SOIL CONSERVATION THROUGH EXTENDED CROP ROTATIONS

EFFECTIVE FERTILIZER APPLICATION

G.L. Hnatowich[1], J.T. Harapiak[2] and N.A. Flore[2]

[1]Saskatchewan Wheat Pool, 15 Innovation Blvd., Saskatoon, Sask. S7N 2X8
[2]Westco Fertilizers, P. O. Box 2500, Calgary, Alberta, T2P 2N1

INTRODUCTION

A reduced frequency of summerfallowing associated with extended rotations could be beneficial in terms of helping to arrest and possibly overcome the degree of soil degradation that has taken place. However, in the east central region of Saskatchewan, extended stubble cropping is frequently perceived as being impractical because of the high input costs that are involved. In most cases,the major input cost in recropping is fertilizer. Therefore, if extended recropping programs are to be accepted by more of the farming community, the benefits of effective fertilizer application need to be demonstrated under local conditions. The objective of this study is to help create an awareness of the importance of effective fertilizer application in making extended crop rotations practical and profitable. This report will review the results obtained during the growing season of 1987.

MATERIALS AND METHODS

Table 1 outlines the experiments conducted in 1987.

TABLE 1. RESEARCH TRIALS

Experiment	Trials Established
1. Methods of N-P Placement Fall vs Spring	18
2. Depth of Bands	7
3. N-P Rate Study	12
4. Drill in vs Banded N-P	5
5. K Source Study	10
6. Banding in Heavy Textured Soils	3
Total	59

A total of 59 fertility trials, representing 6 different experiments, were established at 21 separate sites in east central Saskatchewan.

Experiments were established in randomized complete block, split-plot or split-split plot designs replicated six times. Subplots were 9.1 x 1.5m separated by two rows of spring seeded winter wheat. Fertilizer applications were applied in October 1986 and/on May 1987, depending upon experimental design. Results of soil analyses obtained prior to fertilization are given in the Appendix.

All trials were treated with appropriate herbicides and maintained weed free. Yield of most sites was determined by machine harvesting a 7.5 m^2 area of each plot. Yield of heavy textured sites were determined by harvesting either a 2.5 m^2 or 4.0 m^2 centre area of each plot. Harvesting began during the third week of August and continued for approximately 3 weeks.

RESULTS AND DISCUSSIONS

a) Methods of N-P Placement; Fall vs Spring

The information in Table 1 is based upon data collected from 14 separate fall and spring trials. Individual site yields and statistical analysis are included in the appendix. Results in Table 1 are based upon 4 wheat and 10 barley trials that included fall and spring applied fertilizer treatments.

TABLE 1. AVERAGE YIELD RESPONSE (BASED ON 14 TRIALS) TO FALL & SPRING APPLICATIONS OF FERTILIZER

Treatment	Grain Yield Increase (kg/ha) Fall	Spring	Average
N Broadcast	885	1,146	1,016
N Broadcast+	1,004	1,368	1,186
N Band	1,454	1,495	1,475
N Band+	1,582	1,684	1,633
N-P Band	1,671	1,725	1,698
N-½P Band, ½ P Drill	1,656	1,778	1,717
N+3/3 P Band, ¼ P Drill	1,673	1,768	1,721
Average	1,418	1,566	1,492

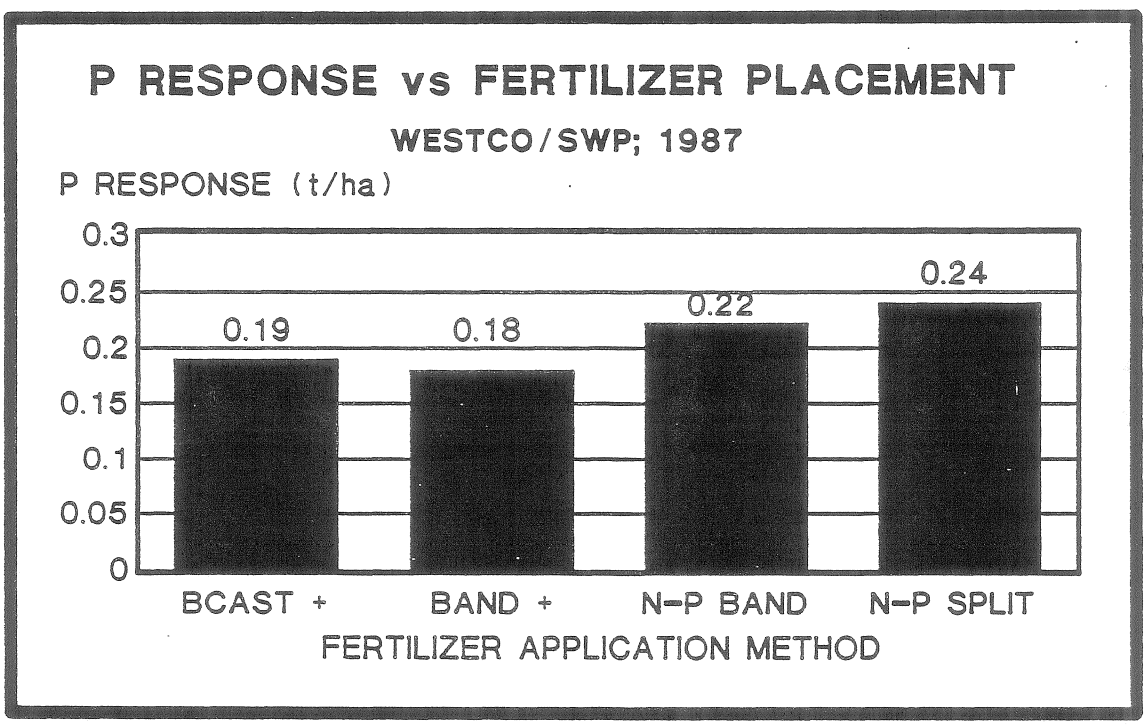
+ Indicates drill in P applied.

Rates: N as 46-0-0 at 70 kg N/ha
P as 0-45-0 at 36 kg N/ha

Check Yield: Fall - 1,869 kg/ha
Spring - 1,947 kg/ha

Highest grain yields were obtained when the nitrogen was banded rather than broadcast. For the two comparable treatments, banding resulted in a 45% and 38% yield advantage over broadcasting based on the yield response to fertilizer. A significant yield difference between comparable band and broadcast treatments occurred at all locations. Phosphorus additions were beneficial in elevating grain yields, however, phosphate placement had a limited effect on grain yield. Yield for treatments where N was banded indicates a slight advantage to banding or splitting the phosphate as opposed to the conventional method of seed placing all the phosphate though the difference was small (approximately 1 bu/ac). Top average yields were achieved where the P application was split between the band and the seedrow. At one site (8724) the two split P treatments were significantly higher yielding than either the dual band or drill in P treatments while at another site (8711) the dual band application was significantly higher than the drill in P application. This is in agreement with results of 1986 where very little difference in yield occurred, on average, between methods of P application but where, at times, one method may have an advantage over another. The average results comparing response to phosphate based on the method of P placement is summarized in Figure 1.

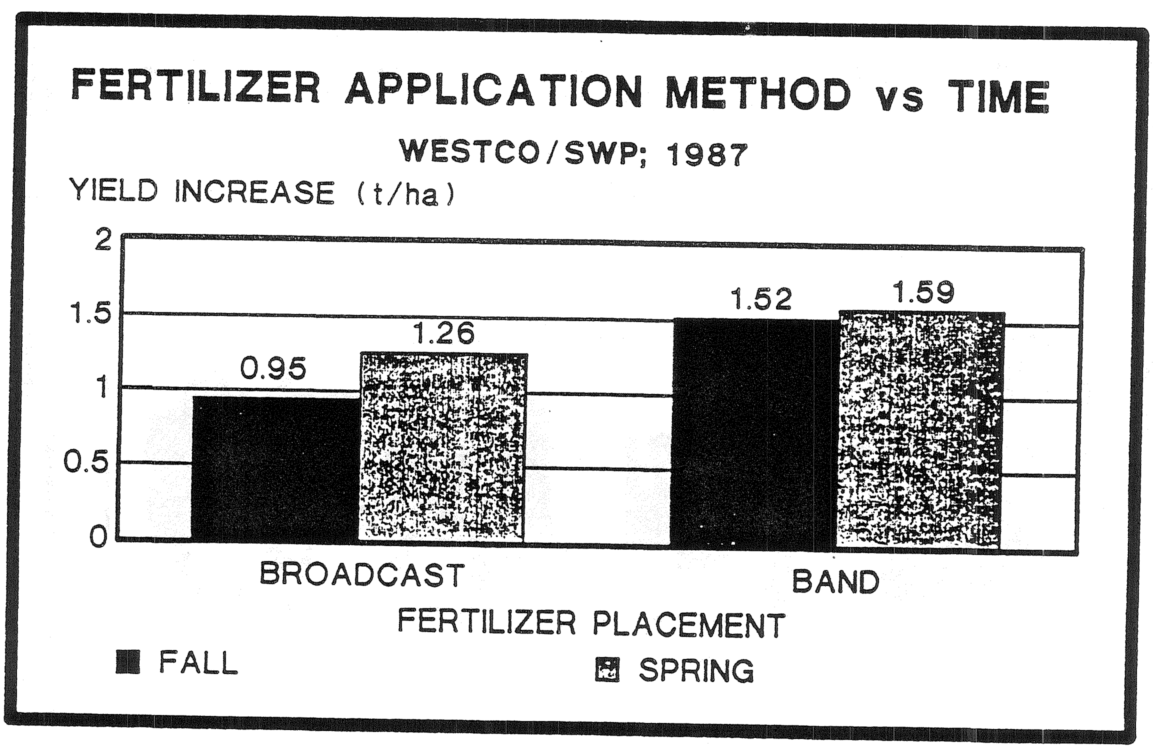
<u>FIGURE 1</u>
(AVERAGE OF 17 SITES)



On average, spring applications were 10% higher yielding than fall applications. However, this figure is somewhat misleading when comparing yield changes between the fall vs spring broadcast and fall vs spring band treatments. The average yield of the two spring broadcast applications was 33% higher than that of the fall applications. Spring band applications exceeded fall applications by only 5% as illustrated in Figure 2. It is apparent that yields are influenced less by over winter environmental conditions when fertilizer is banded than when broadcast. The overall benefit to spring applications is somewhat of a puzzle in view of the relatively dry spring. One might have expected the fall applications to favour those of the spring, such as occurred in 1986. It should also be stated that the advantage of spring applications as determined by test plots is somewhat biased in that the actual yield differences between times of application under field conditions is probably less than that observed. This suggestion is based on the manner of plot establishment since all fertilization, seedbed preparation and seeding is performed within hours. On a commercial scale these operations are often separated by at least several days which could contribute to increased seedbed moisture loses. Therefore any extra spring tillage operation (eg. fertilizer application) can significantly reduce soil moisture availability and therefore crop response.

A total of 3 trials compared spring applications only (8730, 8731, 8732-appendix). Results from these trials are in agreement with previously stated observations regarding methods of fertilizer applications.

<u>FIGURE 2</u>
(AVERAGE OF 2 TREATMENTS OVER 14 SITES)



a) Response To Increasing N Rates

The effects of increasing rates of nitrogen was evaluated at a total of 12 sites (1 wheat, 11 barley). The yield of individual sites and their associated statistical analysis are shown in the appendix. All sites responded to at least one increment of supplemental N, three sites (8713, 8720B, 8720C) had significant yield responses to 140 kg N/ha. The average response to band applied N is summarized in Figure 3. On average, grain yields continued to increase to 140 kg N/ha exceeding the check yield (1596 kg grain/ha) by 87%.

Four of the trials were established in the fall, (ie. 8711, 8713, 8718, 8724) eight in the spring. All nitrogen treatments were evaluated with a standard rate of drill in P_2O_5 (30 kg/ha).

c) Response to Increasing P_2O_5 Rates

At a total of 12 sites (1 wheat, 11 barley) the response to increasing increments of P_2O_5 was evaluated. All phosphate fertilizer was seed placed, at 4 (8711, 8713, 8718, 8724) sites nitrogen fertilizer and where appropriate the required phosphate was banded during the fall. In all cases the phosphate treatments were evaluated at a standard rate of pre-plant banded N (105 kg/ha). Individual site results and statistical analysis are outlined in the appendix. All but one site (8718 wheat) responded significantly to added phosphate. The lowest yield response to 60 kg P_2O_5/ha was 5% (8726) while the highest was 31% (8720). At no site did a significant yield response occur beyond the 45 kg P_2O_5/ha addition. Mean yield responses to increasing rates of drill in P_2O_5 are shown in Figure 4. On average yields increased to 45 kg P_2O_5/ha and then levelled.

FIGURE 3
(AVERAGE OF 12 SITES)

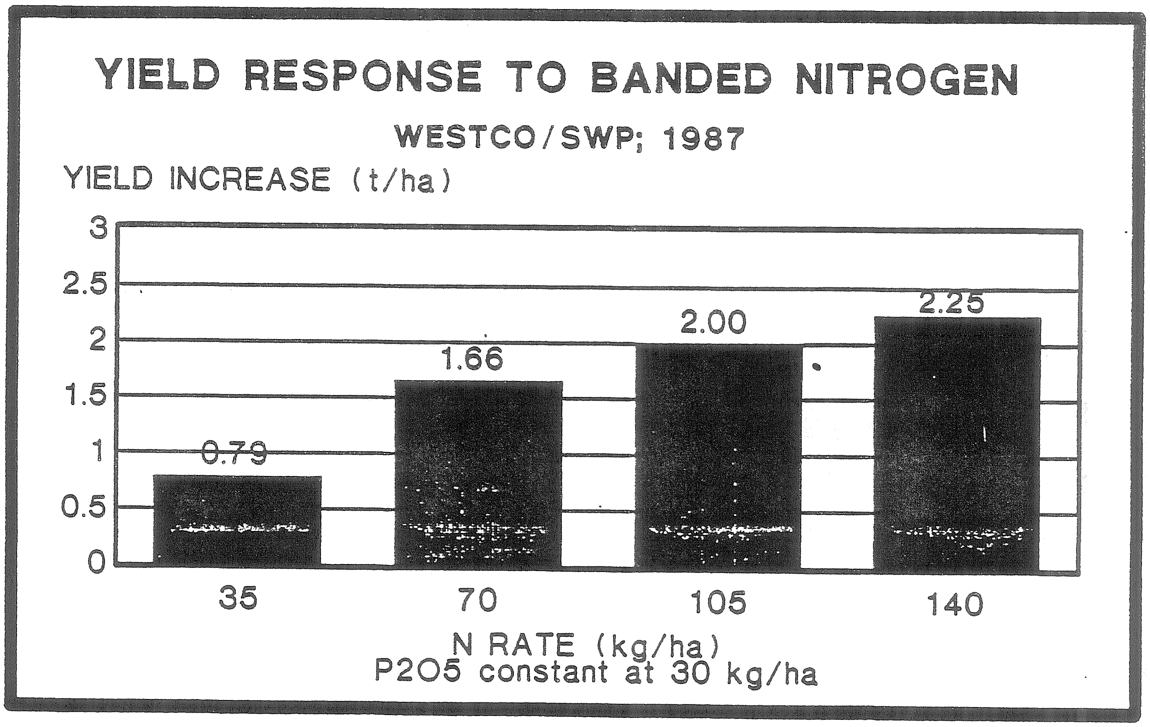
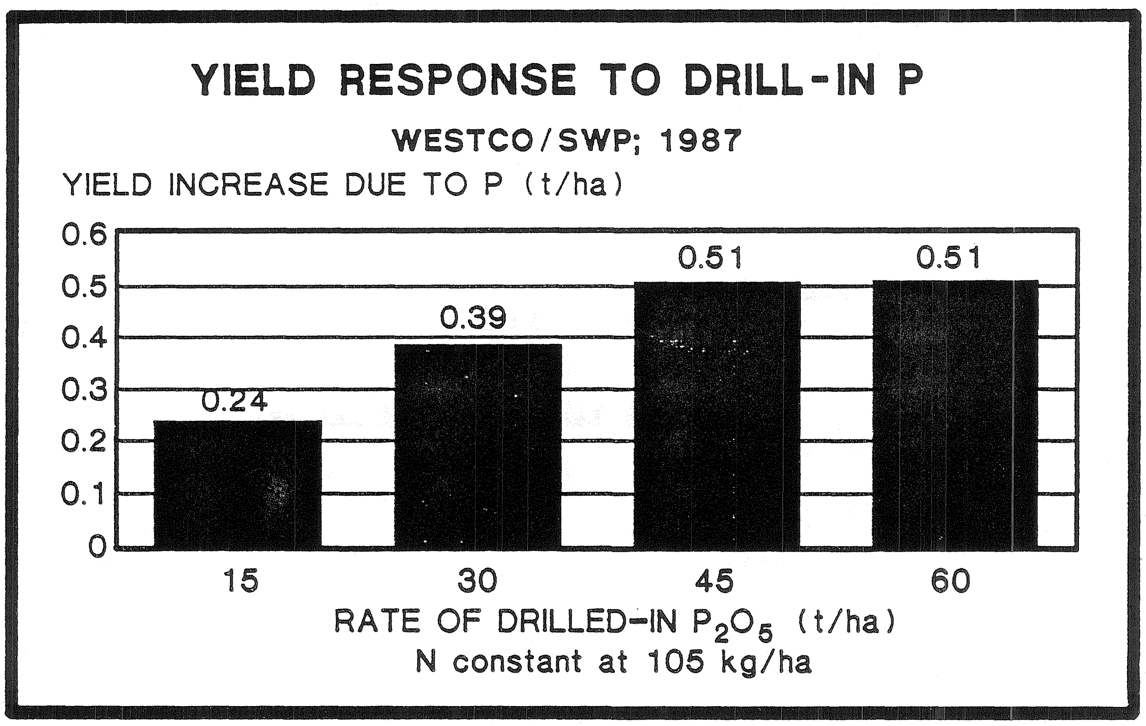


FIGURE 4
(AVERAGE OF 12 SITES)



D) Depth of Bands

At 5 sites (2 wheat, 3 barley) the depth of banding (3", 6") in the fall and spring was evaluated, at 1 site (barley) the depth of banding was evaluated in the spring only. Results and accompanying statistics for each site are shown in the appendix. At all sites 3 methods of fertilization were also assessed, the rate of N and P_2O_5 application was 70 and 30 kg/ha respectively.

The average check (unfertilized) yields for the 2 depths of bands are summarized in Table 2.

TABLE 2. INFLUENCE OF DEPTH OF BANDING ON GRAIN YIELD OF UNFERTILIZED CHECK TREATMENTS (KG/HA)

	Grain Yield (kg/ha)		
Depth	Fall	Spring	Average
3"	1702	1655	1679
6"	1627	1622	1625
Average	1665	1639	1652

For both fall and spring operations increasing the depth of the band to 6" appeared to result in a yield reduction (tillage effect) in the unfertilized treatments. On average, the tillage effect of the banding operation resulted in slightly lower check yields when conducted in the spring compared to fall.

The average response to 3 methods of fertilizer application as influenced by depth and time of banding is summarized in Table 3.

TABLE 3. GRAIN YIELD RESPONSE (KG/HA) DUE TO TIME AND DEPTH OF BANDING*

	Grain Yield Increase (kg/ha)		
Depth	Fall	Spring	Average
3"	1423	1783	1603
6"	1645	1845	1745
Average	1534	1814	1674

* Based on average of 3 different fertilizer treatments

The average yield response to applied fertilizer was greater as the depth of banding was increased, however, this result was statistically significant at only one site (8721). Spring banding was superior to fall banding at all but 1 site (8725).

Table 4, 5 and 6 summarize the grain yield increases obtained for each of the 3 methods of fertilizer applications.

TABLE 4. GRAIN YIELD RESPONSE (KG/HA) DUE TO TIME AND DEPTH OF N BAND

	Grain Yield Increase (kg/ha)		
Depth	Fall	Spring	Average
3"	1355	1699	1527
6"	1612	1797	1705
Average	1484	1748	1616

TABLE 5. GRAIN YIELD RESPONSE (KG/HA) DUE TO TIME AND DEPTH OF N-P BAND

	Grain Yield Increase (kg/ha)		
Depth	Fall	Spring	Average
3"	1452	1874	1663
6"	1672	1834	1753
Average	1562	1854	1708

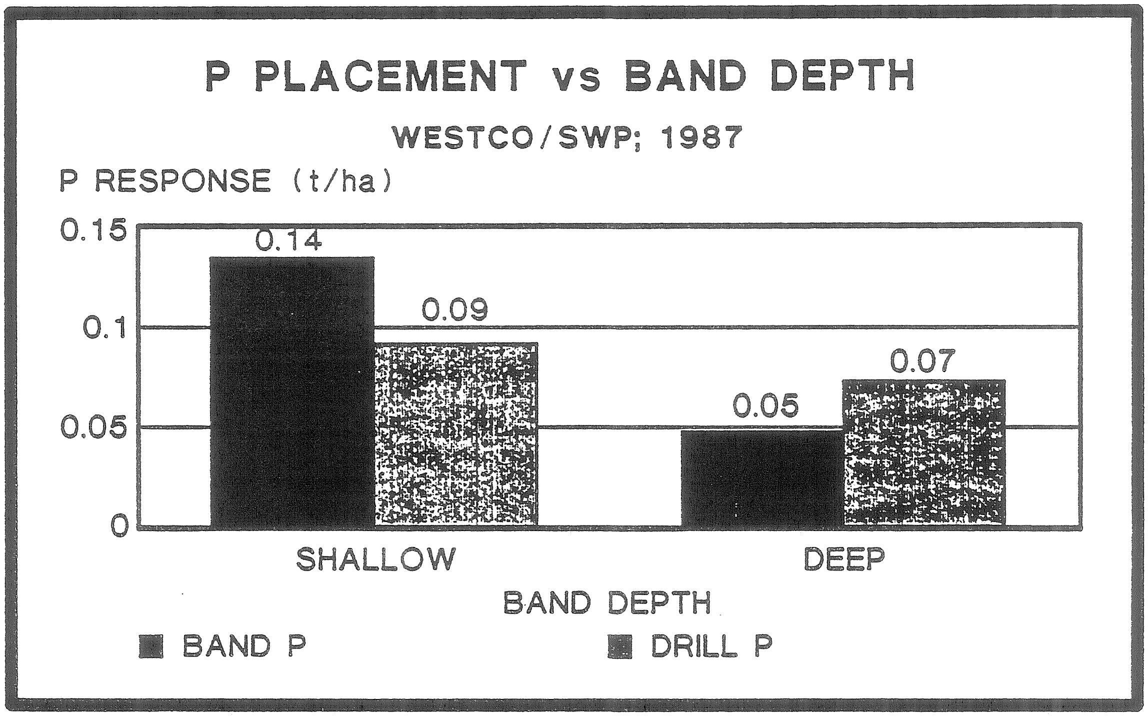
TABLE 6. GRAIN YIELD RESPONSE (KG/HA) DUE TO TIME AND DEPTH OF N BAND; P DRILL-IN

	Grain Yield Increase (kg/ha)		
Depth	Fall	Spring	Average
3"	1462	1775	1619
6"	1652	1904	1778
Average	1557	1840	1699

In all cases of fall application increasing the depth of banding from 3" to 6" resulted in increased yields. This was also true for the spring treatments except in the case where the fertilizer treatment consisted of a dual N-P band (see Table 5) in which case placing the N and P at a shallower depth was slightly more effective. This data would suggest that the need for some starter P when dual N-P bands are placed at greater depths.

The difference in response to method of P application depending on the depth of N banding is graphically illustrated in Figure 5 (includes 1 spring trial). In these trials banded P was superior to drill in P at the shallow band depth but at the greater depth of banding, the reverse occurred. Similar results have been previously observed suggesting that the benefit of including some drill in P (ie. starter P) appears to be more important as the depth of banding increases.

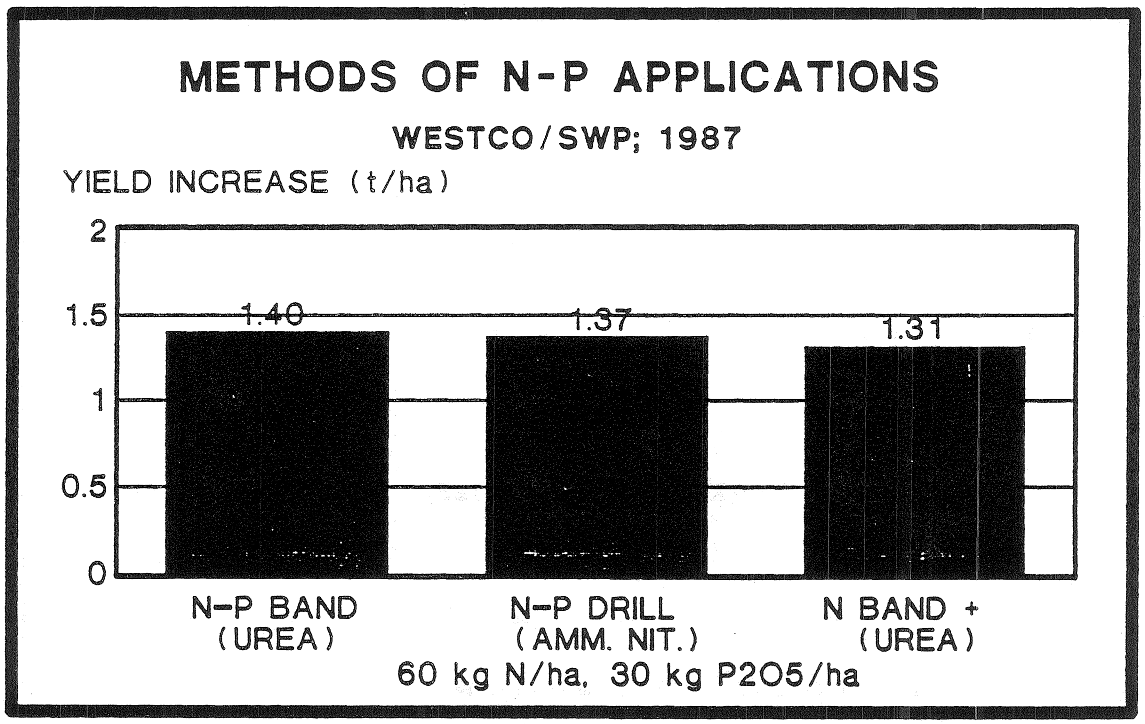
FIGURE 5
(AVERAGE OF 5 SITES)



e) Drill in vs Banded N-P

Placing significantly higher amounts of N directly in the seedrow as an alternative to conducting a separate pre-plant banding operation was evaluated at 5 different sites (1 wheat, 4 barley). Three of the sites were established in the fall of the year. The rate of N and P application was 60 and 30 kg/ha respectively. The source of the band N was urea, while drill in N source was ammonium nitrate. Individual site results and associated statistics are reported in the appendix. A significant response in grain yield to fertilizer application occurred at all sites. A significant difference between fertilizer treatments occurred at only one location (8731). At this site the dual band application was more effective than the N band, P drill in application, the yield difference between these two treatments amounted to 9.3 bushels/acre of barley.

FIGURE 6
(AVERAGE OF 5 SITES)

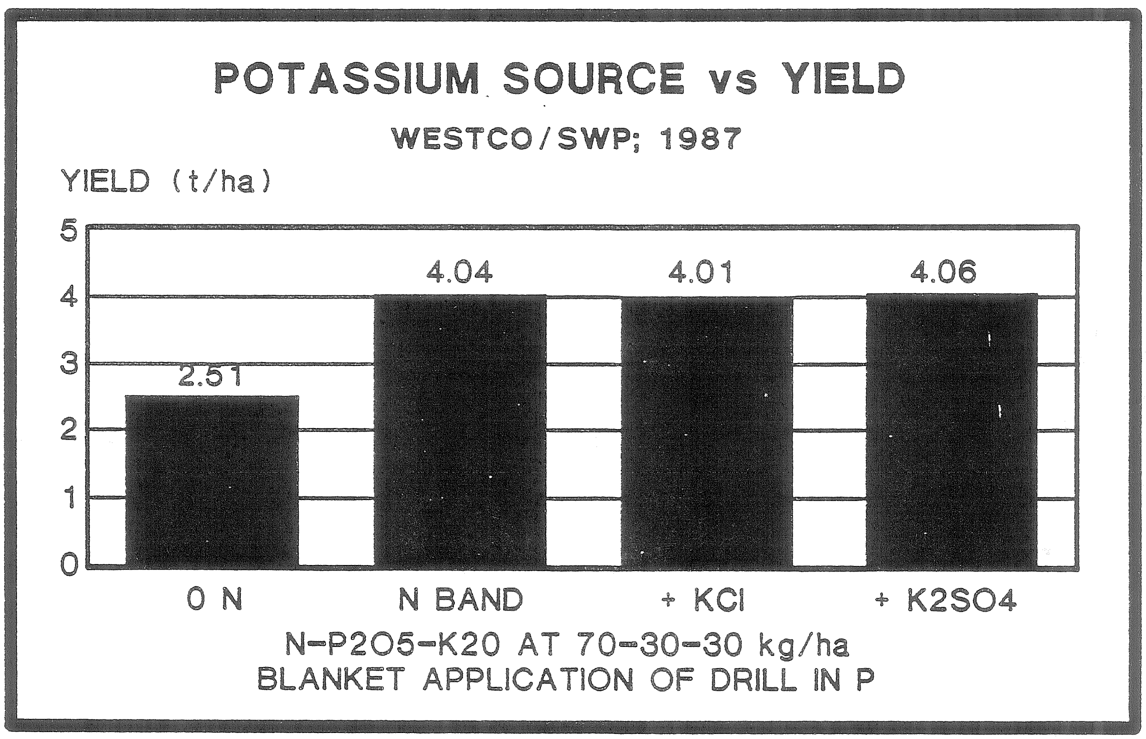


The average yield response to the three methods of fertilizer application is graphically shown in Figure 6. On average, the three methods of application performed equally well. Of some surprise is the effectiveness of the N-P drill in application. The total amount of ammonium nitrate fertilizer seed placed (60 kg N/ha) significantly exceeds the maximum amount of ammonium nitrate (ie. 45 kg N/ha) that is normally suggested as a safe limit for seedrow application with a press drill. Though sub soil moisture conditions were favorable at time of seeding the seedbed moisture conditions were less than ideal. Furthermore several sites experienced a period of moisture stress during the early portion of the growing season. This resulted in a significant reduction of the plant stand at several locations and a delay in maturity for the drill in N-P treatment. However, as moisture conditions improved, plants present appeared to compensate through tillering. The results of this application would suggest that further investigation is warrant. Based upon the results obtained in these trials there appeared to have been no benefit for the retention of seed placed (starter) phosphate as opposed to a dual N-P pre-plant application in 1987.

f) Potassium Source Study

At 9 different sites (1 wheat, 8 barley) the chloride and sulphate sources of potash were evaluated. Individual site results and associated statistics are reported in the appendix. At no site was there a statistical difference between potash sources nor was there a significant response in yield to potash additions. The effects of potash fertilization are graphically illustrated in Figure 7. On average no yield differences occurred with the addition of either potash source. Recent Canadian and U.S. studies have reported yield responses to potassium chloride fertilization. It is thought that in some situations the chloride ion can suppress the influence of several cereal grain diseases. In this trial cereal diseases were not deemed to have affected any site to any significant extent. Soil analyses revealed that all sites selected for this study contained adequate levels of soil chloride.

FIGURE 7
(AVERAGE OF 9 SITES)



g) <u>Banding in Heavy Textured Soils</u>

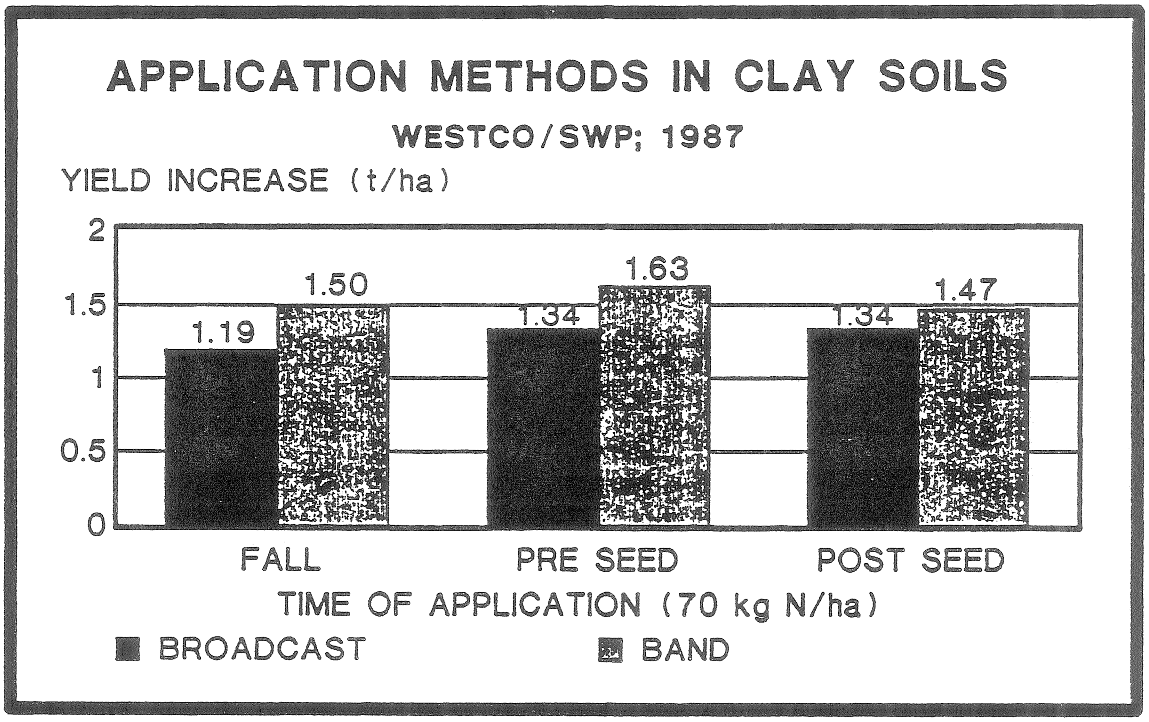
A total of 3 sites (2 wheat, 1 barley) were established to compare options of nitrogen application on heavy textured soils. Fall banding on these soils is often difficult to conduct if they are dry. Spring banding prior to seeding can result in serious compaction of clay soils which in turn has an adverse influence on seedbed quality. In this study an attempt was made to evaluate the time and method of N application, depth of post seeding bands and, at 1 location, the effect of speed on post seeding applications. It should be noted that the wheel tracts (ie. areas of potential soil compaction) were not included in the samples that were harvested for yield determinations. In other words, this study did not attempt to address the potential impact of compaction by application equipment at any of the application dates.

i) <u>Time and Method of N Applications</u>

Average yield data and associated statistics are given in the appendix. All fertilizer applications were made in a direction perpendicular to that of seeding. The rate of N application in these trials was 70 kg N/ha, P was seed placed by the co-operating producer at a rate of approximately 30 kg P_2O_5/ha. Trials were seeded using co-operators field equipment (discer seeder, air seeder, hoe-drill). Statistically, the time of N application did not affect grain yield at the three sites. At all locations N additions significantly increased grain yield and at 2 sites band N yields were significantly higher than broadcast N yields (4.6 and 5.9 bushels/acre increase of barley and wheat respectively).

The average results for the three trials are shown in Figure 8. On average, spring pre-seeding band applications were the most effective in terms of increasing yields. At all times of application broadcast N was less effective than banded N. These findings are in support of results obtained in 1986.

FIGURE 8
(AVERAGE OF 3 SITES)



ii) Depth of Post Seeding Bands

Average yield data by site and associated statistics are given in the appendix. Average yield response to the three depths of post seeding bands is outlined in Table 7.

TABLE 7. GRAIN YIELD RESPONSE TO DEPTH OF POST SEEDING BANDS*

Depth	0 kg N/ha	Grain Yield kg/ha 70 kg N/ha	Grain Yield Response (kg/ha)
0-1"	993	2574	1581
2-3"	970	2471	1501
4-5"	983	2479	1496
Average	982	2508	1526

* Average response of 3 sites. All N banded.

Band N applications significantly increased yield at all band depths. There was a trend for grain yield responses to N additions to decrease as band depth increased.

At 2 sites a broadcast application of N was included in the experiment. Average yield responses are shown in Table 8.

TABLE 8. GRAIN YIELD RESPONSE TO DEPTH OF POST SEEDED BANDS AND BROADCAST N*

N Application	Depth	0 kg N/ha	70 kg N/ha	Grain Yield Response (kg/ha)
Band	0-1"	910	2213	1303
Band	2-3"	887	2208	1321
Band	4-5"	937	2161	1224
Broadcast	0-1"	944	2044	1100
Average		920	2157	1237

All band N applications were superior to the broadcast application.

iii) Speed of Post Seeding Band Applications

At one site the speed (2-3 vs 5-6 mph) of post seeding band operations was evaluated. Yield and statistical analysis is given in the appendix and in Table 9.

TABLE 9. GRAIN YIELD RESPONSE TO SPEED OF POST SEEDING BANDS*

Speed of Banding (mph)	0 kg N/ha	70 kg N/ha	Grain Yield Response (kg/ha)
2-3	766	2165	1399
5-6	774	2300	1526
Average	770	2233	1463

* One site only.

Yield was not significantly influenced by the speed of the tillage operations in the unfertilized treatments (ie. 0 kg N/ha), this agree with field observations where no difference in soil disturbance was noted. When 70 kg N/ha was applied the yield of the faster operating speed was significantly higher than that of the slower speed. The reason for this yield difference is not readily apparent and warrants further investigation. It is possible that the higher speed resulted in less disturbance of the seedbed and the germinating seedlings. Some of the germinating seedlings were displaced onto the soil surface where their survival would be questionable.

ACKNOWLEDGEMENTS

The authors would like to gratefully acknowledge financial support from the Canada - Saskatchewan Economic Regional Development Agreement.

SASKATCHEWAN

ERDA PROJECT

APPENDIX

AVERAGE YIELD DATA & STATISTICAL ANALYSES

N-P PLACEMENT STUDY 1987

YIELD (T/HA)

Treatment	8711A	8712A	8713A	8715A	8716A	8717A
Fall	3.461a	3.515b	2.584a	2.827a	2.715b	1.182b
Spring	3.509a	4.043a	2.660a	2.874a	2.972a	1.565a
Check	2.070d	2.003d	1.135e	1.935d	1.376c	0.539c
N Broadcast	3.148c	3.416c	1.914d	2.558c	2.617b	0.998b
N Band	3.690ab	4.129ab	3.010b	2.889b	2.750b	1.659a
N + P Band	3.976a	4.371a	3.217a	3.212a	3.250a	1.717a
N+3/4 P Band; ¼P Drill	3.690ab	3.622bc	2.128c	2.912ab	2.790b	1.037b
N B'Cast, P Drill	3.530b	2.722ab	3.239a	3.103ab	3.315a	1.666a
N+½ P Band; ½ P Drill	3.731ab	4.384a	3.145ab	3.051ab	3.392a	1.672a
CV	12.3	15.5	7.6	11.7	11.5	12.2
Treatment	NS	**	NS	NS	**	**
Sub	**	**	**	**	**	**
Treatment * Sub	NS	NS	**	NS	NS	**

N-P PLACEMENT STUDY 1987

YIELD (T/HA)

Treatment	8718A	8719A	8720A	8721A	8722A	8724A
Fall	1.986a	2.251b	3.802b	4.255b	3.844b	4.569a
Spring	2.014a	2.569a	4.208a	4.573a	3.984a	4.749a
Check	1.568c	1.193c	2.052d	2.724d	2.057c	3.322g
N Broadcast	1.930b	2.058b	3.587c	4.129c	3.713b	4.356f
N Band	1.910b	2.789a	4.339b	4.669b	4.253a	4.559ef
N + P Band	2.086a	2.764a	4.698a	4.915a	4.336a	4.911cd
N+3/4 Band; ¼ P Drill	2.227a	2.791a	4.640a	4.920a	4.393a	5.199ab
N Broadcast; P Drill	1.930b	2.092b	3.623c	4.127c	3.901b	4.655de
N Band; P Drill	2.147a	2.766a	4.472ab	4.942a	4.293a	4.958bc
N+½ P Band; ½ P Drill	2.191a	2.831a	4.628a	4.880ab	4.368a	5.310a
CV	9.2	7.6	7.7	6.0	6.7	6.7
Treatment	NS	**	**	**	**	NS
Sub	**	**	**	**	**	**
Treatment * Sub	NS	NS	NS	NS	NS	NS

N-P PLACEMENT 1987

YIELD (T/HA)

Treatment	8725A	8726A	8730A	8731A	8732A
Fall	2.227b	4.297b			
Spring	2.317a	4.401a			
Check	1.214c	3.499c	2.475c	3.286c	4.707b
N Broadcast	2.271b	4.229d	3.378b	4.844b	5.195a
N Band	2.309b	4.398bcd	4.007a	5.595a	5.223a
N+3/4 P Band; ¼ P Drill	2.487a	4.465abcd	3.961a	5.545a	5.343a
N Broadcast, P Drill	2.448a	4.356cd	4.078a	4.904b	5.352a
N Band, P Drill	2.474a	4.635ab	4.090a	5.432a	5.398a
N+½ P Band; ½ P Drill	2.503a	4.658	4.072a	5.455a	5.321a
CV	5.9	6.1	6.9	5.0	4.2
Treatment	**	*8	**	**	**
Sub	**	**			
Treatment * Sub	**	NS			

P RATE STUDY - SITE MEANS

YIELD (KG/HA)

Treatment	8711b	8713b	8718b	8720b	8720c	8722c	8724b	8726b	8730c	8731c	8731d	8732b
0 kg P_2O_5	2854b*	3674b	2006a	4330b	4922a	4927a	4379d	4311b	3396c	5616b	4776c	5359b
15 kg P_2O_5	2947b	4047a	2030a	5061a	5206a	4903a	4785c	4677a	3570c	5592b	4975bc	5628a
30 kg P_2O_5	3204ab	4016a	2046a	5404a	5251a	5085a	4977bc	4677ac	3844b	5872ab	5191ab	5612a
45 kg P_2O_5	3369a	4096a	2167a	5620a	5172a	5152a	5309ab	4769ab	4170a	5970a	5193ab	5662a
60 kg P_2O_5	3260ab	4083a	2159a	5683a	5174a	5159a	5509a	4508ab	3993ab	6078a	5466a	5615a
C.V.	10.1	5.8	8.1	10.7	6.0	4.3	6.0	4.5	5.0	4.6	6.1	3.1

* According to Duncan's Multiple Range Test, numbers followed by the same letter are not statistically significant at P=0.05.

N RATE STUDY - SITE MEANS

YIELD (KG/HA)

Treatment	8711b	8713b	8718b	8720b	8720c	8722c	8724b	8726b	8730c	8731c	8731d	8732b
0 kg N/ha	2332b*	1052e	1548b	2161e	1991e	2253d	3370c	3385d	2397c	3184d	2608d	4860c
30 kg N/ha	2529b	2038d	1910a	3288d	3346d	3379c	3952b	4125c	3207b	3909c	3633cc	5324b
70 kg N/ha	3236ab	3267c	2038a	4494c	4581c	4501b	4866ac	4393bc	3917a	5343bb	4785bb	5629a
105 kg N/ha	3204a	4016b	2046a	5404b	5251b	5085a	4977ab	4677ab	3844a	5872a	5191ab	5612a
140 kg N/ha	3369ab	4616a	2070a	5976a	5881a	5269a	5088a	4777ab	3857ab	6183a	5410a	5641a
C.V.	14.5	8.8	14.3	4.4	7.3	6.3	7.2	6.7	9.5	5.9	5.1	4.2

* According to Duncan's Multiple Range Test, numbers follwed by the same letter are not statistically significant at P=0.05.

DEPTH OF BANDS, 1987

YIELD (KG/HA)

Treatment	8712b	8717b	8721b	8722b	8725b	8730b
Fall	2615b	1215b	4121b	4031b	2089a	
Spring	2824a	1550a	4323a	4217a	2079a	
Shallow	2676a	1357a	4133b	4113a	2123a	3561a
Deep	2764a	1408a	4311a	4137a	2044a	3448b
Check	1360c	511b	2732b	2668b	989c	2403d
N Band	3077b	1655a	4712a	4556a	2333b	3653c
Dual Band	3253a	1662a	4756a	4644a	2483a	3890b
N Band, P Drill	3193ab	1704a	4689a	4633a	2530a	4074a
CV	9.4	8.9	8.5	10.4	7.1	5.7
Treatment	**	**	**	**	NS	**
Sub	NS	NS	**	NS	NS	**
S Sub	**	**	**	**	**	
Treatment x Sub	**	**	NS	NS	NS	NS
Trt x S Sub	**	**	NS	NS	NS	
Sub x S Sub	NS	NS	NS	NS	NS	
Trt x Sub x S Sub	**	NS	NS	NS	NS	

DRILL VS BANDED N - P 1987

YIELD (T/HA)

Treatment	8713d	8715b	8719b	8730e	8731e
Check	0.921	1.912b	1.104b	2.518b	2.870c
Dual Band	2.630a	2.960a	2.397a	3.756a	4.560a
N-P Drilled In	2.850a	2.927a	2.451a	3.665a	4.283ab
N Band, P Drill	2.739a	2.973a	2.274a	3.838a	4.058b
CV	8.4	11.4	13.7	10.5	6.0
Treatment	**	**	**	**	**

K SOURCE + DISEASE 1987

YIELD (T/HA)

Treatment	8711c	8713c	8716b	8717c	8721c	8726c	8730d	8731b
P Drill	2.259b	0.903b	1.767b	0.545b	2.789b	3.764b	2.697b	3.133b
N Band, P Drill	3.461a	3.063a	3.366a	1.545a	5.041a	4.961a	3.940a	5.529a
N Band, P + KCL	3.208a	3.042a	3.524a	1.506a	4.895a	4.781a	4.177a	5.356a
N Band, P + K_2SO_4	3.304a	3.103a	3.480a	1.493a	4.919a	4.923a	4.185a	5.569a
CV	15.6	10.4	6.4	8.8	5.7	10.4	9.5	4.6
Treatment	**	**	**	**	**	**	**	**

TIME & METHOD OF N APPLICATION

HEAVY TEXTURED SOILS, 1987

YIELD (KG/HA)

Treatment	8727a	8728a	8729a
Fall	2526a	1739a	1927a
Pre-Seed	2594a	1744a	1870a
Post Seed	2489a	1827a	1799a
Check	1306c	1221b	822c
Broadcast	3028b	2005a	2188b
Band	3278a	2085a	2586a
CV	13.6	14.8	9.1
Treatment	NS	NS	NS
Sub Treatment	**	**	**
Trt x Sub	NS	NS	NS

DEPTH OF POST SEEDING BANDS, 1987

YIELD (KG/HA)

Treatment	8727b	8728b	8729b
0-1" Band	2130a	1652a	1521a
2-3" Band	2068a	1489a	1605a
4-5" Band	2098a	1536a	1560a
0-1" Broadcast		1556a	1432a
0 kg N/ha	1123b	1020b	816b
70 kg N/ha	3128a	2070a	2243a
CV		7.5	7.3
Treatment		NS	NS
Sub Treatment		**	**
Treatment x Sub		**	**

SPEED OF POST SEEDING BAND APPLICATIONS

YIELD (KG/HA)

Treatment	8729c
2-3 mph	1466b
5-6 mph	1537a
0 kg N/ha	770b
70 kg N/ha	2233a
CV	5.3
Treatment	**
Sub Treatment	**
Treatment x Sub	NS

APPENDIX ROUTINE SOIL TEST VALUES AS DETERMINED BY THE SASKATCHEWAN SOIL TESTING LABORATORY

Site	Depth	Texture	pH	Cond.	PPM NO_3-N	P	K	SO_4-S	Cl
8711	0-6"	L	7.9	0.9	6.0	6.0	140	12+	7.4
	6-12"	CL	8.1	1.4	3.0			12+	13.4
	12-24"	CL	8.3	2.3	2.0			12+	25.2
8712	0-6"	L	8.1	1.5	3.5	5.0	135	12+	7.2
	6-12"	CL	8.1	2.3	3.0			12+	7.2
	12-24"	CL	8.2	2.8	3.0			12+	10.9
8713	0-6"	L	8.3	0.7	4.0	11.5	140	12+	4.7
	6-12"	CL	8.2	2.6	1.5			12+	4.8
	12-24"	CL	8.4	3.0	1.0			12+	5.1
8714	0-6"	L	8.1	1.4	6.5	10.0	175	12+	15.1
	6-12"	L	8.1	2.7	6.0			12+	30.8
	12-24"	CL	8.3	3.1	3.0			12+	25.2
8715	0-6"	L	8.3	0.3	3.5	10.0	80	12+	1.7
	6-12"	L	8.2	0.5	3.0			12+	2.1
	12-24"	L	8.5	0.3	1.5			12+	1.8
8716	0-6"	L	8.2	0.4	4.5	6.0	185	12+	12.0
	6-12"	L	8.3	1.0	3.0			12+	12.0
	12-24"	CL	8.4	0.9	1.5			12+	4.2
8717	0-6"	L	8.0	0.3	2.5	7.5	185	5.0	-
	6-12"	L	7.8	0.2	1.5			8.0	-
	12-24"	L	7.8	0.3	1.0			5.5	-
8718	0-6"	L	8.0	0.5	9.0	4.0	140	12+	-
	6-12"	CL	8.3	0.4	4.5			8.0	-
	12-24"	CL	8.3	0.4	2.0			12+	-
8719	0-6"	CL	7.8	0.5	5.0	35.5	450+	12+	6.5
	6-12"	CL	7.7	0.4	1.5			6.5	2.3
	12-24"	CL	7.9	0.5	1.0			7.0	1.1
8720	0-6"	CL	7.7	0.5	4.0	8.0	115	12+	7.7
	6-12"	CL	7.9	0.4	1.5			6.0	0.7
	12-24"	CL	8.3	0.5	1.0			7.0	0.4

APPENDIX ROUTINE SOIL TEST VALUES AS DETERMINED BY THE SASKATCHEWAN SOIL TESTING LABORATORY

Continued

					PPM				
Site	Depth	Texture	pH	Cond.	NO_3-N	P	K	SO_4-S	Cl
8721	0-6"	L	8.2	0.4	6.0	9.5	115	12+	7.7
	6-12"	L	8.4	1.0	2.5			12+	5.3
	12-24"	CL	8.4	2.1	2.5			12+	11.3
8722	0-6"	L	8.1	0.4	5.5	9.0	260	12+	1.3
	6-12"	L	8.2	0.3	2.0			4.5	0.1
	12-24"	CL	8.3	0.4	1.0			4.0	0.0
8723	0-6"	L	8.2	0.5	7.5	5.0	130	12+	13.4
	6-12"	L	8.2	1.3	2.5			12+	2.7
	12-24"	CL	8.2	1.8	1.5			12+	2.1
8724	0-6"	L	8.0	0.6	9.5	9.0	290	12+	17.9
	6-12"	L	7.9	1.2	2.5			12+	5.2
	12-24"	CL	8.1	3.0	1.5			12+	10.2
8725	0-6"	L	8.1	0.4	5.0	7.0	150	12+	2.0
	6-12"	L	8.2	0.6	2.0			12+	1.1
	12-24"	CL	8.4	0.8	1.5			12+	0.9
8726	0-6"	L	8.1	2.1	10.0	14.0	170	12+	1.5
	6-12"	CL	8.2	2.7	9.0			12+	0.9
	12-24"	CL	8.3	3.8	7.5			12+	2.8
8727	0-6"	C	8.4	0.6	4.5	7.5	280	5.5	1.5
	6-12"	C	8.4	0.6	1.5			10.0	0.9
	12-24"	C	8.5	0.6	1.0			12+	0.6
8728	0-6"	C	8.3	0.6	3.5	4.0	210	6.5	2.1
	6-12"	C	8.3	0.7	4.5			9.5	3.2
	12-24"	C	8.3	0.7	2.5			5.5	1.2
8729	0-6"	C	8.1	0.6	4.0	3.5	285	5.0	2.1
	6-12"	C	8.2	0.6	2.0			5.0	1.7
	12-24"	C	8.2	0.5	1.0			5.5	0.5

February 15, 1988.
GH/ci
ERDA.RPT#2