THE EFFECT OF N AND P FERTILIZER PLACEMENT ON YIELD OF CANOLA AND WHEAT IN A CONTINUOUS CROP ROTATION ON MELFORT SILTY CLAY

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Nitrogen and phosphorus fertilizer was applied in a continuous crop rotation at rates of 75 kg N/ha and 0 to 40 kg of P/ha (80 lb. phosphate per acre) in combination with broadcast and incorporated (BR), deep banded (BA), and seed (S) placement methods. Two experiments were designed one in which the fertilizer was banded to a depth of 10 cm (Table 1) and the other, to a depth of 15 cm (Table 4). The fertilizer was banded perpendicular to the direction of seeding a width of 22.9 cm with narrow anhydrous ammonia applicator knives.

The results show that there is little difference in yield of canola between application methods (10 cm depth) in Table 1. Generally with the highest fertilizer rates of phosphorus, yields of canola are the highest with the greatest economic return per hectare or acre. The results show that the heaviest rate of phosphorus (30 P or 60 lb. phosphate/acre) deep banded gave a good return on fertilizer invested. The lower rates banded in combination with nitrogen banded showed an economic loss.

Similarly, in Table 2, little difference in yield of wheat was obtained between application methods (10 cm). The highest yields were obtained with the highest fertilizer rates averaged over 1982 to 1984. On the average, over the 1982 to 1984 period there was no economic loss on fertilizer invested with wheat (Table 3).

With the deeper banding of fertilizer (Table 4) to 15 cm there was no

advantage over the 10 cm deep banding application method. At the heaviest rates of P, combinations of seed placed, broadcast and deep banded fertilizer gave the highest yields. The highest yields generally gave the greatest return on fertilizer invested (Table 5).

The treatments resulting in the lowest yields of wheat generally had the highest amount of nitrate at the 30 to 60 cm depth (Table 6). Higher uptake of N because of higher yields would explain the low soil test results where N fertilizer was applied at 75 kg per ha.

In both Tables 7 and 8, it is shown that the soil test for phosphorus is increased with the highest phosphorus fertilizer rates. The highest yields, therefore, are associated with the highest phosphorus soil tests and associated inversely with the nitrate-nitrogen test at the 30 to 60 cm depth.

The results indicate that broadcasting and incorporating; and deep banding of N were equally effective methods of applying N fertilizer (34-0-0 or ammonium nitrate) for wheat and canola. The results indicate, also, that seed placement; deep banding; and combination of seed placement and deep banding of P were equally effective methods of applying phosphorus fertilizer for wheat and canola grown on Melfort silty clay. However urea (46-0-0) is now a very popular N fertilizer and is much more volatile than 34-0-0. Farmers are advised to apply this fertilizer in accordance with the recommendations of the "Saskatchewan Fertilizer Practices" guide available at Agriculture Canada Research Stations, Department of Soil Science, University of Saskatchewan and local Agricultural Representative offices.

Table 1. Effect of N P Fertilizer Placement on Yield of Canola and Economic Return, 1981

Code	Fertilizer placement and rate N		Fertilizer placement and rate P**	Regent Canola yield	Return over fertilizer cost*
	----- kg/ha -----			t/ha	-- $/ha --
6	75	BR	30 S	1.20	78.30
23	75	BA	20 S+BA	1.13	71.80
21	75	BA	30 BA	1.08	42.30
9	75	BR	30 BA	1.07	38.40
24	75	BA	30 S+BA	1.06	37.20
18	75	BA	30 S	1.05	32.40
17	75	BA	20 S	1.02	38.80
10	75	BR	10 S+BA	1.01	48.80
5	75	BR	20 S	1.00	33.70
22	75	BA	10 S+BA	0.93	27.20
4	75	BR	10 S	0.92	22.70
12	75	BR	30 S+BA	0.90	-12.00
7	75	BR	10 BA	0.87	9.20
16	75	BA	10 S	0.85	2.60
1	75	BR	0	0.84	14.70
8	75	BR	20 BA	0.84	-15.50
15	11	BA	20 BA	0.80	14.44
3	11	S	20 S	0.73	-4.76
11	75	BR	20 S+BA	0.73	-49.10
19	75	BA	10 BA	0.71	-40.30
20	75	BA	20 BA	0.71	-55.10
13	75	BA	0	0.68	-34.50
2	0		0	0.63	0.00

BR - Broadcast and incorporated
BA - Deep banded, 10 cm
S - Seed placed
S+BA - One-half seed placed and deep banded

Canola - $300/t; N = 66¢/kg, P = $1.45/kg or 64¢/kg P_2O_5

*To convert return of $/ha to $/ac. divided by 2.5.
**The rate of phosphorus shown multiplied by 2 gives the rate of phosphate (P_2O_5) in lb/acre.

Table 2. Effect of N P Fertilizer Placement on Yield of Wheat

Code	Fertilizer placement and rate		Neepawa wheat yield			
	N	P	1982	1983	1984	1982-84
	----- kg/ha -----		---------- t/ha ----------			
21	75 BA	30 BA	3.80	3.13	2.60	3.18
6	75 BR	30 S	3.58	3.15	2.51	3.08
24	75 BA	30 S+BA	3.57	2.91	2.74	3.08
9	75 BR	30 BA	3.61	3.07	2.52	3.07
5	75 BR	20 S	3.67	2.96	2.38	3.00
18	75 BA	30 S	3.71	2.91	2.30	2.97
22	75 BA	10 S+BA	3.71	2.76	2.28	2.92
12	75 BR	30 S+BA	3.65	3.11	1.96	2.91
16	75 BA	10 S	3.36	3.06	2.27	2.89
17	75 BA	20 S	3.39	3.01	2.22	2.87
23	75 BA	20 S+BA	3.48	2.82	2.32	2.87
4	75 BR	10 S	3.28	2.93	2.35	2.85
8	75 BR	20 BA	3.53	2.86	2.07	2.82
7	75 BR	10 BA	3.46	2.86	2.05	2.79
10	75 BR	10 BA	3.34	2.98	2.00	2.77
11	75 BR	20 BA	3.20	2.99	2.12	2.77
20	75 BA	20 BA	3.53	2.87	1.88	2.76
19	75 BA	10 BA	3.09	2.82	2.15	2.69
13	75 BA	0	3.05	2.80	1.87	2.58
3	11 S	20 S	2.88	2.83	1.84	2.51
1	75 BR	0	2.91	2.93	1.53	2.45
15	11 BA	20 BA	2.76	2.17	2.13	2.36
2	0	0	2.71	1.97	1.39	2.02

BR - Broadcast and incorporated
BA - Deep banded, 10 cm
S - Seed placed
S+BA - One-half seed placed and deep banded

Table 3. Effect of N P Fertilizer Placement on Economic Return with Wheat

Code	Fertilizer placement and rate N		Fertilizer placement and rate P		Return over fertilizer cost 1982	1983	1984	1982-84
	----- kg/ha -----				---------- $/ha ----------			
21	75	BA	30	BA	125.40	138.60	148.80	137.40
6	75	BR	30	S	79.80	143.60	131.00	118.00
24	75	BA	30	S+BA	79.60	95.60	177.40	117.40
9	75	BR	30	BA	87.20	128.00	133.00	116.00
5	75	BR	20	S	112.30	119.30	119.90	117.10
18	75	BA	30	S	107.40	95.00	88.60	96.80
22	75	BA	10	S+BA	136.40	94.00	113.80	114.60
12	75	BR	30	S+BA	95.40	136.00	19.80	83.60
16	75	BA	10	S	65.80	153.60	111.20	110.00
17	75	BA	20	S	57.90	129.30	88.10	91.50
23	75	BA	20	S+BA	75.90	91.30	106.50	91.10
4	75	BR	10	S	49.80	128.20	128.20	102.00
8	75	BR	20	BA	85.30	100.30	56.50	80.50
7	75	BR	10	BA	85.60	113.40	68.60	89.00
10	75	BR	10	BA	61.60	138.40	57.20	85.60
11	75	BR	20	BA	19.10	125.90	66.50	70.30
20	75	BA	20	BA	85.30	101.70	18.90	68.50
19	75	BA	10	BA	12.00	107.20	87.20	68.60
13	75	BA	0		18.30	117.70	46.90	60.90
3	11	S	20	S	-3.26	135.74	53.34	61.74
1	75	BR	0		-10.50	142.30	-22.50	36.30
15	11	BA	20	BA	-26.26	4.54	111.94	29.94
2	0		0		0.00	0.00	0.00	0.0

BR - Broadcast and incorporated
BA - Deep banded, 10 cm
S - Seed placed
S+BA - One-half seed placed and deep banded

Wheat - $200/t; N = 66¢/kg, P = $1.45/kg or 64¢/kg P_2O_5
*To convert return of $/ha to $/ac, divide by 2.5.

Table 4. Effect of N P Fertilizer Placement (15 cm banding) on Yield of Wheat

Code	Fertilizer placement and rate N	P	Neepawa wheat yield 1982	1983	1984	1982-84
	----- kg/ha ------		---------- t/ha ----------			
10	75 BA	30 S+BA	3.10	2.49	2.46	2.68
12	75 BA	40 S+BA	2.93	2.58	2.48	2.66
13	75 BA	40 BR+BA	2.81	2.25	2.60	2.55
7	75 BA	20 S	2.31	2.68	2.45	2.48
11	75 BA	30 BR+BA	2.68	2.16	2.56	2.47
9	75 BA	20 BA	2.54	2.28	2.51	2.44
6	75 BA	10 BA	2.30	2.52	2.38	2.40
8	75 BA	20 BR	2.24	2.50	2.34	2.36
5	75 BA	0	2.39	2.63	1.97	2.33
3	11 S	20 S	2.80	2.06	1.90	2.25
4	11 BR	20 BR	2.19	2.21	1.82	2.07
2	11 S	0	2.26	1.98	1.71	1.98
1	0	0	2.07	1.60	1.65	1.77

Table 5. Effect of N P Fertilizer Placement (15 cm banding) on Economic Return with Wheat

Code	Fertilizer placement and rate N	P	Return over fertilizer cost* 1982	1983	1984	1982-84
	----- kg/ha ------		---------- $/ha ----------			
10	75 BA	30 S+BA	112.40	84.00	69.00	88.40
12	75 BA	40 S+BA	64.50	87.70	58.50	70.30
13	75 BA	40 BR+BA	39.50	21.70	83.70	48.30
7	75 BA	20 S	-31.10	137.50	82.70	63.10
11	75 BA	30 BR+BA	29.60	18.00	89.20	45.60
9	75 BA	20 BA	15.10	57.10	93.10	55.10
6	75 BA	10 BA	-18.00	119.80	82.40	61.40
8	75 BA	20 BR	-44.90	100.70	59.70	38.50
5	75 BA	0	13.90	156.30	15.30	61.90
3	11 S	20 S	110.34	54.34	14.74	59.74
4	11 BR	20 BR	-12.06	84.54	-2.26	23.34
2	11 S	0	0.54	38.14	-24.06	4.94
1	0	0	0.00	0.00	0.00	0.00

BR - Broadcast and incorporated
BA - Deep banded, 15 cm
S - Seed placed
S+BA - One-half seed placed and deep banded
Wheat - $200/t; N = 66¢/kg; P = $1.45/kg or 64¢ kg P_2O_5.
*To convert return of $/ha to $/lb, divide by 2.5.

Table 6. Effect of N P Fertilizer Placement (10 cm banding) on Nitrate-N in Soil

Code	Fertilizer placement and rate N	P	Nitrate-N 30-60 cm	Code	Fertilizer placement and rate N	P	Nitrate-N 30-60 cm
	---- kg/ha ----		- µg/2g -		---- kg/ha ----		- µg/2g -
4	75 BR	10 S	14.3	6	75 BR	30 S	4.9
14	0	0	13.6	17	75 BA	10 BA	4.5
9	75 BR	30 BA	11.7	8	75 BR	20 BA	4.2
12	75 BA	30 S+BA	10.1	18	75 BA	30 S	4.2
20	75 BA	20 BA	9.4	22	75 BA	10 S+BA	3.1
3	11 S	20 S	9.4	21	75 BA	30 BA	2.6
10	75 BR	10 S+BA	7.0	13	75 BA	0	2.4
5	75 BR	20 S	6.3	11	75 BR	20 S+BA	2.4
16	75 BA	10 S	5.9	24	75 BA	30 S+BA	2.4
2	0	0	5.6	17	75 BA	20 S	2.4
23	75 BA	20 S+BA	5.2	7	75 BR	10 BA	2.3
1	75 BR	0	4.9	15	11 BA	20 BA	2.1

Table 7. Effect of N P Fertilizer Placement (10 cm banding) on Sodium Bicarbonate Soluble-P in Soil

Code	Fertilizer placement and rate N	P	$NaHCO_3$-P 0-15 cm	Code	Fertilizer placement and rate N	P	$NaHCO_3$-P 0-15 cm
	---- kg/ha ----		µg/g		---- kg/ha ----		µg/g
21	75 BA	30 BA	16.6	23	75 BA	20 S+BA	9.5
18	75 BA	30 S	16.1	11	75 BR	20 S+BA	8.9
24	75 BA	30 S+BA	15.4	16	75 BA	10 S	8.9
19	75 BA	10 BA	11.7	6	75 BR	30 S	8.3
5	75 BR	20 S	11.6	14	0	0	7.1
15	11 BA	20 BA	11.5	22	75 BA	10 S+BA	7.0
12	75 BR	30 S+BA	11.2	4	75 BR	10 S	6.7
20	75 BA	20 BA	11.1	10	75 BR	10 S+BA	6.3
3	11 S	20 S	10.8	7	75 BR	10 BA	5.7
8	75 BR	20 BA	10.0	2	0	0	5.5
9	75 BR	30 BA	9.8	1	75 BR	0	5.0
17	75 BA	20 S	9.7	13	75 BA	0	4.7

Table 8. Effect of N P Fertilizer Placement (15 cm banding) on Sodium Bicarbonate Soluble-P in Soil

Code	Fertilizer placement and rate N	P	$NaHCO_3$-P 0-15 cm
	------ kg/ha ------		- µg/g -
12	75 BA	40 S+BA	23.1
13	75 BA	40 BR+BA	21.7
11	75 BA	30 BR+BA	20.4
4	11 BR	20 BR	15.9
8	75 BA	20 BR	15.1
10	75 BA	30 S+BA	14.9
9	75 BA	20 BA	12.8
3	11 S	20 S	9.8
6	75 BA	10 BA	8.7
7	75 BA	20 S	8.3
1	0	0	7.9
2	11 S	0	5.6
5	75 BA	0	5.4