

Title: Effects of nitrogen, phosphorus, potassium, and chloride on grain yield and quality of spring barley.

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Objectives: (1) To determine spring barley yield and protein response to N fertilizer and N soil tests; (2) to determine spring barley response to P fertilizer and P soil tests; (3) survey spring barley response to K and Cl fertilization; and (4) at the end of project (three growing seasons) prepare yield, protein, and N and P fertilizer prediction models or equations using the soil tests and climatic information.

Results: The data are summarized in Tables 1 and 2. All barley response parameters, yield, test weight, plump, thins, and protein responded to N except yield at the northeast location. The northeast (Table 2) location had too much initial nitrate-N for a significant yield response. The north location (Table 1) had optimum yield at the 40 N rate. When added to the initial nitrate-N soil test (0-3'), the optimum yield was produced with 98 lbs. N/ac or 1.2 lbs. of N/bu. The responses to P, K, or Cl were all non-significant.

Preplant and post-harvest soil nitrate-N levels are shown in Figs. 1 and 2. Soil nitrate-N levels were all below preplant levels, however, the northeast location had accumulations from the two highest N rates. The post-harvest, nitrate-N levels for the optimum fertilizer rates (40 N for the north Cut Bank and 0 N for northeast Cut Bank) were negligible.

Preplant and post-harvest soil ammonium-N levels are presented in Figs. 3 and 4. These data make little sense, and probably explain why ammonium-N is not used for predicting N fertilizer response.

Preplant and post-harvest soil water content data are shown in Figs. 5 and 6. These data show barley using water to at least 3 feet at about 1.5 inches of water/foot of soil.

Summary: Spring barley response to N was related to initial nitrate-N level and N fertilizer rate. These first year results indicate about 1.2 lbs N (both soil nitrate-N and fertilizer-N)/bu are needed to produce malting barley. More data are needed before P, K, and Cl responses are well defined.

Future Plans: Continue gathering barley fertilizer response information for 3 more growing seasons.

Table 1. The effect of N, P, K and Cl on spring barley yield and quality. Experiment located north of Cut Bank, MT. Western Triangle Ag. Research Center, Conrad, 1997.

No.	N	Treatment			Grain Yield (bu/ac)	Test Weight (lbs/bu)	Plump %	Thin %	Protein %
		P ₂ O ₅ (lbs/acre)	K	Cl					
12	120	50	30	30	81.60	46.40	54.27	17.90	12.89
8	120	25	30	30	81.00	47.33	63.57	13.77	12.87
4	120	0	30	30	83.00	46.03	62.17	13.53	13.18
11	80	50	30	30	81.40	48.07	70.30	10.03	11.34
14	80	50	30	0	82.80	48.90	66.53	10.90	11.50
13	80	50	0	30	84.83	48.73	67.83	10.37	11.37
7	80	25	30	30	81.50	48.00	67.43	10.77	11.73
3	80	0	30	30	77.33	47.13	69.57	10.60	11.74
10	40	50	30	30	81.27	50.10	86.03	3.97	9.03
6	40	25	30	30	77.57	50.80	86.90	3.43	8.84
2	40	0	30	30	82.00	50.00	83.93	5.33	9.29
9	0	50	30	30	66.10	51.73	91.93	2.13	7.31
5	0	25	30	30	60.20	51.93	92.70	1.77	7.44
1	0	0	30	30	69.17	51.20	92.57	2.00	7.64

Statistical Table					
Experimental Means	77.84	49.03	75.41	8.32	10.44
Error Mean Square	21.75	0.887	31.28	6.04	0.307
P-value	0.0000	0.0000	0.0000	0.0000	0.0000
Standard Error	4.66	0.942	5.59	2.46	0.554
Standard Error of the Mean	2.69	0.544	3.23	1.42	0.320
C.V. 1: (s/mean)*100	5.99	1.92	4.28	17.05	5.31
LSD (0.05)	7.83	1.58	9.39	4.12	0.930

Nitrogen Summary					
120	81.87	46.59	60.00	15.07	12.98
80	80.61	47.90	68.41	10.6	11.63
40	80.28	50.30	85.62	4.24	9.05
0	65.16	51.62	92.40	1.97	7.46
LSD (0.05)	9.02	1.08	7.99	3.47	0.662

Phosphorus Summary					
50	77.99	49.20	75.11	8.61	10.16
25	75.07	49.52	77.65	7.43	10.22
0	77.88	48.59	77.06	7.87	10.46
LSD (0.05)	NS	NS	NS	NS	NS
Interaction P-value	0.9334	0.8308	0.9168	0.8328	0.9957

Variety: Harrington
 Planted: 5/1/97
 Harvested: 8/20/97
 Previous Crop: Fallow

Soil Tests:
 O.M. = 2.45%, pH = 8.0

Depth (ft.)	Cl	NH ₄ -N	NO ₃ -N	SO ₄ -S
(lbs/ac)				
0-1	6.6	10.5	31.8	136.7
1-2	10.2	15.9	17.4	49.5
2-3	6.1	17.6	9.1	102.8
3-4	9.6	22.4	4.0	4122.2

Element (0-6")	Amount (ppm)
P	12.3
Zn	0.64
Mn	6.23
K	302
Cu	1.62
Fe	9.09
B	0.28

Table 2. The effect of N, P, K and Cl on spring barley yield and quality. Experiment located north east of Cut Bank, MT. Western Triangle Ag. Research Center, Conrad, 1997.

Entry	N	Treatment			Grain Yield (bu/ac)	Test			
		P ₂ O ₅ (lbs/acre)	K	Cl		Weight (lbs/bu)	Plump %	Thin %	Protein %
12	120	50	30	30	59.21	42.45	20.13	53.85	16.05
8	120	25	30	30	62.99	43.28	28.18	46.75	15.48
4	120	0	30	30	60.10	42.33	23.30	49.40	15.39
11	80	50	30	30	66.42	43.10	23.70	46.03	15.13
14	80	50	30	0	62.56	43.08	25.60	44.42	14.72
13	80	50	0	30	61.15	43.35	27.90	47.50	14.93
7	80	25	30	30	62.06	43.65	32.05	41.28	14.51
3	80	0	30	30	67.91	43.45	34.38	36.83	14.18
10	40	50	30	30	65.33	43.63	36.80	34.15	13.58
6	40	25	30	30	64.99	45.40	45.35	32.17	13.54
2	40	0	30	30	58.79	43.10	29.72	44.78	13.91
9	0	50	30	30	65.00	45.80	56.55	21.30	11.72
5	0	25	30	30	65.24	46.10	49.80	26.42	12.24
1	0	0	30	30	68.66	45.73	53.25	23.77	12.30

Statistical Table

Experimental Means	63.60	43.89	34.76	39.19	14.12
Error Mean Square	37.22	2.24	123.83	64.13	0.899
P-value	0.4331	0.0040	0.0001	0.0001	0.0000
Standard Error	6.10	1.50	11.13	8.01	0.948
Standard Error of the Mean	3.05	0.749	5.56	4.00	0.474
C.V. 1: (s/mean)*100	4.80	1.71	16.01	10.22	3.36
LSD (0.05)	NS	2.14	15.92	11.45	1.36

Nitrogen Summary

120	60.77	42.68	23.87	50.00	15.64
80	64.45	43.42	30.72	41.36	14.54
40	63.04	44.04	37.29	37.03	13.68
0	66.30	45.88	53.20	23.83	12.09
LSD (0.05)	NS	1.89	12.88	10.69	1.29

Phosphorus Summary

50	63.23	43.76	34.80	38.82	14.07
25	63.82	44.61	38.84	36.66	13.94
0	63.87	43.65	35.16	38.69	13.95
LSD (0.05)	NS	NS	NS	NS	NS
Interaction P-value	0.734	0.980	0.792	0.656	0.962

Variety: Harrington Growing Season ppt. = 6+ "

Planted: 5/1/97

Harvested: 8/20/97

Previous Crop: Fallow

Soil Tests:

O.M. = 2.27%, pH = 8.0

Depth (ft.)	Cl	NH ₄ -N (lbs/ac)	NO ₃ -N	SO ₄ -S
0-1	8.9	6.6	82.8	98.3
1-2	7.4	6.9	39.9	78.7

Element (0-6")	Amount (ppm)
P	15.6
Zn	0.33
Mn	6.53
K	272
Cu	1.13
Fe	6.63
B	0.3

Fig. 1. Preplant and Post-harvest Soil Nitrate-N in Barley.

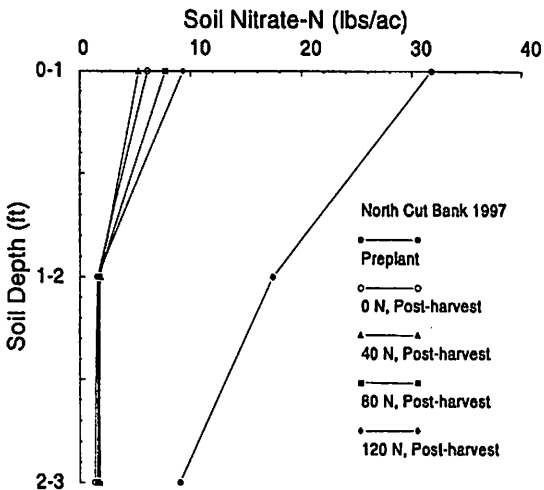


Fig. 2. Preplant and Post-harvest Soil Nitrate-N in Barley.

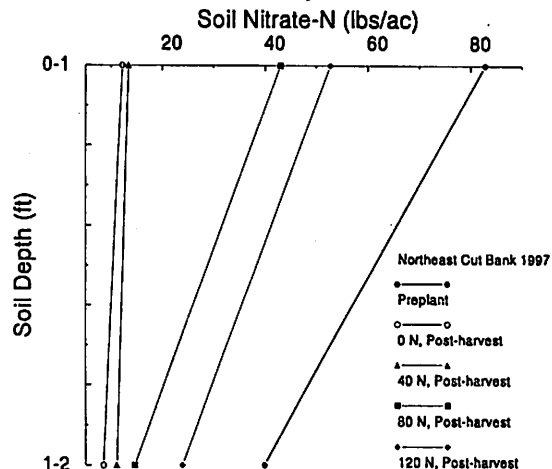


Fig. 3. Preplant and Post-harvest Soil Ammonium-N in Barley.

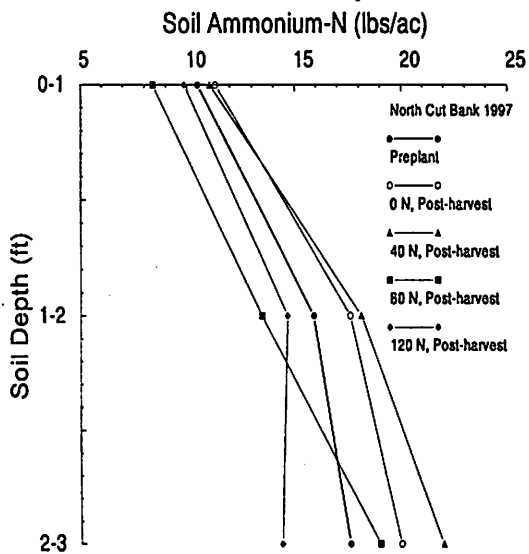


Fig. 4. Preplant and Post-harvest Soil Ammonium-N in Barley.

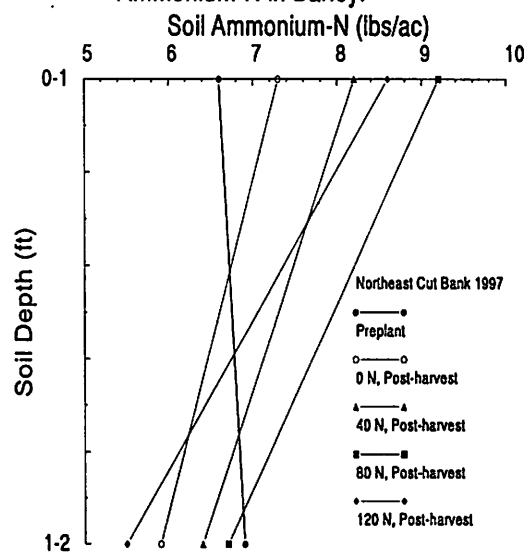


Fig. 5. Preplant and Post-harvest Soil Water in Barley.

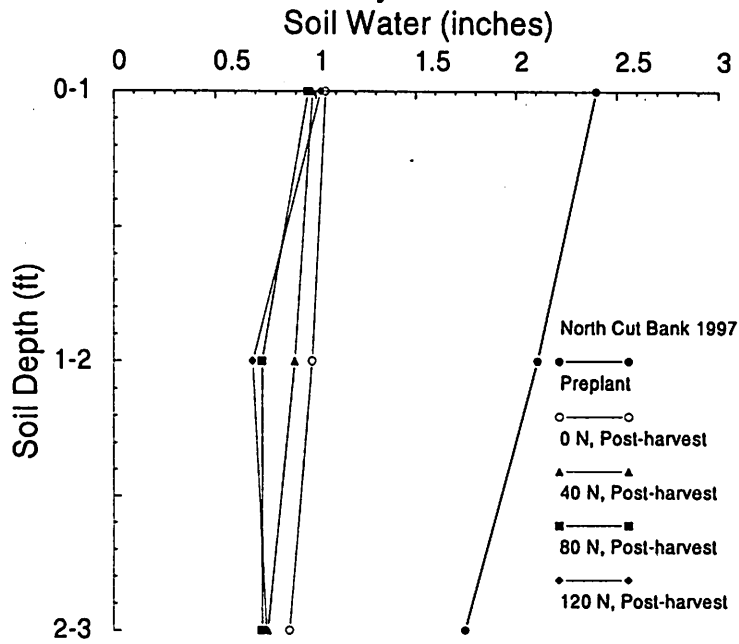


Fig. 6. Preplant and Post-harvest Soil Water in Barley.

