RECOVERY OF FIELD-GROWN CANOLA FROM SULPHUR DEFICIENCY

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ABSTRACT

A field trial was conducted to assess the extent of recovery of seed yield and oil content obtained by topdressing S-deficient canola with sulphate-S. Plots were topdressed with 10 or 40 kg S/ha (S_{10}, S_{40}) at 4 growth stages up to flowering. S_{10} was inadequate for maximum seed yield, but restored oil content at all times of application. Topdressing with S_{40} as late as stem elongation fully restored seed yields and oil content. However, there was a 20% yield penalty for delaying the S_{40} topdressing until flowering, but there was no penalty in seed oil content.

INTRODUCTION

Sulphur (S) deficiency in Australian canola *(Brassica napus)* was first recognized in 1988, and since then has become widespread in S.E. Australia. Losses to growers can be as high as 80% of seed yield plus a 20% reduction in seed oil concentration. Sulphur deficiency in canola is often not apparent until the period of rapid growth during stem elongation. There is considerable uncertainty among growers about the extent of yield recovery that can be obtained by topdressing sulphate-S fertilizer onto a canola crop that has been diagnosed as S-deficient in the pre-flowering stages of growth. This paper reports results from a field trial to determine the extent of recovery of seed yield and oil content when S-deficient canola was topdressed with sulphate-S at 4 stages of development.

EXPERIMENTAL

The field trial, sown to canola cv. Hyola 42 on 26 May, 1993, was at Cargo (33°27'S, 148°31'E), NSW, Australia, in the wetter (690 mm annual rainfall) part of the cereal belt. The soil was a clay-loam low in S (<1.0 mg sulphate-S/kg, 0-15 cm), with a pH (1:5 $CaCl_2$) of 5.2 in the top 0-15 cm. The trial site had grown a legume-based pasture for the previous 5 years, and had received no sulphate-S for the previous 20 years. Two rates of N fertilizer, 80 and 160 kg/ha as urea, were used as there was evidence that high N can exacerbate S deficiency. Phosphorus at 20 kg/ha was banded between the rows at sowing. Plots were topdressed by hand with mixtures of potassium sulphate and potassium chloride at rates of 0, 10 and 40 kg S/ha (S_0, S_{10} and S_{40}) so that a standard amount of K (106 kg/ha) was applied to all plots. The topdressings were applied at the following stages : sowing, 5-6 leaf rosette (RS), flower buds visible (BV), start of stem elongation (SE), and start of flowering (SF). These growth stages correspond to 1.05-1.06, 3.1, 3.5 and 4.2 of the rapeseed development code of Sylvester-Bradley and Makepeace (1984). The three replicate plots (2x30 m) of each treatment, arranged in randomized blocks, were machine harvested at maturity, 189 days after sowing. Seed oil contents were determined by wide-band nuclear magnetic resonance, and concentrations of total S and glucosinolates by X-ray spectrometry.

RESULTS AND DISCUSSION

There were few significant differences due to N because the site was unresponsive, so data have been pooled for the two rates of N. Rain within 12 h of each topdressing dissolved the sulphate-S into the soil solution.

Plants from the S_0 plots developed visual symptoms of S deficiency just before the start of stem elongation, and their seed yields and oil contents were low (Table 1a,b). Topdressing with S_{10} was clearly inadequate because, although it restored seed oil content, seed yields were lower than from the S_{40} plots (Table 1a,b). Topdressing with S_{40} up to stem elongation restored seed yields and oil contents to the levels of S_{40} applied at sowing. However, there was a 20% penalty in seed yield, but no penalty in seed oil percentage when the S_{40} topdressing was delayed until flowering. Our results are consistent with those of Janzen and Bettany (1984) who reported a complete recovery of seed yield when S was applied to moderately S-deficient canola up to flowering.

Seed S concentrations of the S_0 and S_{10} plants were below the critical value of 0.36% (Pinkerton *et al.*, 1993) separating seed of S-deficient plants from seed of S-adequate plants, but S concentrations in seed of S_{40} plants were all above this value (Table 1c). A critical seed N:S ratio of 7.5 has been determined for campestris rapeseed (*Brassica campestris*), with higher values indicating S deficiency (Aulakh *et al.*, 1980). Seed N:S ratios for the S_0 and S_{10} plants in our study were above 10, whereas the ratio for the S_{40} plants was 7.6 (data not shown). As in other studies (Josefsson, 1970), seed glucosinolate contents increased with the application of S, but even at S_{40}, the levels were well below the canola standard of 40 μmol/g total glucosinolates (Table 1d).

In conclusion, a complete recovery of seed yield and oil content can be obtained by topdressing S-deficient canola with an adequate rate of sulphate-S as late as stem elongation, and topdressing even later, at first flowering, can still result in 80% of normal seed yield and a complete recovery of oil content.

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TABLE 1. Effects of timing and rate of S applied on seed yield and oil content (@ 8.5% moisture), seed S concentration and seed glucosinolate content.

Rate of S applied (kg/ha)	Stage at which S applied*					Zero S Control
	Sowing	RS	BV	SE	FL	
a) **Seed yield (t/ha)**						
10	1.56	1.70	1.60	1.33	1.56	1.01
40	2.17	2.30	2.04	2.16	1.84	
l.s.d. (P=0.05)	0.43					
b) **Oil content (%)**						
10	39.9	41.4	41.4	40.8	41.7	33.6
40	43.4	42.6	42.9	42.8	41.6	
l.s.d. (P=0.05)	1.4					
c) **S concentration (%)**						
10	0.27	0.30	0.30	0.32	0.34	0.24
40	0.45	0.46	0.47	0.46	0.46	
l.s.d. (P=0.05)	0.04					
d) **Glucosinolate content (μmol/g)**						
10	0.70	1.23	1.42	1.75	3.02	0.35
40	5.92	6.90	6.80	6.74	7.50	
l.s.d. (P=0.05)	1.18					

*RS, 5-6 leaf rosette; BV, flower buds visible; SE, stem elongation; FL, start of flowering