EFFECT OF SULPHUR AND BORON ON CANOLA YIELD

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I. Northeastern Saskatchewan

For many years, crops grown on Gray Wooded soils have often shown sulphur (S) deficiency. Not all Gray Wooded soils cause this problem, so a soil test was developed recently to determine specific deficiencies in farm fields. Previously general recommendations were to apply sulphur on Gray soils in combination with nitrogen (N) and phosphorus (P). Two common fertilizers are 16-20-0 (14% S) and 21-0-0 (24% S). The latter is ammonium sulphate and the former a mixture of monoammonium phosphate and ammonium sulphate; the sulphur could be obtained as a bonus when purchasing these fertilizers.

A trend towards applying higher analysis fertilizers has led to a depletion of sulphur in many Gray Wooded soils and also in some Gray-Black soils. In 1977 and 1978, about 500 ha of canola in northern Saskatchewan did not set seed. The symptoms were typical of boron (B) deficiency. Soil tests showed that the fields were deficient in sulphur as well.

Greenhouse experiments on soils from two sites showed that both S and B affected growth and yield of Regent canola. Field experiments in 1979 showed a dramatic increase in yield of canola cultivars from applied S. Boron increased the yield of one cultivar. However, yields were poor because of dry soil conditions.

In 1980 and 1981, yield response to both S and B were obtained, but was not consistent from one year to the next or among varieties. For example, in 1980 (Tables 1 and 2), sulphur alone increased yield of 'Regent' canola by an average of 130 kg/ha. Boron increased yield by 180 kg/ha, but with the cultivar 'Candle' little or no response was obtained. In 1981, S and B enhances the yield of Candle, but yield response was not consistent with the variety Regent (Tables 3 and 4).

Table 1. YIELD RESPONSE OF CANDLE AND REGENT CANOLA TO SULPHUR AND BORON -- 1980 GRONLID, SYLVANIA FINE SANDY LOAM

Fertilizer Elements					Cultivars	
N	P	K	S	B	Candle	Regent
(kg/ha)					(Yield kg/ha)	
100	20	50			1093	1592
100	20	50	25		996	1705
100	20	50	25	1.4	1136	2103
100	20	50		1.4	1147	1782

Table 2. YIELD RESPONSE OF CANDLE AND REGENT CANOLA TO SULPHUR AND BORON -- 1980 VALPARAISO, WAITVILLE LOAM

Fertilizer Elements					Cultivars	
N	P	K	S	B	Candle	Regent
(kg/ha)					(Yield kg/ha)	
100	20	50			956	1083
100	20	50	25		1093	1230
100	20	50	25	1.4	843	1558
100	20	50		1.4	1113	1258

Table 3. YIELD RESPONSE OF CANDLE AND REGENT CANOLA TO SULPHUR AND BORON -- 1981 GRONLID, SYLVANIA FINE SANDY LOAM

Fertilizer Elements					Cultivars	
N	P	K	S	B	Candle	Regent
(kg/ha)					(Yield kg/ha)	
100	20	50			1354	1627
100	20	50	25		1624	2205
100	20	50	25	1.4	1818	1975
100	20	50		1.4	1621	1625

Table 4. YIELD RESPONSE OF CANDLE AND REGENT CANOLA TO SULPHUR AND BORON -- 1981 BEATTY, MELFORT LOAM

Fertilizer Elements					Cultivars	
N	P	K	S	B	Candle	Regent
(kg/ha)					(Yield kg/ha)	
100	20	50			1598	2319
100	20	50	25		1792	2624
100	20	50	25	1.4	1954	2487
100	20	50		1.4	1718	2886

In 1982, frost was a factor in affecting yield. Boron together with sulphur increased yield of Regent 655 kg/ha at Gronlid (Table 5). Boron without added sulphur gave the highest yield of Regent at the Beatty site (Table 6). Frost damage severely reduced the yield of Regent at Beatty. Sulphur and boron together increased the oil concentration in the grain of Candle and Regent at Gronlid, but not at Beatty (Tables 7 and 9). Gluconsinolate concentration increase

was greater in Candle than Regent canola from the application of S and B fertilizer nutrients (Tables 8 and 10). At Beatty, S and B fertilizers actually reduced glucosinolate concentration in Regent canola.

Table 5. YIELD RESPONSE OF CANDLE AND REGENT CANOLA TO SULPHUR AND BORON -- 1982 GRONLID, SYLVANIA FINE SANDY LOAM

Fertilizer Elements					Cultivars	
N	P	K	S	B	Candle	Regent
(kg/ha)					(Yield kg/ha)	
100	20	50			1868	1278
100	20	50	25		2750	1844
100	20	50	25	1.4	2319	1933
100	20	50		1.4	1993	1190

F test significant at 1% probability level

Table 6. YIELD RESPONSE OF CANDLE AND REGENT CANOLA TO SULPHUR AND BORON -- 1982 BEATTY, MELFORT LOAM

Fertilizer Elements					Cultivars	
N	P	K	S	B	Candle	Regent
(kg/ha)					(Yield kg/ha)	
100	20	50			1632	801
100	20	50	25		1576	856
100	20	50	25	1.4	1638	843
100	20	50		1.4	1306	943

F test not significant

Table 7. EFFECT OF SULPHUR AND BORON ON OIL PERCENTAGE OF CANOLA, 1981 GRONLID, SYLVANIA FINE SANDY LOAM

Fertilizer Elements					Cultivars	
N	P	K	S	B	Candle	Regent
(kg/ha)					- % -	
100	20	50			40.6	40.5
100	20	50	25		40.5	42.1
100	20	50	25	1.4	41.5	41.9
100	20	50		1.4	40.7	41.1

Table 8. EFFECT OF SULPHUR AND BORON ON GLUCOSINOLATE CONCENTRATION OF CANOLA, 1981 GRONLID, SYLVANIA FINE SANDY LOAM

Fertilizer Elements					Cultivars	
N	P	K	S	B	Candle	Regent
(kg/ha)					mg/g	
100	20	50			0.70	0.35
100	20	50	25		2.58	0.65
100	20	50	25	1.4	2.45	1.00
100	20	50		1.4	1.03	0.10

Table 9. EFFECT OF SULPHUR AND BORON ON OIL PERCENTAGE OF CANOLA, 1981 BEATTY, MELFORT LOAM

Fertilizer Elements					Cultivars	
N	P	K	S	B	Candle	Regent
(kg/ha)					- % -	
100	20	50			40.2	42.7
100	20	50	25		40.0	42.9
100	20	50	25	1.4	40.2	42.5
100	20	50		1.4	39.9	42.8

Table 10. EFFECT OF SULPHUR AND BORON ON GLUCOSINOLATE CONCENTRATION OF CANOLA, 1981 BEATTY, MELFORT LOAM

Fertilizer Elements					Cultivars	
N	P	K	S	B	Candle	Regent
(kg/ha)					mg/g	
100	20	50			2.80	0.95
100	20	50	25		3.23	0.85
100	20	50	25	1.4	3.00	0.70
100	20	50		1.4	3.55	0.55

II. Northwestern Saskatchewan

Yield of Regent canola (1982) appears to be higher (Table 1) with applied S and B fertilizer. Maturity and development of seed pods has been observed to be increased with B application. No effect of boron on Candle grain yield is apparent. Similarly with

Candle canola (Table 2), no boron effect is evident. Similarly, in 1981, there is no effect of boron on yield of Regent and Candle (Table 3). However, in Table 4, response in grain yield to boron is quite evident. The highest yielding treatment (1991) obtained with 200 kg N/ha applied, also had the lowest oil percentage (46.2%). Sulphur increased glucosinolate concentration in Regent canola (Table 5). Boron had no apparent effect on glucosinolate content.

In general, response to B was inconsistent. Soil tests and plant analyses diagnosis techniques could give more precise estimates of boron deficiency. As soil moisture, soil pH, percentage organic matter and clay and exchangeable calcium may affect B availability, some inconsistency in response to B may be expected.

Table 1. EFFECT OF SULPHUR AND BORON APPLICATION ON YIELDS OF CANOLA ON A SULPHUR-DEFICIENT LUVISOLIC LOON RIVER LOAM - 1982

Treatment		Seed Yield
Variety	Fertilizer	kg/ha
Regent*	Check	730
	NPK	521
	$NPKS_1$	812
	$NPKS_2$	864
	NPKB	794
	$NPKS_1B$	978
Candle	Check	990
	NPK	1482
	$NPKS_1$	1741
	$NPKS_2$	1610
	NPKB	1415
	$NPKS_1B$	1716

*Frost damage
N, P, K = 100, 20, 50 kg/ha respectively
S_1 = 25 kg/ha, S_2 = 50 kg/ha
B = 1.4 kg/ha

Soil Tests
N = 105, P = 12, K = 146, S = 8,
B = 1.26 kg/ha

Table 2. EFFECT OF FERTILIZERS ON THE YIELD OF CANDLE CANOLA ON A LUVISOLIC LOON RIVER LOAM SOIL - 1982

Kg/Ha					Seed Yield
N	P	K	S	B	kg/ha
0	20	50	25	1.4	1742
25	20	50	25	1.4	1918
100	20	50	25	1.4	2042
200	20	50	25	1.4	1876
100	20	50	0	1.4	1248
100	20	50	10	1.4	1319
100	20	50	50	1.4	2164
100	20	50	25	0	2046
100	20	50	0	0	1395
100	20	0	25	1.4	1956
Check					1570

Table 3. RESPONSE OF CANOLA TO SULPHUR AND BORON ON A LOON RIVER LOAM SOIL - 1981

Variety	Fertilizer	Seed Yield kg/ha	% Oil In Seed (ODB)
Regent	Check	847	48.09
	NPK	1266	44.27
	$NPKS_1$	1841	47.19
	$NPKS_2$	1736	47.03
	NPKB	747	44.14
	$NPKS_1B$	1764	47.73
Candle	Check	245	44.76
	NPK	492	39.34
	$NPKS_1$	937	42.54
	$NPKS_2$	977	43.63
	NPKB	670	40.97
	$NPKS_1B$	868	43.68

N, P, K = 100, 20, 50 kg/ha
S_1 = 25 kg/ha, S_2 = 50 kg/ha
B = 1.4 kg/ha

Table 4. RESPONSE OF REGENT CANOLA TO N AND S FERTILIZERS ON A LOON RIVER LOAM SOIL - 1981

Treatment kg/ha					Seed Yield	% Oil
N	P	K	S	B	kg/ha	(ODB)
200	20	50	25	1.4	1991	46.2
100	20	50	25	2.8	1864	47.1
100	20	50	25	1.4	1898	46.8
100	20	50	25	1.4	1747	47.7
100	20	50	25	1.4	1636	48.2
100	20	50	25	0	1625	47.0
Check					703	

Table 5. EFFECT OF NITROGEN AND SULPHUR FERTILIZERS ON GLUCOSINOLATE CONTENTS IN REGENT CANOLA GROWN ON A LUVISOLIC LOON RIVER LOAM - 1981

Fertilizer Applied kg/ha					Glucosinolates in Seed
N	P	K	S	B	μ Moles/gm Oil Free Meal
40	20	50	10	0.6	8.97
40	20	50	40	0.6	11.67
160	20	50	10	0.6	8.49
160	20	50	40	0.6	16.73
0	20	50	25	1.4	11.69
100	20	50	25	1.4	15.16
200	20	50	25	1.4	9.02
100	20	50	0	1.4	2.89
100	20	50	50	1.4	14.28
100	20	50	0	0	3.87
Check					8.91