

EFFECT OF NSB FERTILIZER NUTRIENTS ON YIELD AND QUALITY OF CANOLA IN A ROTATIONAL COMPOSITE DESIGN

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Abstract

Experiments were set out as a rotational composite design with 5 rates of N, S and B at 10 sites over a period of four years on Sylvania fine sandy loam, Waitville, and Melfort silty clay loam in northeastern Saskatchewan and Loon River loam in northwestern Saskatchewan. Experiments on Sylvania fine sandy loam over four years showed that N, and the S by B interaction increased 'Regent' canola yield significantly. Other sites in northeastern Saskatchewan showed yield increases from N fertilizer and sites from northwestern Saskatchewan showed significant yield increases from N and S fertilizer. On the Sylvania fine sandy loam site over a period of four years, the lowest yield was 1.04 t per ha (ha^{-1}) with 0 kg N, 25 kg S and 1.4 kg of Boron (B) ha^{-1} . The highest yield of 1.82 kg ha^{-1} was obtained with 200 kg N, 25 kg S and 1.4 kg B per ha^{-1} . Sulphur increased glucosinolate concentration from 7.3 to 10.1 $\mu\text{moles g}^{-1}$. Nitrogen fertilizer decreased oil concentration (46.1 to 43.3%) but S increased oil content (43.9 to 45.5%). Conversely, N increased protein content from 48.4 to 51.6%. Also, S increased protein content from 48.9 to 49.9%. The above variables also, were affected similarly at other sites in northeastern and northwestern Saskatchewan.

Yield and Quality of Canola in a Rotational Composite Design

Experiments were set out in a composite design as shown in Table 1, with 17 treatments which is a 3 x-variable (factor) N, S, B rate rotatable type

with 3 center points (Cochrane and Cox 1957). The advantage of this design was the low number of treatments which could be used in testing 5 rates of three different factors (nutrients) for 1st order and 2nd order interactions. A disadvantage of the design is that some meaningful treatments still may be left out. The statistical analyses of this experiment is complicated and requires the assistance of a qualified statistician.

Because all nutrients applied by fertilizers may interact with one another and those in the soil, a knowledge of the main effects and significant interactions on crop yield and quality is essential. Previously, (Nuttall 1983), the effect of N, S, B elements on canola yield and quality in a simple split plot design with two cultivars was presented. With the rotational design, it has been shown that there is an interaction effect of S and B affecting yield (Table 2) on Sylvania fine sandy loam soil. In Table 3, the effect of N on yield is shown. The effect of S alone was not significant. In Table 4, the effect of N increasing and S increasing protein % of canola is shown. In Table 5, the effect of N decreasing oil percentage and S increasing both oil content and glucosinolates is shown. The interaction of N by S, also, increased oil content. Nitrogen increased yield at other sites (Wvl and M sicl) in northeastern Saskatchewan (Table 6). There was a tendency of canola grain to respond to S fertilizer as well. On Loon River loam, both N and S increased yields, Table 7.

The protein, oil and glucosinolate content of canola were affected similarly by N and S on Waitville loam, Melfort silty clay loam and Loon River loam. Boron did not have an effect on quality of grain on the Sylvania fine sandy loam sites. A N by B interaction resulted in reduced protein at the other sites in northeastern and northwestern Saskatchewan. This interaction also resulted in increased oil content of the grain.

The Sylvania fine sandy loam soil had soil test values less than 0.35 $\mu\text{g/g}$ which is low enough that B application would be recommended by the Sask. Soil Testing Lab. A regression equation relating yield response of canola to S and B fertilizers and soil tests for these elements should be tested to confirm soil test benchmarks.

TABLE 1. TREATMENTS IN A 3-FACTOR ROTATIONAL DESIGN WITH N, S, AND B FERTILIZER

CODE	FERTILIZER TREATMENT			CODE	FERTILIZER TREATMENT		
	N	S	B		N	S	B
	----- KG HA ⁻¹ -----				----- KG HA ⁻¹ -----		
1	160	10	0.6	10	200	25	1.4
2	40	10	0.6	11	100	0	1.4
3	160	40	0.6	12	100	50	1.4
4	40	40	0.6	13	100	25	0.0
5	160	10	2.2	14	100	25	2.8
6	40	10	2.2	15	100	25	1.4
7	160	40	2.2	16	100	25	1.4
8	40	40	2.2	17	100	25	1.4
9	0	25	1.4	18	0	0	0

TABLE 2. INTERACTION OF S AND B ON YIELD OF REGENT, GRONLID, 1980-83

B* KG/HA	S*, KG/HA					MEAN
	0	10	25	40	50	
----- T/HA -----						
0	--	--	1.69	--	--	1.69
0.6	--	1.54	--	1.44	--	1.49
1.4	1.36	--	1.55	--	1.74	1.55
2.2	--	1.39	--	1.63	--	1.51
2.8	--	--	1.55	--	--	1.55
MEAN	1.36	1.46	1.57	1.53	1.74	1.53

*S By B interaction significant at 1% probability level.

TABLE 3. EFFECT OF N AND S ON YIELD OF REGENT CANOLA, Sy f1, N.E. SASK. 1980-83

S KG/HA	N**, KG/HA					MEAN
	0	40	100	160	200	
----- T/HA -----						
0	--	--	1.36	--	--	1.36
10	--	1.25	--	1.67	--	1.46
25	1.04	--	1.62	--	1.82	1.56
40	--	1.28	--	1.79	--	1.53
50	--	--	1.74	--	--	1.74
MEAN	1.04	1.26	1.60	1.73	1.82	

**N fertilizer significant at 1%, linear, quadratic.

TABLE 4. EFFECT OF N AND S ON PROTEIN OF REGENT CANOLA, Sy fl,
N.E. SASK. 1980-83

S** KG/HA	N**, KG/HA					MEAN
	0	40	100	160	200	
----- % PROTEIN -----						
0	--	--	48.9	--	--	48.9
10	--	47.2	--	50.7	--	49.0
25	48.4	--	49.9	--	51.6	49.9
40	--	48.0	--	51.9	--	50.0
50	--	--	49.7	--	--	49.7
MEAN	48.4	47.6	49.7	51.3	51.6	

**N significant, linear 1% and S significant, linear 1%, quadratic, 5%.

TABLE 5. EFFECT OF N AND S ON OIL CONTENT OF REGENT CANOLA, Sy fl,
N.E. SASK. 1980-83 AND GLUCOSINOLATES

S* KG/HA	N**, KG/HA					MEAN	GLUC.
	0	40	100	160	200		
----- % OIL -----							uM/G
0	--	--	43.9	--	--	43.9	7.3
10	--	46.7	--	43.7	--	45.2	7.3
25	46.1	--	45.0	--	43.3	44.9	9.3
40	--	46.5	--	44.3	--	45.4	10.1
50	--	--	45.5	--	--	45.5	9.1
MEAN	46.1	46.6	44.9	44.0	43.3	45.1	8.9

*S and NS effects significant at 1% and positive in increasing oil content.

**N fertilizer significant at 1% in decreasing oil content.

TABLE 6. N AND S ON REGENT CANOLA YIELD, OTHER SITES, N.E. SASK.

S KG/HA	N, KG/HA					MEAN
	0	40	100	160	200	
	----- YIELD, T/HA -----					
0	--	--	1.15	--	--	1.15
10	--	1.25	--	1.44	--	1.34
25	1.09	--	1.34	--	1.41	1.31
40	--	1.29	--	1.49	--	1.39
50	--	--	1.25	--	--	1.25
MEAN	1.09	1.26	1.30	1.47	1.41	

TABLE 7. N AND S ON REGENT CANOLA YIELD LOON RIVER,
N.W. SASK. - 1981

S** KG/HA	N**, KG/HA					MEAN
	0	40	100	160	200	
	----- YIELD, T/HA -----					
0	--	--	0.71	--	--	0.71
10	--	1.16	--	1.61	--	1.39
25	1.00	--	1.76	--	1.99	1.69
40	--	1.18	--	1.83	--	1.50
50	--	--	1.77	--	--	1.77
MEAN	1.00	1.17	1.61	1.72	1.99	

**N and S significant at 1%, linear and quadratic.

References

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