Nitrogen and Potash Trials on Sugarbeet Rotation: Since 1974 was the last year of the rotation trials, these plots were divided into four equal parts and 60 lbs of potash were added (see Table 7b). In the fall of 1973, 250 lbs of 0-46-0 were broadcast and incorporated into the plot area.

Yield: Beet yields for 1974 for the "check" and "nitrogen plots" are taken from Tables 4, 5, 6, 7 and 7a. Yield results from the addition of potash and nitrogen plus potash are variable in Table 7b, but they did increase yields on the three fallow rotations. The single application of nitrogen gave the highest beet yields on the three non-fallow rotations.

Recoverable Sugar: The treatments that increased sugarbeet yields also increased recoverable sugar.

Percent Sugar: Results are variable.

Impurity Index: Applications of nitrogen and nitrogen plus potash produced the highest impurities in beets, except beets from the black fallow plots.

Table 7b. Yield, recoverable sugar, percent sugar and impurity index of beets from application of nitrogen[1] and potash on sugarbeet rotation, 1974.

Rotation	Yield	Recoverable Sugar	Percent Sugar	Impurity Index
	T/A	lbs/A	%	
Bl. Fallow--Check	13.43	3686	15.37	701
N 24 lb	13.15	3601	15.22	691
K 60 lb	13.63	3787	15.52	701
NK 24-0-60	13.58	3763	15.60	647
Leg. Fallow--Check	13.67	3654	14.92	707
N 21 lb	14.19	3661	14.72	829
K 60 lb	15.73	4326	15.35	694
NK 21-0-60	15.75	4283	15.52	827
Alf. Fallow--Check	13.25	3624	15.38	760
N 32 lb	13.83	3773	15.43	761
K 60 lb	13.25	3302	14.28	850
NK 32-0-60	15.26	4048	15.20	850
Barley--Check	11.49	3313	15.82	596
N 81 lb	14.55	4074	15.85	798
K 60 lb	11.73	3442	16.02	562
NK 81-0-60	12.94	3611	15.45	646
Soybeans--Check	10.80	3235	16.10	465
N 91 lb	13.48	3855	15.75	623
K 60 lb	11.48	3354	15.57	604
NK 91-0-60	12.80	3716	16.05	637
Oats--Check	12.10	3662	16.40	515
N 77 lb	14.50	4121	15.63	606
K 60 lb	12.42	3784	16.55	531
NK 77-0-60	13.96	3927	15.50	617

[1] Ammonium nitrate was added to each plot, if needed, to equal 125 lbs per acre including soil nitrate-nitrogen in 0-20 inch depth.

Sodium, Potassium and Amino-Nitrogen: Table 7c gives this data for the nitrogen and potash treatments on the sugarbeet rotation plots for 1974. The "potash" and "nitrogen plus potash" treatments almost doubled the sodium and potassium content in the sugarbeet brie when compared to the check. The sodium and potassium values were much lower for the three non-fallow rotations, but followed the same increase pattern.

The amino-nitrogen results were variable, but the "nitrogen plus potash" treatment was the highest on four of the rotations.

Table 7c. Amount of sodium, potassium and amino-nitrogen in sugarbeet brie, 1974.

Rotation lbs/A	Na	K	Amino-Nitrogen
	ppm		
Bl. Fallow--Check	520	1319	333
N 24 lb	480	1370	327
K 60 lb	765	1842	379
NK 24-0-60	710	1647	367
Leg. Fallow--Check	620	1335	411
N 21 lb	647	1341	435
K 60 lb	998	1593	335
NK 21-0-60	1055	1775	495
Alf. Fallow--Check	560	1267	382
N 32 lb	573	1241	432
K 60 lb	1148	1718	402
NK 32-0-60	1052	1725	518
Barley--Check	378	1370	272
N 81 lb	531	1397	373
K 60 lb	535	1760	287
NK 81-0-60	677	1808	326
Soybeans--Check	333	1411	263
N 91 lb	474	1283	334
K 60 lb	625	1643	328
NK 91-0-60	713	1693	368
Oats--Check	321	1338	212
N 77 lb	456	1363	299
K 60 lb	532	1670	289
NK 77-0-60	657	1528	363

Table 8. Crop yields for six sugarbeet rotations, 1974.

Beets		Wheat	Barley	Black Fallow
No N	Added N			
13.4 T	13.2 T	64 bu.	57 bu.	--
Beets		Wheat	Barley	Legume Fallow
13.7	14.2	57	46	2.2 T[1]
Beets		Wheat	Barley	Alfalfa Fallow
13.3	13.8	60	56	2.1 T[2]
Beets		Potato	Wheat	Barley
11.5	14.6	379[3]	64	53
Beets		Wheat	Barley	Soybeans
10.8	13.5	55	56	28
Beets		Wheat	Barley	Oats
12.1	14.5	54	56	69

[1] Tons dry matter per acre
[2] 15.5% moisture
[3] Number one potato, bushels per acre

Potash Trials on Sugarbeets, 1972-74: This trial, which was started in 1972, has followed the same procedure for the past three years (see 1972 and 1973 annual reports). The growing seasons varied during this period and affected the results in a different way each year. The 1973 growing season was most favorable and produced the highest yields. The lowest yields were recorded in 1972.

The results of five rates of potash on yield and percent sugar for 1974 and 1972-74 averages are given in Table 9. The 1974 yields were good considering the late spring planting and mid-summer drought. The 200- and 400-lb treatments were significantly higher in yield than the check plot, but not from one another.

There were no yield differences between the 0- and 5-lb treatments for the 3-year period. The three highest rates of potash were similar in yield and approximately one ton greater than the 0- and 50-lb treatments. The 100-lb rate was the most efficient from the standpoint of fertilizer cost, yield and recoverable sugar per acre.

Table 9. Results of five rates of potash on yield and percent sugar for 1974 and 1972-74 average.

Treatment	Yield, Tons/A		% Sugar	
lbs/acre	1974	1972-74	1974	1972-74
Check	13.90	15.95	14.92	13.90
50	13.93	15.92	14.90	14.04
100	15.43	16.96	14.60	14.15
200	16.50	16.90	14.41	14.12
400	17.04	17.04	14.90	13.73
LSD 5%	2.46			

Soil Test:		pH	O.M.	P	K	NO_3-N
	1972	8.1	H	62 lb/A	600 lb/A	
	1973	8.0	H	72 lb/A	385 lb/A	105 lb/A
	1974	7.9	H	32 lb/A	530 lb/A	78 lb/A

Percent Sugar: There was little difference in the percent sugar for 1974. The 100-lb rate had the highest 3-year average but not much higher than the other treatments.

Recoverable Sugar: The recoverable sugar and impurity index for 1974 and the 3-year averages are given in Table 10. The 1973 trials had the largest amounts of recoverable sugar while the 1972 trials had the lowest. In 1974, the 400-lb rate produced the highest amount of recoverable sugar. In the 3-year average results, the 100-lb rate had the highest amount of recoverable sugar, but not much different from the 200- and 400-lb rates.

Impurity Index: The impurities in the beets in 1974 were the highest of the three-year period because of the adverse growing conditions. The three-year averages in Table 10 are lower than the 1974 results which indicate that the 1974 sugarbeets were immature.

Table 10. Amount of recoverable sugar and impurity index for 1974 and 1972-74 average.

Treatment lbs/acre	Recoverable Sugar ------lbs/A------		Impurity Index	
	1974	1972-74	1974	1972-74
Check	3584	3846	918	866
50	3586	3876	906	854
100	3842	4186	983	790
200	4044	4127	997	871
400	4362	4065	940	913

Sodium, Potassium and Amino-Nitrogen: Table 11 gives the amount of sodium, potassium and amino-nitrogen in the sugarbeet brie for 1973-74 average.

Table 11. Amount of sodium, potassium and amino-nitrogen in sugarbeet brie, 1973-74.

Treatment lbs/acre	Na	K	Amino-Nitrogen
	----------ppm----------		
Check	597	1894	539
50	595	1888	546
100	608	2094	498
200	571	2085	540
400	512	2265	491

The above results are variable and no definite trend is apparent. All three values were higher in 1974 than in 1973.

EFFECT OF CULTIVATION ON YIELD AND QUALITY OF SUGARBEETS, 1974

This study was started in 1973 and two years data are now available. The results are given in Table 12. Because of the late spring and erratic growing conditions, the yields were low in 1974 compared to 1973. Plots that were cultivated five times had the lowest yields, and those cultivated three times had the highest yields.

Two-year average data followed the same pattern. The yields from the plots cultivated three times were approximately one ton higher than those from the "weed free" plots and three tons higher than those cultivated five times.

Table 12. Effect of cultivation on yield and percent sugar for 1974 and 1973-74 average.

No. Cultivations and date	Yield, tons/acre		Percent Sugar	
	1974	1973-74	1974	1973-74
0	11.96	15.09	14.78	13.35
1 (6-26)	11.23	15.11	14.43	13.48
2 (7-9)	11.20	14.89	14.57	13.78
3 (7-18)	12.19	16.24	14.60	13.71
4 (7-24)	12.08	15.48	14.48	13.55
5 (7-31)	10.63	13.08	14.95	13.97

Date planted: May 27, 1974
Date harvested: September 30, 1974

Soil Test:	pH	O.M.	P	K	NO_3-N
	7.9	H	33	530	78

Fertilizer treatment: 100 lbs 0-46-0 applied fall 1973

Percent Sugar: These results are shown in Table 13 for 1974 and 1973-74 average. The sugar content for 1974 was higher than those from 1973. The sugar percentages are similar for both 1974 and 1973-74 and no definite conclusions can be given.

Recoverable Sugar: The recoverable sugar is given in Table 13 for 1974 and 1973-74 average. Recoverable sugar in 1974 was considerably lower than in 1973. The "3 cultivations" had the highest 1974 recoverable sugar but not significantly higher than the other treatments. Plots with "4 and 5 cultivations" were progressively lower than the other treatments. The 1973-74 results followed the same pattern.

Impurity Index: This information is given in Table 13 for 1974 and 1973-74 average. Results for 1974 are variable, but the indices tend to increase with increased cultivations. The 1973-74 averages follow this same pattern.

Table 13. Results of cultivation on recoverable sugar and impurity index of sugarbeets, 1974 and 1973-74 averages.

No. Cultivations	Recoverable Sugar ------lbs/A------		Impurity Index	
	1974	1973-74	1974	1973-74
0	3091	3381	837	941
1	2802	3470	903	907
2	2837	3547	873	830
3	3092	3838	874	835
4	3063	3613	829	844
5	2789	3157	815	822

Amount of Sodium, Potassium and Amino-Nitrogen in Sugarbeet Brie: This data is given in Table 14 for 1974 and 1973-74. The sodium, potassium and amino-nitrogen content of the 1974 beets were higher than those from the 1973 trials. There are no definite conclusions that could be made from these data at this time.

Table 14. Amounts of sodium, potassium and amino-nitrogen in sugarbeet brie, 1974 and 1973-74 average.

Treatment	Na		K		Amino-Nitrogen	
Cultivations	1974	1973-74	1974	1973-74	1974	1973-74
0	683	763	1783	1760	582	568
1	805	727	1848	1815	589	549
2	792	686	1812	1688	571	520
3	780	656	1912	1783	553	510
4	748	676	1885	1754	492	501
5	833	700	1858	1752	486	502

EFFECT OF CULTIVATION ON EVAPO-TRANSPIRATION AND WATER USE BY SUGARBEETS, 1974

The trial was started in 1973 and continued this year following the same procedure and design. The results are given in Table 15. The "0" or check plots were not cultivated and weeds were controlled by hand hoeing.

Table 15. Effect of cultivation on available water use per day and total water use by sugarbeets for period.

Treatment No. of Cultivations	Water Use Per Day Inches	Total Water Use Inches
0	.096	7.01
1	.148	10.81
2	.133	9.73
3	.147	10.70
4	.163	11.92
5	.136	9.93

The results are variable, but the "0" cultivation had the lowest water use per day and for the season. Plots with four cultivations had the highest water use.

FERTILIZER TRIALS WITH ANHYDROUS AMMONIA AND AMMONIUM NITRATE, 1974

This trial was started last fall (1973) when four rates (0-40-80-120 lbs/A) each of anhydrous ammonia and ammonium nitrate were applied on September 1, October 1 and October 29, 1973. The 1974 spring application was made on May 22. Cree barley, which was seeded on May 24, was the test crop. Soil samples were taken of the 0-24 inch depth prior to last fall's fertilizer applications and were taken again this spring of these same plots before planting. The results are given in the following tables.

The purpose of this trial was to determine if any loss occurred of the two fertilizers from fall versus spring application.

Table 16. Amount of nitrate-nitrogen in 24-inch soil depth.

Date	Pounds Per Acre (NO_3-N) Fall 1973	Spring 1974
September 1, 1973	88	
October 1, 1973	110	
October 29, 1973	60	
May 22, 1974		62

Soil samples taken this spring give the amount of nitrate-nitrogen (Table 2) in the 0-24 inch depth before planting Cree barley.

Table 17. Amount of nitrate-nitrogen (NO_3-N) in 0-24 inch depth, spring 1974.

Amount Applied lbs/A	Date Applied	Amount of NO_3-N in Soil 5/10/74 (lbs/A)
0 NH_3	Sept. 1, 1973	60
40 NH_3		85
80 NH_3		122
120 NH_3		204
0 NH_4NO_3	Sept. 1, 1973	81
40 NH_4NO_3		127
80 NH_4NO_3		108
120 NH_4NO_3		115

Table 17. (continued)

Amoutn Applied lbs/A		Date Applied	Amount NO_3-N in Soil 5/10/74 (lbs/A)
0	NH_3	Oct. 1, 1973	83
40	NH_3		102
80	NH_3		177
120	NH_3		209
0	NH_4NO_3	Oct. 1, 1973	86
40	NH_4NO_3		116
80	NH_4NO_3		188
120	NH_4NO_3		153
0	NH_3	Oct. 29, 1973	72
40	NH_3		98
80	NH_3		131
120	NH_3		134
0	NH_4NO_3	Oct. 29, 1973	61
40	NH_4NO_3		85
80	NH_4NO_3		126
120	NH_4NO_3		151

There doesn't seem to be any loss of nitrate-nitrogen from the September and October dates of application compared to the November date.

Barley yields which are given in Table 3 show some variance, but there are no significant yield differences between the dates of fertilizer applieations. The yields from the spring applications are lower than those from the fall applications, but the late, wet spring may have affected these results.

Table 18. Effect of four rates of anhydrous ammonia and ammonium nitrate, applied at four different dates on yield of Cree barley.

Treatment	Time of Application				
Anhydrous Ammonia lbs/A	8/31/73	10/2/73	10/29/73	5/22/74	Avg.
	bushels per acre				
0	58.6	63.4	58.4	55.9	59.1
40	65.1	60.1	56.6	49.4	57.8
80	64.4	65.0	68.9	56.8	63.8
120	59.2	61.8	65.3	67.8	63.5
LSD	NS	NS	NS	NS	NS

Table 18. (continued)

Ammonium Nitrate lbs/A	Time of Application 8/31/73	10/2/73	10/29/73	5/22/74	Avg.
0	49.6	61.4	67.0	49.9	57.0
40	70.1	62.6	66.3	58.5	64.4
80	65.3	54.8	64.3	51.7	59.0
120	63.8	58.0	72.1	70.4	66.1
LSD	NS	NS	NS	NS	NS

The bushel weights are given in Table 4. There was no apparent effect of the two fertilizers or dates of application on the bushel weights.

Table 19. Bushel weight of Cree barley, 1974.

Treatment	Time of Application				
Anhydrous Ammonia lbs/A	8/31/73	10/2/73	10/29/73	5/22/74	Avg.
	lbs/bushel				
0	46.7	46.6	47.2	46.3	46.1
40	44.8	46.1	46.0	45.8	45.7
80	45.9	45.0	45.9	46.4	45.8
120	46.0	47.0	46.6	47.2	46.7
Ammonium Nitrate					
0	44.1	47.0	46.2	46.8	46.0
40	45.3	46.2	44.3	45.2	45.2
80	45.3	46.0	46.6	45.3	45.8
120	46.0	46.5	46.0	46.4	46.2

The percent of plump kernels is an important factor in barley production and nitrogen fertilizers may influence kernel development. Table 5 gives the percent plump for the two fertilizers and dates of application. There is some evidence from the data that anhydrous ammonia produced a greater percentage of plump kernels, especially the late fall and spring applications, than the ammonium nitrate treatments. The 120 lb treatment of anhydrous ammonia gave the best results. However, the check had the same average percent plump as the 120 lb treatments.

Table 20. Percent plump kernels of Cree barley, 1974.

Treatment	Time of Application				
Anhydrous Ammonia lbs/A	8/31/73	10/2/73	10/29/73	5/22/74	Average
0	64	58	73	76	68
40	46	62	70	58	59
80	58	53	65	74	62
120	65	62	69	75	68
Ammonium Nitrate					
0	56	61	68	58	61
40	56	59	56	61	58
80	59	54	67	59	60
120	56	51	69	64	60

AVAILABLE SOIL MOISTURE STUDIES

Moisture held in the soil above the gravitational pull and below the permanent wilting point is available for plant growth. This amount varies with the type of soil, but the Fargo and Bearden soils can hold approximately 17 inches of total available water in the top five feet of soil. However, the amount for optimum plant growth is approximately eight to ten inches.

Soil samples were collected from three different cropping systems during the growing season. Available soil moisture determinations were made at this station on 840 samples of soil during the year. The first samples were taken on May 6 at all three sampling sites.

The data in Tables 21, 22, 23 and 24 give the sampling dates, the precipitation for each period, inches of available soil moisture for each depth and the total for the season. Each table gives the last sampling in the fall of 1973 so that the accumulated overwinter and early spring moisture can be determined. Site 11 was in alfalfa and was plowed in late June and fallowed and the results in Table 25 are for the last sampling of the year.

The available moisture supply was low at the end of the 1973 cropping season at sites 1 and 9 but was adequate at site 10 where the field had been fallowed. The soil moisture increased on all sites over the winter months reaching near optimum soil moisture conditions by the time of the first sampling on May 6.

The below average rainfall during the growing season through July along with above average temperatures in June and July caused a gradual decline in available soil moisture. All three sites showed a moisture deficit in the upper six-inch layer for two consecutive sampling periods. At site 9 a deficit of 0.30 inch was measured for the five-foot profile by the end of July. Sites 1 and 10 which had been fallowed for part of the season in 1973 still contained from two to four inches of available moisture.

Adequate precipitation in August helped to relieve the drought condition in the Valley. At the end of the season the supply of available moisture has been recharged enough so with the overwinter moisture we should be in good shape for next spring.

Table 21 summarizes the available moisture in the soil at the end of the growing seasons of 1972, 1973 and 1974 for sites 1, 9 and 10.

Table 21. Available soil moisture at the end of the growing season, Northwest Experiment Station, 1972, 1973 and 1974.

Site	Soil Type	Texture	Available Water 5-Ft. Depth (Crop)		
			1972	1973	1974
1	Fargo	S. Clay Loam	1.81 (Alfalfa)	2.98 (Alfalfa)	8.70 (Fababeans)
9	Bearden	Silt Loam	4.82 (Alfalfa Fallow)	1.94 (Beets)	4.19 (Barley)
10	Fargo	S. Clay Loam	--	6.33 (Alfalfa Fallow)	4.49 (Beets)

Table 22. Site 1. Fababeans (Alfalfa Fallow 1973) Available moisture in inches, 1974.

Sampling Date	Precip. Inches	Depth in Inches 0-6	7-12	13-18	19-24	25-36	37-48	49-60	Total
10/29/73	--	0.58	0.69	0.62	0.48	0.87	-0.10	-0.16	2.98
5/6/74	5.92	1.30	0.90	0.96	0.84	1.77	1.74	0.53	8.04
6/3/74	2.53	1.31	0.88	0.82	0.74	1.70	2.04	1.32	8.81
7/1/74	1.86	-0.43	0.14	0.32	0.36	1.23	1.68	1.33	4.63
7/31/74	2.97	-0.03	0.11	0.14	-0.01	0.28	1.26	1.09	2.84
9/3/74	5.80	0.62	0.74	0.78	0.67	1.18	1.39	1.74	7.12
10/3/74	0.07	0.36	0.48	0.57	0.38	1.06	1.71	2.06	6.62
11/10/74	3.51	1.25	0.97	1.04	0.83	1.54	1.40	1.67	8.70
Total precip.	22.66								

Table 23. Site 9. Barley (Sugarbeets 1973) Available moisture in inches, 1974.

Sampling Date	Precip. Inches	Depth in Inches 0-6	7-12	13-18	19-24	25-36	37-48	49-60	Total
10/29/73	--	-0.01	0.29	0.19	0.13	0.50	0.88	-0.04	1.94
5/6/74	5.92	0.83	0.87	0.72	0.80	1.97	0.88	0.14	6.21
6/3/74	2.53	0.49	0.57	0.91	0.66	1.82	2.09	1.37	7.91
7/1/74	1.86	-0.59	-0.43	-0.43	-0.29	0.69	1.55	0.93	1.43
7/31/74	2.97	-0.34	-0.44	-0.36	-0.26	0.14	0.29	0.67	-0.30
9/3/74	5.80	0.21	0.48	0.30	0.41	0.80	0.28	0.15	2.63
10/3/74	0.07	0.01	0.27	0.38	0.31	0.74	0.41	0.70	2.82
11/11/74	3.51	0.77	0.72	0.46	0.48	1.26	0.26	0.24	4.19
Total precip.	22.66								

Table 24. Site 10. Sugarbeets (Alfalfa Fallow 1973) Available moisture in inches, 1974.

Sampling Date	Precip. Inches	Depth in Inches 0-6	7-12	13-18	19-24	25-36	37-48	49-60	Total
10/31/73	--	0.39	0.51	0.56	0.46	1.51	1.93	0.97	6.63
5/6/74	5.92	1.38	1.38	1.14	0.90	1.72	1.92	1.96	9.40
6/3/74	2.53	0.97	0.94	0.90	0.76	1.78	2.09	1.32	8.76
7/1/74	1.86	-0.24	0.33	0.51	0.42	1.24	1.65	0.72	4.63
7/31/74	2.97	-0.11	0.01	0.21	0.31	1.36	2.01	0.66	4.45
9/3/74	5.80	0.18	0.19	0.25	0.23	0.92	1.67	0.64	4.08
10/3/74	0.07	-0.15	0.17	0.41	0.40	0.73	1.23	0.38	3.17
11/11/74	3.51	1.20	0.77	0.61	0.36	0.70	1.02	-0.17	4.49
Total precip.	22.66								

Table 25. Site 11. Sugarbeets (Alfalfa Fallow 1974) Available moisture in inches, 1974.
Fall sample taken 11/25/74

	Depth in Inches 0-6	7-12	13-18	19-24	25-36	37-48	49-60	
Percent Moisture	28.6	27.4	20.2	20.3	23.8	25.0	25.5	---
Available Water	0.73	0.83	0.48	0.42	1.77	2.16	1.32	7.71
Deficit - inches	0.93	0.66	1.23	1.26	1.53	1.59	2.13	9.33

WATER USE PER DAY

From the available moisture study it is possible to calculate the water use per day for the three crops mentioned above. The data is given in Table 26.

Table 26. Water use per day for barley, sugarbeets and fababeans at the Northwest Experiment Station, 1974.

	Water Use Per Day In Inches		
Sample period	Fababeans	Sugarbeets	Barley
5/6 - 6/3	.052	.101	.020
6/4 - 7/1	.209	.207	.291
7/2 - 7/31	.149	.095	.147
8/1 - 9/3	.028	.164	.067
9/4 - 10/3	.019	.032	-.004
10/4 - 11/10	.028	.048	.047
Total for season	14.41	19.98	17.09

The site planted with fababeans was substantially lower in total water use due to the crop being harvested on July 30 as a forage for livestock.

This is the thirteenth year that we have compared the water use of a small grain crop to sugarbeets. Based on the 13 years of data sugarbeets consume 3.25 inches more water during the growing season compared to the small grain crops such as wheat and barley. The 1974 data above shows this to be true again with sugarbeets using 2.89 inches more water than the barley crop. This difference can be attributed to the length of the growing season for the two crops. Grain crops, like wheat and barley, use considerable soil moisture during the growing season but are harvested earlier than sugarbeets. Sugarbeets are low users during the early growing season but by mid-season require large amounts of soil moisture.

EVAPORATION FROM OPEN PAN

The average monthly and daily evaporation from an open pan together with mean water temperature are given in Table 27. The readings are taken at 5:00 p.m. each day except Saturday and Sunday. The collection of these data started May 1 and ended October 31 when the water froze solid. June and July were very similar and had the highest daily and monthly evaporation.

Table 27. Average daily and monthly evaporation from open pan together with mean water temperature, 1974.

Month	Inches Daily	Inches Monthly	Mean Water Temp.
May	.123	3.80	51.2
June	.297	8.90	66.0
July	.296	9.13	74.2
August	.276	8.29	65.2
September	.207	6.22	55.4
October	.120	3.36	44.8

Table 28 gives the average daily evaporation for 1968-74 and seven-year data.

Table 28. Average daily evaporation from open pan during the growing season, 1968-74.

Month	1968	1969	1970	1971	1972	1973	1974	Avg.
May	.155	--	--	.252	--	.239	.123	.192
June	.315	--	.204	.213	--	.317	.297	.269
July	.251	.181	.288	.219	.250	.291	.296	.254
Aug.	.210	.297	.270	.242	.253	.268	.276	.260
Sept.	.134	.180	.180	.170	.160	.164	.207	.171
Oct.*	.087	--	--	.219	.137	.104	.120	.134

* Terminated when water froze.

Table 29. Number of clear, partly cloudy and cloudy days for 1974.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Clear	14	14	7	12	3	13	19	7	10	13	9	13	11
P. Cloudy	8	4	10	6	14	14	11	16	14	5	4	5	9
Cloudy	9	10	14	12	14	3	1	8	6	13	17	13	10

WEATHER SUMMARY 1974

The summary of the 1974 weather at the Northwest Experiment Station has been marked by several extremes in monthly weather patterns.

Looking at precipitation, April, August, October and November were all well above the 70-year average amounts of precipitation for their respective periods. In contrast, September was the driest month on record in the history of the Crookston Station since 1895. Only 0.07 inch of precipitation was measured for the month.

The total precipitation for the year totaled 21.51 inches which is 1.31 inches greater than the 70-year average. Of this 21.51 inches, 19.33 inches fell as rain and the remaining 2.18 inches were received in the form of 35.4 inches of snow. The moisture content of the snow for 1974 (0.062 in./1 in. snow) was less than the long-time average of 0.077 inch/1 inch of snow.

Table 30 shows the weather summary data for 1974 including precipitation, mean temperature and long-time averages.

The last spring frost occurred on May 6 when the temperature dropped to 30°F. The first fall frost occurred on September 22 with a recorded temperature of 20°F. The frost-free period of 139 days during 1974 was two weeks longer than the long-time average of 125 days.

Temperatures for the most part were normal at the station in 1974 with January being the coldest month and July the warmest. March was also about 5°F above normal.

Table 30. Weather summary for 1974 with averages for precipitation and mean temperatures for 1900-1970.

	Precipitation, inches					Mean Temperature	
						------degrees------	
Month	Snow Inch	Precip. Inch	Rain	Total	1900-70	1974	1910-70
Jan.	8.3	0.40	0.00	0.40	0.56	-1.5	4.9
Feb.	5.7	0.19	0.00	0.19	0.61	9.4	8.8
March	8.7	0.42	0.01	0.43	0.79	21.1	16.3
April	2.0	0.15	3.18	3.33	1.51	41.3	41.4
May	T	0.01	2.57	2.58	2.62	51.2	54.6
June	0.0	0.00	1.98	1.98	3.36	65.8	64.0
July	0.0	0.00	2.97	2.97	2.98	74.0	69.7
Aug.	0.0	0.00	5.80	5.80	2.89	65.4	67.5
Sept.	0.0	0.00	0.07	0.07	2.11	55.1	57.2
Oct.	0.0	0.00	2.00	2.00	1.34	47.2	45.0
Nov.	5.0	0.80	0.75	1.55	0.86	29.5	27.2
Dec.	5.7	0.21	0.00	0.21	0.59	13.9	11.6
Total	35.4	2.18	19.33	21.51	20.20	Avg.=39.4	39.0

AVERAGE WEEKLY SOIL TEMPERATURES

The daily soil temperatures at the four-inch depth were averaged for the week and the results are given in Table 31 for the period January 1 to September 17. Average soil temperature reached a high of 75.9° during the week of July 22 and a low of 17.9° during the week of January 21. Average temperatures of 60° or higher were maintained from the first week in July through the last week of August.

Daily soil temperatures varied and the highest readings were recorded during July and the first part of August.

Table 31. Average weekly soil temperatures, 1974. (4-inch soil depth)

Week		High	Low	Avg.
Jan.	7	19.7	19.1	19.4
	14	19.7	16.6	18.2
	21	18.2	17.6	17.9
	28	23.0	20.4	21.7
Feb.	4	20.2	19.7	20.0
	11	19.9	19.1	19.5
	18	20.6	20.0	20.3
	25	22.3	21.2	21.8
Mar.	4	23.0	19.4	21.2
	11	25.3	24.2	24.8
	18	26.6	24.8	25.7
	25	24.5	17.9	21.2
Apr.	1	22.7	22.2	22.5
	8	26.8	23.4	25.1
	15	27.5	24.9	26.2
	22	31.3	28.2	29.8
	29	36.9	34.9	35.9
May	6	40.5	33.9	37.3
	13	41.0	37.4	39.2
	20	44.8	38.6	41.7
	27	51.1	43.5	47.3
June	3	57.4	49.4	53.4
	10	62.6	54.0	58.3
	17	61.5	52.1	56.8
	24	63.9	54.9	59.4
July	1	71.8	61.2	66.5
	8	78.6	66.0	72.3
	15	79.9	69.1	74.5
	22	82.0	69.8	75.9
	29	79.9	68.3	74.1
Aug.	5	74.4	61.8	68.1
	12	70.3	61.6	65.9
	19	68.0	59.8	63.9
	26	68.0	56.6	62.3
Sept.	3	52.9	48.3	50.6
	10	58.1	52.7	55.4
	17	54.0	48.2	51.1

GROWING SEASON 1974

The 1974 growing season at the Northwest Experiment Station has been marked by several extremes in monthly weather patterns.

The Valley saw a maximum snow cover of 11 inches during the month of February which gradually decreased to expose the soil surface by April 6. The remainder of the snow caught by windbreaks and ditches disappeared by April 14. At this time the ground frost had thawed 3 inches and by May 11 the total 35 inches of frost had melted.

The spring work was delayed due to over a twofold increase in precipitation in April together with an undesirable distribution of an average amount of rain in May. Precipitation was recorded 25 out of the 31 days in May with 28 of the 31 days having partly cloudy or cloudy skies. Field preparation went on despite the wet conditions and the crops were "mudded in" between showers. All of the planting was completed by May 31 on the Station.

With sufficient soil moisture from the spring the crops grew well during the early part of the summer. June and the first half of July was an unusually dry and hot period which reduced the soil moisture available to the plant in the upper six to twelve inches to nearly zero. This, together with the compaction effect on the soil from the wet spring field work, showed a definite stress on the crops. Many tillers lost in the small grains coupled together with lack of moisture at heading time reduced the grain yields significantly. The row crops were not yet tall enough to shade the exposed ground surface and conserve moisture and consequently were also stunted.

The last half of July and the whole month of August marked another period of extremely wet conditions. The normal precipitation for this small grain harvest period is 3.50 inches although we received nearly two and one-half times this in the amount of 8.68 inches. Many farmers encountered difficulties in harvesting the grain crops and were forced to set up drying facilities to continue harvesting. The grain harvest was completed on the station by September 14. The rains were needed though for the row crops.

The fall work went fine with nearly perfect weather. Potato and sugarbeet harvest got underway September 11 and was completed by October 22. A light frost occurred on September 3 when the temperature dropped to 32°F. September 22 was the date of the first killing frost of 20°F which is normal for the Crookston area. This frost initiated corn harvest for silage on September 23. A record low of 0.07 inch of precipitation was recorded in September which facilitated the completion of fall harvest in good shape.

COMPARATIVE VALUE OF SEVERAL SMALL GRAIN CROPS FOR FORAGE AND GRAIN IN NORTHWEST MINNESOTA

CROOKSTON, MINNESOTA - 1974

C. A. Simkins, L. Smith, R. Schoper

In 1974, a study of the comparative value of Era wheat, Froker oats and Cree barley as grain or forage under various levels of fertility was conducted. Four rates of N (0, 60, 90, and 120 lbs./A) arranged in a randomized complete block design and replicated four times were broadcast at seeding time. In addition to the nitrogen treatments, 100 pounds per acre of 0-46-0 was applied with the seed.

The soil nitrate nitrogen level at seeding time in the 0-24 inch zone was 51 lbs/A. Soil test levels of P and K both tested very high.

Moisture received during the growing season was above normal, but due to a poor seasonal distribution, the potential yield of the late seeded small grain (May 29) was significantly reduced.

The grain yield, forage yield, protein levels and total N removed for each crop is summarized in tables 1, 2 and 3.

Nitrogen fertilizer produced significant increases in grain yield in both wheat (14 bu/A) and barley (31 bu/A). In order of greatest poundage of grain produced per acre, Cree barley was highest at 3792 lbs/A, followed by Era wheat and Froker oats. The highest significant yields for all three species was recorded with the use of 60 pounds nitrogen fertilizer per acre, which correlates well with recommendations based on the nitrate-nitrogen test.

Forage yields in all three species were significantly increased with nitrogen fertilizer. Froker oats produced the greatest amount of dry matter per acre at 4.28 T/A, followed by Era wheat and Cree barley.

Table 1. Forage and grain yields, protein levels and total nitrogen removed by Era wheat, Crookston, Minnesota - 1974.

Lbs. N/A	Grain Bu/A	Grain % protein	Forage Tons/A	Forage % protein	Forage N removed
0	34	13.2	2.33	7.0	63
60	46	14.6	3.10	8.0	80
90	48	15.5	3.25	9.4	97
120	48	15.2	3.40	9.5	102
Significance	**	ns	*	ns	ns
BLSD	8		0.94		