

Correcting Sulphur Deficiency on Canola During the Growing Season

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ABSTRACT

A field experiment was conducted in 1998 at two sites (Porcupine Plain - Gray soil, and Star City - Dark Gray soil) in northeastern Saskatchewan to determine the influence of rate, time and method of application of sulphate-S fertilizer in increasing yield and quality of canola, and to find if canola yields can be restored by applying S fertilizer at different growth stages during the growing season on S-deficient soils. At Porcupine Plain, there was a marked seed yield response of canola to S fertilization. Increases in canola yield from S fertilizer were generally similar for various times or methods of application. At Star City, canola yield increased moderately with application of S fertilizer, but topdress application gave lower yield increase than foliar applied S at bolting and at flowering at the 15 kg S/ha rate. At this site, yield increase was lower when S fertilizer was applied at flowering compared to that obtained at bolting or at sowing, and topdress application at flowering gave the lowest increase in seed yield. The preliminary assessment of results (based on only one year's data) indicates that canola yields can be restored on S-deficient soils with application of sulphate-S fertilizer as late as flowering stage, provided there is enough rainfall after topdress application to move the S fertilizer into the subsoil where roots can intercept it. Foliar application of S seemed a more powerful technique to restore seed yield in S-deficient canola when S fertilizer is applied late in the growing season, especially when there is inadequate rainfall.

INTRODUCTION

In the Prairie provinces, canola is the principal cash crop and there are about 3.5 million ha of agricultural land under canola production (1.6 million ha in Saskatchewan). In Saskatchewan and other prairie provinces, most of canola is grown in the Parkland region where many soils are deficient or potentially deficient in sulphur (S). Nutrients like S are involved in flowering, fruiting and seed formation. Being immobile in plants, it does not move from older plant portions to new growing points if deficiencies occur at any growth stage. Therefore, canola seed production is critically dependent on this nutrient and constant supply is required during active growth periods, flowering, fruiting and seed formation.

Sulphur is the third most important nutrient in the prairie provinces. Soil test values for SO₄-S indicate that more than 4 million ha of agricultural soils are deficient in S. Substantially greater areas are potentially deficient to support the high requirements of canola (Bettany 1982, Doyle and Cowell 1993). Traditionally S deficiencies occurred most commonly on Gray and Dark Gray soils (Nyborg et al. 1974; Nuttall et al. 1987), but some coarse textured Black soils also contained insufficient plant-available S to meet crop needs. Canola has high S requirement (Grant and Bailey 1993). The use of high yielding canola cultivars and high rates of N and P fertilizers under continuous cropping will result in faster depletion of S from soil. Consequently, there will be increased instances of S deficiencies, even on fine-textured Black soils. On soils marginally deficient in S and well fertilized with N and P, the S deficiencies on canola can occur during peak growing period or thereafter.

On S-deficient soil, S fertilizers are usually applied at or prior to seeding (Ukrainetz 1982;

Janzen and Bettany 1984). Information regarding S uptake and utilization by S-deficient rapeseed plants of S fertilizer applied at various growth stages is mainly limited to growth chamber pot experiments (Janzen and Bettany 1984). Field information is lacking regarding the influence of S fertilizer, when applied at different growth stages during growing season, on S uptake and utilization by canola plants and in restoring yield and quality of canola on S-deficient soils.

The objective of the study was to determine the influence of rate, time and method of application of sulphate-S fertilizer in increasing yield and quality of canola, and to find if canola yields can be restored by applying S fertilizer at different growth stages during the growing season on S-deficient soils.

MATERIALS AND METHODS

A field experiment on canola was conducted in 1998 at two sites (Porcupine Plain - Gray soil, and Star City - Dark Gray soil) in northeastern Saskatchewan. At both sites S deficiency on canola appeared at flowering in the summer of 1997, so these sites were selected. In both experiments, each treatment was replicated four times in a randomized complete block design. Each plot received a blanket application of P and K fertilizer. Individual plots were 2 m by 7 m. The information on treatments and fertilizers is as follows:

1. Control.
2. N (120 kg S/ha) sidebanded at seeding.
3. S (30 kg S/ha) sidebanded at seeding.
4. N at seeding and pre-seeding incorporated S (15 kg S/ha).
5. N at seeding and pre-seeding incorporated S (30 kg S/ha).
6. N at seeding and sidebanded S at seeding (15 kg S/ha).
7. N at seeding and sidebanded S at seeding (30 kg S/ha).
8. N at seeding and seedrow placed S (15 kg S/ha).
9. N at seeding and seedrow placed S (30 kg S/ha).
10. N at seeding and topdressed S at bolting (15 kg S/ha).
11. N at seeding and topdressed S at bolting (30 kg S/ha).
12. N at seeding and foliar S at bolting (15 kg S/ha).
13. N at seeding and foliar S at bolting (30 kg S/ha).
14. N at seeding and topdressed S at flowering (15 kg S/ha).
15. N at seeding and topdressed S at flowering (30 kg S/ha).
16. N at seeding and foliar S at flowering (15 kg S/ha).
17. N at seeding and foliar S at flowering (30 kg S/ha).

The N fertilizer (urea) was sidebanded at sowing, and the source of S was potassium sulphate. The crop was harvested at maturity for seed yield.

RESULTS AND DISCUSSION

At Porcupine Plain, there was a substantial increase in canola seed yield from S fertilizer over the control treatment (Table 3). Increases in canola yields from S fertilization were similar, regardless of times and methods of S application. Thus, indicating that canola yields can be restored on S-deficient soils with application of sulphate-S fertilizer as late as flowering (10% bloom). At this site, there was a good rainfall after topdress applications to move the S fertilizer into the subsoil where roots can intercept it. At seeding time, 30 kg S/ha gave higher seed yield than the 15 kg S/ha

rate for incorporation and sidebanded S fertilizer, but for seedrow application there was no yield difference between the two S rates. In reality, lower rate of S tended to give more seed yield than the higher S rate and application of 15 kg S/ha in seedrow had seed yield similar to 30 kg S/ha rate when incorporated or sidebanded. At bolting and flowering stages, 30 kg S/ha rate tended to give greater seed yield than the 15 kg S/ha rate but the differences were not statistically significant. Seed yield of canola in the N only treatment decreased compared to control. This suggests that the soil was very deficient in plant-available S. The S only treatment gave the maximum seed yield, suggesting that soil was not deficient in plant-available N.

At Star City, there was a good seed yield response of canola to S fertilizer but yields differed with methods, time and rates of S application (Table 4). At the 15 kg S/ha rate, topdress application was less effective in increasing canola yield than foliar application at bolting and at flowering growth stages. Foliar applications at 15 kg S/ha produced seed yields equal to or greater than the 30 kg S/ha rate when S fertilizer was topdressed. Application of S at flowering gave lower seed yield than at bolting or at sowing, particularly when S fertilizer was topdressed at 15 kg S/ha rate. For topdressing, 30 kg S/ha had more seed yield than the 15 kg S/ha rate especially when S fertilizer was applied at bolting.

Seed yields of canola in 1998 at both sites were much lower than normal. This was because of a heavy rain/wind storm near flowering which caused a substantial damage to canola plants. In addition, there was also some hail damage to the crop at Porcupine Plain.

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Table 1. Relative effectiveness of S fertilizer applied at different growth stages in increasing seed yield of canola at Porcupine Plain in 1998

Method of application and growth stage	Seed yield increase (kg/ha) at S rates (kg S/ha)	
	15	30
Pre-seeding incorporated	1031	1307
Sidebanded at seeding	997	1312
Seedrow placed	1272	1160
Topdress at bolting	1056	1134
Foliar at bolting	1106	1177
Topdress at flowering	1034	1175
Foliar at flowering	1057	1140

Notes: - Seed yields in the unfertilized, only 120 kg N/ha and only 30 kg S/ha treatments were 192, 28 and 1437 kg/ha, respectively.
- LSD0.05 value was 226.

Table 2. Relative effectiveness of S fertilizer applied at different growth stages in increasing seed yield of canola near Star City in 1998

Method of application and growth stage	Seed yield increase (kg/ha) at S rates (kg S/ha)	
	15	30
Pre-seeding incorporated	548	620
Sidebanded at seeding	357	567
Seedrow placed	415	558
Topdress at bolting	233	457
Foliar at bolting	485	511
Topdress at flowering	83	205
Foliar at flowering	356	310

Notes: - Seed yields in no fertilizer, only 120 kg N/ha and only 30 kg S/ha treatments were 355, 511 and 1026 kg/ha, respectively.
- LSD0.05 value was 168.