Indian Journal of Agricultural Sciences **81** (3): 280–2, March 2011

Production potential of canola oilseed rape (*Brassica napus*) cultivars in response to nitrogen and sulphur nutrition*

VIRENDER SARDANA[1] and PARVENDER SHEORAN[2]

Punjab Agricultural University, Ludhiana 141 004

Received: 12 July 2010; Revised accepted: 3 January 2011

Key words: *Brassica napus*, Canola, Nitrogen, Oil yield, Seed yield, Sulphur

Rapeseed–mustard (*Brassica* spp) oil is primarily used for cooking or salad dressings, whereas protein-rich seed meal after oil extraction serves as valuable animal feed. Traditional cultivars of rapeseed-mustard including oilseed rape (*Brassica napus* L.) possess high amount (>50%) of long chain saturated fatty acids mainly erucic acid, low proportion of thermo-stable mono-unsaturated oleic acid (15–20%) in the oil and high concentration of glucosinolates (>100 µm/g) in defatted oil meal. The nutritionally undesirable erucic acid is reported to impair myocardial conductance causes lipidosis in children and increases blood cholesterol contributing to heart diseases in humans (Chauhan *et al*. 2010); whereas, high glucosinolate content in seed meal lowers palatability and causes nutritional disorders, enlargement of thyroid glands and haemorrhiza liver syndrome in animals (Vermorel *et al.* 1986). To overcome these ill effects, oilseed rape cultivars with favourable modifications in fatty acid composition have been recently developed in Punjab. Canola oilseed rape refers to the one having <2% erucic acid in the oil and <30 µm glucosinolates/g in de-oiled seed meal.

Nitrogen (N) and sulphur (S) play multiple roles in growth and development of oilseeds and are considered as the key nutrients influencing seed yield, oil formation and quality of oilseeds (Ahmad and Abdin 2000, Sardana and Atwal 2007). It was considered imperative to study the response of these newly developed canola cultivars of oilseed rape to these nutrients. The present investigation was, therefore, conducted to study the relative production potential and N and S requirements of canola oilseed rape cultivars under irrigated conditions.

The field study was conducted during winter (*rabi*) of 2004–07 at the Punjab Agricultural University, Ludhiana. The sandy loam soil in the beginning of the experiment was neutral in reaction (*p*H 7.8), low in organic carbon (0.30%), rich in available phosphorus (24.8 kg P_2O_5/ha), available potassium (142 kg/ha) and medium in available sulphur (14 ppm). Treatments replicated thrice were assigned in split-plot design with two cultivars, namely 'GSC 5' and 'GSC 6' in the main plots and combinations of three doses of N (75, 100 and 125 kg/ha) and two doses of sulphur (0 and 20 kg/ha) in the sub plots. Each treatment comprised nine rows each of 5 m length. The seeds were manually sown on 29 October 2004, 25 October 2005 and 31October 2006. The crop was sown at row spacing of 0.45 m with plant spacing of 0.10–0.12 m maintained by thinning extra plants about two weeks after complete germination. Half dose of N in the form of urea (46% N) and full dose of S in the form of gypsum (13.5% S) as per treatments along with 30 kg P_2O_5/ha as single super phosphate (16% P_2O_5) were applied at field preparations. The remaining half dose of N through urea was applied after first irrigation, ie about 35 days after sowing. Three post sowing irrigations were applied at critical stages of crop growth. Both cultivars were harvested between 22 to 28 March in different years.

Plant height, number of primary and secondary branches and siliquae/plant were recorded at maturity from five representative plants in each treatment. Number of seeds/siliqua was recorded from average of 25 randomly collected siliquae in each treatment. Seeds were randomly collected from the produce of net plot to determine 1000-seed weight. Biomass and seed yields were recorded from seven inner rows excluding one row on each side. Nuclear Magnetic Resonance Spectroscope (Newport Analyzer model MK 111A) employing non-destructive method of oil estimation was used to determine oil content in the whole seed (Alexander *et al.* 1967). Split-plot design was used to test the significance of treatments for various parameters as per the procedure described by Cochran and Cox (1967) using computer programme CPCS 1 (Cheema and Singh 1990).

Canola cultivar 'GSC 6' required more number of days

*Short note:

[1]Agronomist (e mail: sarvir2@rediffmail.com), [2]Assistant Agronomist (e mail: sheoran76@rediffmail.com), Department of Plant Breeding and Genetics

for flowering initiation and maturity as compared to 'GSC 5' (data not given). In general, cultivars did not differ in plant height and number of primary and secondary branches/ plant (Table 1). Cultivar 'GSC 6' gave higher number of siliquae/ plant in all the years with mean increase of 6.1% (significant) over 'GSC 5' (Table 1). Though the number of seeds/siliqua was similar in both cultivars, 1000-seed weight of 'GSC 6' was conspicuously higher than 'GSC 5'. Marked increases in number of siliquae/plant and seed size (1000-seed weight) in 'GSC 6' culminated in mean seed yield increase of 20.6% over 'GSC 5' (Table 1). Stover yield followed similar trend with 'GSC 6' giving 10.9% higher mean stover yield as compared to 'GSC 5' (Table 1). Harvest index which is indicative of physiological capacity of the plant to mobilize photo-assimilates to organs of economic importance was also higher in 'GSC 6' (21.9%) than the 'GSC' 5 (20.4%). There was no difference in oil content between 'GSC 6' and 'GSC 5', the increase is oil yield in the former was, however, significant due to higher seed yield in all the years (Table 1). Consequently 'GSC 6' gave 20.7% higher mean oil yield than 'GSC 5'.

Nitrogen application failed to influence plant height and branching in different years. However, mean plant height with 100 kg N/ha was significantly higher than that registered with 75 kg N/ha (Table 1). Nitrogen application of 100 kg/ha increased the seed yield over 75 kg/ha in all years with mean

Table 1 Effect of cultivars and application of nitrogen and sulphur on growth parameters, yield attributes, yields and harvest index of canola oilseed rape (mean of three years)

Treatment	Plant height (cm)	Branches/plant *P	Branches/plant *S	Siliquae/ plant	Seeds/ siliqua	1000-seed weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)	Oil content (%)	Oilyield (kg/ha)
Cultivars											
'GSC 6'	146	4.6	5.7	227	21.2	3.87	1 532	5 554	21.9	39.3	601
'GSC 5'	137	4.3	5.6	214	21.7	3.46	1 270	5 009	20.4	39.3	498
CD (*P*=0.05)	NS	0.1	NS	7	NS	0.08	171	526	NS	NS	54
Doses of nitrogen (kg/ha)											
75	139	4.2	5.5	217	21.1	3.58	1 354	5 103	21.0	39.5	534
100	143	4.6	5.5	225	21.6	3.70	1 428	5 310	21.4	39.5	563
125	142	4.5	6.0	219	21.5	3.71	1 421	5 432	20.9	38.8	552
CD (*P*=0.05)	3.1	NS	NS	NS	NS	NS	64	195	0.4	NS	NS
Doses of sulphur (kg/ha)											
0	141	4.4	5.4	212	20.9	3.58	1 366	5 176	21.2	39.2	537
20	142	4.5	6.0	228	21.9	3.75	1 436	5 388	21.1	39.4	566
CD (*P*=0.05)	NS	NS	0.4	NS	0.8	0.09	53	159	NS	NS	19

* P, Primary; S, secondary

Table 2 Seed yield and oil yield (kg/ha) of canola oilseed rape cultivars as influenced by doses of nitrogen and sulphur (mean of three years)

Cultivar	Nitrogen (kg/ha) 75		100		125		Mean		
	Sulphur (kg/ha) 0	20	0	20	0	20	0	20	Mean
				Seed yield (kg/ha)					
'GSC 6'	1 422	1 512	1 529	1 628	1 499	1 602	1 483	1 581	1 532
'GSC 5'	1 213	1 269	1 264	1291	1 270	1 316	1 249	1 292	1 270
Mean	1 354		1 428		1 422		1 366	1 436	
				Oil yield (kg/ha)					
'GSC 6'	562	595	604	636	584	626	583	619	601
'GSC 5'	483	498	498	514	490	508	490	507	498
Mean	534		563		552		537	563	
CD (*P*=0.05)			*Seed yield*		*Oil yield*				
Cultivars×nitrogen			NS		NS				
Cultivars×sulphur			NS		NS				
Nitrogen×sulphur			NS		NS				
Cultivars×nitrogen×sulphur			NS		NS				

increase of 5.5% (Table 1). The increase in seed yield accrued from marginal increases in number of siliquae/plant and 1000-seed weight. Number of seeds/siliqua is genetically determined and generally not influenced by N application. oil content and oil yield were not influenced by different doses of nitrogen and the increase in mean oil yield with 100 kg N/ha over 75 kg N/ha (Table 1) was almost similar (5.4%) to increase in seed yield. Similar increase in seed yield of canola with N application has been reported earlier (Momoh *et al.* 2004).

Application of 20 kg S/ha did not influence maturity, plant height and branching (Table 1). Sulphur is a constituent of amino acids which constitute building blocks of protein. Application of S markedly increased the number of siliquae/plant, number of seeds/siliqua and 1000-seed weight (Table 1). Mean seed yield with 20 kg S/ha was 5.1% higher, whereas stover yield increased by 4.2% over that of without S application. Harvest index was not influenced by applied S. Though the effect of S on oil content was inconspicuous in different years, mean oil yield increased by 5.4% with application of 20 kg/ha of S over without its application (Table 1). Abdin *et al.* (2003) and Ahmad *et al.* (2005) also reported increase in seed yield of rapeseed-mustard with S application.

Different interactions for seed yield and oil yield (Table 2) were non-significant. The highest mean seed yield (1 628 kg/ha) and oil yield (636 kg/ha) were given by 'GSC 6' with application of 100 kg N + 20 kg S/ha, whereas 'GSC 5' applied with only 75 kg N/ha (without S) gave the lowest mean seed yield (1 213 kg/ha) and oil yield (483 kg/ha). Both N and S affect enzyme activity in the assimilatory pathways (Ahmad *et al.* 1999) and interact in such a way that inadequacy of one reduces the uptake and assimilation of other (Zhao *et al*. 1999).

SUMMARY

Field investigation carried out for three years revealed higher seed yield (20.6%) and oil yield (20.7%) potential of canola oilseed rape (*Brassica napus* L.) cultivar 'GSC 6' over 'GSC 5' owing to more number of siliquae/plant, 1000-seed weight and improved harvest index. Application of 100 kg N/ha resulted in 5.5% higher seed and oil yield than 75 kg N/ha. Similarly, sulphur application of 20 kg/ha resulted in 5.1% higher seed yield and 5.4% higher oil yield over without its application. Combined application of 100 kg N + 20 kg S/ha to 'GSC 6' resulted in its higher seed yield (1628 kg/ha) and oil yield (636 kg/ha).

REFERENCES

Abdin M Z, Khan N, Khan I, Issar M and Jamal A. 2003. Nitrogen and sulphur interaction in relation to yield and quality attributes of rapeseed-mustard. *Brassica* **5(3&4)**: 35–41.

Ahmad A and Abdin M Z. 2000. Interactive effect of sulphur and nitrogen on the oil and protein content and fatty acid profiles of oil in the seeds of rapeseed (*Brassica campestris* L.) and mustard (*Brassica juncea* (L.) Czern & Coss). *Journal of Agronomy and Crop Science* **185**: 49–54.

Ahmad A, Khan I, Anjum N A, Diva I, Abdin M Z and Iqbal M. 2005. Effect of timing of sulphur fertilizer application on growth and yield of rapeseed. *Journal of Plant Nutrition* **28**: 1049–59.

Ahmad A, Abraham G and Abdin M Z. 1999. Physiological investigation on the impact of nitrogen and sulphur on seed and oil yield of rapeseed (*Brassica campestris* L.) and mustard (*Brassica juncea* L. Czern and Coss) genotypes. *Journal of Agronomy and Crop Science* **183**: 19–25.

Alexander D E, Silvelas L, Collins F I and Rodgers R C. 1967. Analysis of oil content of maize by wide line NMR. *Journal of American Oil Chemists Society* **44**: 555.

Chauhan J S, Kumar S, Singh K H, Meena S S, and Meena M L. 2010. Oil and seed meal quality indices of Indian rapeseed-mustard varieties. *Journal of Plant Biochemistry and Biotechnology* **19** (1): 83–6.

Cheema H S and Singh B. 1990. *A User's Manual to CPCS 1*, pp 40. Punjab Agricultural Uniersity Ludhiana.

Cochran W G and Cox G M. 1967. *Experimental Designs*. pp 617. John Willey and Sons Inc., New York.

Momoh E J, Song W J, Li H Z and Zhou W J. 2004. Seed yield and quality response of winter rape (*Brassica napus*) to plant density and nitrogen fertilization. *Indian Journal of Agricultural Sciences* **74**: 420–4.

Sardana V and Atwal A K. 2007. Influence of nitrogen and sulphur on seed yield and quality of hybrid canola. *Proceedings of 12th International Rapeseed Congress Sustainable Development in Cruciferous Oilseed Crops Production*, held during March 26-30, 2007 at Wuhan, China.

Vermorel M, Heaney R K and Fenwick G R. 1986. Nutritive value of rapeseed: Effects of individual glucosinolates. *Journal of Science, Food and Agriculture* **37**: 1197–202.

Zhao F J, Hawkesford M J and McGrath S P. 1999. Sulphur assimilation and effects of yields and quality of wheat. *Journal of Cereal Science* **30**: 1–17.