CANOLA RESPONDS TO NITROGEN AND SULPHUR IN NEW SOUTH WALES.

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ABSTRACT

The yields of Canola at 19 sites throughout the major cropping areas of New South Wales in 1992 and 1993 demonstrated the responses possible through the addition of N and S fertilizers. N increased grain yield and, at above commercial rates, reduced grain oil concentration. The reduction in grain oil concentration was exacerbated in the absence of adequate S. Applied S increased yield, reduced yield variability and improved grain oil percentages. In the absence of applied S, significant yield responses to N were recorded at 8 sites. When averaged over all S treatments, significant N responses were recorded at 17 sites. S significantly increased yield at 8 sites and grain oil percentage at 6 sites.

INTRODUCTION

Isolated cases of sulphur (S) deficiencies in canola were reported by farmers and agronomists in the Lockhart and Leeton districts of New South Wales (NSW) in 1989. During the following two seasons there were reports of symptoms resembling S deficiency from widespread areas throughout southern and central NSW. The increased incidence was attributed to a number of factors - substitution of S-containing fertilizers by high analysis products with less than 2% S, the increase in yields achieved through improved management and varieties, the increased input of nitrogen (N) and phosphorus fertilizer with a consequent increased demand for S, the introduction of "double zero" varieties that are reportedly lower in S reserves than the commercial rapeseed varieties used prior to 1987 (Schnug, 1989; Blair, unpublished data), and the cropping of soils of central and southern NSW having a low native S fertility (Blair and Nicholson, 1975).

A major field study of Canola nutrition conducted in NSW by Sykes and Colton (1990) reported average grain yield increases of 700 kg/ha from the addition of 75 kg N/ha following cereal fallow, but recorded no significant responses to S. In Northern Victoria, Walker (unpublished data) studied N and S responses in canola during 1992/1993 and reported only 1 of 7 sites responded significantly to applied S. All sites responded significantly to applied N, with 1 unexplained significant yield reduction.

This paper is a preliminary report on a project aimed at quantifying the extent of S deficiency and its interactions with N, and the calibration of diagnostic analytical soil and plant tissue tests for low glucosinolate varieties. The data is from 1992 and 1993; the 1994 experiments were badly affected by drought and only one of ten sites planted was harvested.

EXPERIMENTAL

All experiments were laid out in commercial fields in April or May using a randomised 5 x 4 factorial design with three replicates of canola (cv Barossa, Yickadee, Oscar or Hyola 42) drilled at 4.0 kg/ha in 2 X 30 metre plots. Nitrogen was applied at 0, 20, 40, 80, 160 kg/ha and sulphate sulphur at 0, 10, 20, 40 kg/ha. The N timing and S source varied between sites and years depending on the equipment and resources of the co-operating researchers. The three major nutrients were applied as follows:

1/ Nitrogen- urea banded between the rows at seeding or topdressed four weeks after.

2/ Sulphur- sulphate of potash, balanced with muriate of potash, broadcast and incorporated at seeding; or, gypsum topdressed four weeks after emergence; or as single superphosphate and triple superphosphate blends applied at seeding.

3/ Phosphorus- banded with the seed as triple superphosphate at 20 kg P/ha; or triple superphosphate and single superphosphate mixtures at 33 kg P/ha banded beside the seed.

Plots were direct headed using small plot harvesters and seed samples analysed for oil concentration, on a clean moisture-free basis, by either Nuclear Magnetic Resonance,or Near Infra Red Spectrometry calibrated by the American Oil Chemists modified solvent extraction method.

RESULTS

Seed yield and seed oil percentages are shown in Tables 1 and 2, grouped according to previous site history and significance of S response. The data for each N or S rate are meaned over all corresponding S and N rates, respectively.

Table 1. The effects of nitrogen, sulphur and previous field history on clean seed yield (kg/ha) of Canola at 8.5% moisture. Numbers in parentheses indicate the proportion of sites at which there was significant response to nitrogen.

Previous Crop	Fertilizer applied (kg/ha)									
	Sulfur				Nitrogen					
	0	10	20	40	0	20	40	80	160	
S responsive sites										
Cereal	2629	2754	2820	2909	2339	2493	2703	2960	3426	(5/5)
Pasture	3248	4119	4380	4533	3923	3939	4047	4102	4208	(3/3)
Non S responsive sites										
Cereal	2491	2495	2558	2577	2073	2209	2369	2633	2978	(6/8)
Pasture	3866	4184	4268	4283	3720	4019	4178	4316	4495	(3/3)

At 17 of the 19 sites there were significant responses to applied N, the responses being larger after cereal than after pasture. Only 8 of the 19 sites were responsive to applied N in the absence of adequate S (20 or 40 kg/ha). Significant S responses occurred at 8 of the 19 sites. S deficiency in canola was most severe following pasture. The mean S yield response following pasture was 1285 kg/ha and 280 kg/ha when canola followed a cereal crop.

Table 2. The effects of nitrogen, sulphur and previous crop on the oil concentration of canola seed at 8.5% moisture. Numbers in parentheses indicate the proportion of sites at which there was a significant response to nitrogen.

Previous Crop	Fertilizer applied (kg/ha)									
	Sulfur				Nitrogen					
	0	10	20	40	0	20	40	80	160	
S responsive sites										
Cereal	43.73	44.10	44.10	44.07	44.13	44.40	44.37	43.87	43.37	(3/3)
Pasture	39.07	39.90	41.72	42.01	44.10	41.20	40.90	40.47	39.63	(3/3)
Non S responsive sites										
Cereal	43.73	43.70	43.70	43.70	44.17	44.13	43.91	43.58	42.04	(0/10)
Pasture	43.77	44.20	43.87	44.00	43.57	43.63	43.43	42.47	42.47	(0/3)

Increasing N rates reduced oil concentration at all sites, and this reduction was significant at 6 sites. These sites also had significant oil concentration increases to applied sulfur. The most significant S responses were recorded at sites where canola followed a legume dominant pasture. At these sites 40 kg/ha of applied S improved the seed oil concentration by an average of 2.9 % percentage points.

DISCUSSION

The total cost of applying 40 kg sulphate-S /ha is approximately A$20/ha, and this cost is minor compared with the potential losses in seed yield and oil content. For example, at a site near Wellington in 1992, 40 kg S/ha increased seed yield by 2.5 t/ha and oil concentration by 8.4 percentage points (Good *et al.*, 1993), lifting gross returns from A$320 to A$1060/ha.

Prior to 1993, it is estimated that an average of 5 kg S/ha was applied to Canola crops in NSW. Based on the results of our experiments, the standard recommendation at present is for Canola crops in NSW to receive 25 to 30 kg S/ha as sulphate at or prior to seeding, the rate depending on previous S application history and S soil test values. From surveys of growers it appears that 90% of the area sown to canola in NSW now receives the recommended application, and that this resulted in an increase of 4×10^4 tonnes of seed in 1993.

From Table 1 and the results of Sykes and Colton (1990) it is evident that there are substantial responses to N, and that the optimum application is about 80 kg/ha after pasture and higher following a cereal crop, provided that S nutrition is adequate. To date there has been a reluctance on the part of growers to apply these N rates because of the extra costs and the element of risk. Future work under this project is therefore aimed at maximising returns to growers by increasing N application rates now that optimum S fertilizer rates are being applied and soil (McCrae *et al.*, 1995) and plant (Pinkerton *et al.*, 1993) analytical tests are available for diagnosis of S deficiency. This work will concentrate on promoting soil tests to encourage higher preplant N fertilizer rates, and developing crop tissue tests for a computer based support system for post-planting N application decisions.

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