	448	616
Spring 400	435	777	446	572
LSD (.05)	NS	NS	NS	NS

Table 8. Effect of sodium chloride application on potassium content (ppm) of sugarbeet roots at Crookston, Fargo and Glyndon, 1997.

Treatment	Crookston	Fargo	Glyndon	Mean
Check	1438	1905	1807	1696
Fall 100	1530	1986	1806	1766
Fall 200	1524	2048	1945	1858
Fall 200S	1541	2029	1980	1828
Fall 400	1488	2155	1637	1782
Spring 100	1517	1909	1926	1770
Spring 200	1558	2116	2040	1875
Spring 200S	1485	2120	1910	1870
Spring 400	1594	2135	2158	1932
LSD (.05)	NS	199	NS	NS

Table 9. Effect of sodium chloride application on sucrose percentage of sugarbeet roots at Crookston, Fargo and Glyndon, 1997.

Treatment	Crookston	Fargo	Glyndon	Mean
Check	16.5	15.0	16.0	15.8
Fall 100	16.4	15.2	16.8	16.0
Fall 200	16.8	14.6	16.3	15.6
Fall 200S	16.5	15.4	17.3	16.0
Fall 400	16.9	14.9	15.6	15.8
Spring 100	16.7	15.6	16.9	16.1
Spring 200	16.6	15.4	15.7	15.9
Spring 200S	16.5	15.0	16.8	15.7
Spring 400	17.1	15.1	15.8	16.0
LSD (.05)	NS	NS	1.2	NS

Table 10. Effect of sodium chloride application nitrate grade of sugarbeet roots at Crookston, Fargo and Glyndon, 1997.

Treatment	Crookston	Fargo	Glyndon	Mean
Check	3.2	4.6	3.8	3.9
Fall 100	3.6	5.2	2.9	4.2
Fall 200	3.0	4.7	3.2	3.9
Fall 200S	3.6	5.2	2.2	4.0
Fall 400	3.5	5.0	3.9	4.2
Spring 100	3.4	4.6	2.6	3.8
Spring 200	3.8	4.4	3.9	4.1
Spring 200S	3.7	4.4	3.1	4.0
Spring 400	3.2	4.7	3.3	3.8
LSD (.05)	NS	NS	NS	NS

Table 11. Effect of sodium chloride application on loss to molasses (percent) in sugarbeet roots at Crookston, Fargo and Glyndon, 1997.

Treatment	Crookston	Fargo	Glyndon	Mean
Check	1.53	1.78	1.57	1.65
Fall 100	1.60	1.78	1.57	1.67
Fall 200	1.47	1.94	1.53	1.69
Fall 200S	1.63	1.72	1.43	1.67
Fall 400	1.52	1.93	1.77	1.74
Spring 100	1.55	1.84	1.50	1.69
Spring 200	1.57	1.77	1.70	1.68
Spring 200S	1.55	1.84	1.50	1.69
Spring 400	1.50	1.86	1.67	1.67
LSD (.05)	NS	NS	NS	NS

Table 12. Effect of sodium chloride application on amino nitrogen content (ppm) of sugarbeets at Crookston, Fargo and Glyndon, 1997.

Treatment	Crookston	Fargo	Glyndon	Mean
Check	633	593	549	603
Fall 100	650	561	556	598
Fall 200	576	640	507	580
Fall 200S	655	549	458	584
Fall 400	602	592	606	601
Spring 100	623	646	533	620
Spring 200	624	535	574	581
Spring 200S	607	590	493	580
Spring 400	580	603	566	576
LSD (.05)	NS	NS	NS	NS

Table 13. Effect of sodium chloride application on harvest population (roots per 100 feet of row) of sugarbeets at Fargo and Glyndon, 1997.

Treatment	Fargo	Glyndon	Mean
Check	126	163	133
Fall 100	125	164	133
Fall 200	122	159	119
Fall 200S	121	168	126
Fall 400	123	157	129
Spring 100	120	189	132
Spring 200	116	158	125
Spring 200S	119	181	126

Spring 400	133	171	135
LSD (.05)	NS	NS	NS

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