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Effect of nitrogen and sulphur fertilizers on the productivity of gobhi sarson (*Brassica napus* L.) under foot hills of Himachal Pradesh

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Abstract

A field experiment was conducted during winter 2002-2003 at Research Sub Station, Akrot CSKHPKV, Palampur to demonstrate the effects of nitrogen and sulphur fertilizers on Gobhi sarson (*Brassica napus* L.,GSC-5). The experiment comprised four levels of nitrogen and sulphur. Total sixteen treatments were replicated thrice in a Randomised Block Design. The seed and straw yield of Gobhi sarson increased by 92 % and 160% using nitrogen and sulphur fertilizers over control, respectively. The application of 120 kg N/ ha and 60 kg S/ ha recorded the maximum yield (straw and seed) and oil yield. Nitrogen and Sulphur application had significant effect on the total uptake of nitrogen and sulphur.

Introduction

Gobhi sarson (*Brassica napus* L.) is a recent introduction to India from Europe and Canada. This crop is replacing Indian mustard in Punjab and its cultivation spreading at higher rate in lower areas of Himachal Pradesh. It is gaining importance because of high yield potential, wider adaptability, suitability for early planting to exploit residual moisture of *kharif* season as well as late planting by transplanting method. Similarly, it contains higher oil content (41-45%) of good quality having high percentage of linolic and oleic acids.

This crop is generally sown on less productive marginal soils which are expected to be deficient in available N and S and responding to its applications, which may play a multiple role for better productivity and quality of oilseeds. Thakur and Singh (1997) reported that there is about 58 per cent reduction in yield of Indian mustard when fertilizer inputs were withdrawn from recommended package of practices. The present investigation was carried out to study the individual as well as collective effect of N and S fertilizers on the yield and uptake of N and S by Gobhi sarson.

Material and Methods

The field experiment was conducted at experimental farm of CSK Himachal Pradesh Krishi Vishvavidyalaya, Research Sub-Station, Akrot during winter 2002-2003. The study area is situated at 30°6' to 32°5' N latitude and 75° 5' to 77° 5' E longitude at an altitude of 425 m a.m.s.l. The experimental soil had pH 7.1, organic carbon 9.5 g/ kg. The initial soil sample contained 136, 12, 12, 226 kg/ ha N, S, P and K, respectively.

The effect of N (0, 40, 80, 120 kg/ ha) and S (0, 20, 40, 60 kg/ ha) fertilizers was observed on Gobhi sarson in a RBD. A uniform basal recommended dose of phosphorous and potassium @ 40 kg/ ha each was applied in all the plots. Nitrogen, phosphorous, potash and sulphur were applied through urea (46% N), SSP (16% P_2O_5 and 12% S), MOP (60 % K_2O), gypsum (70-80 % purity with 13-15 % S), respectively. The cultivar of Gobhi sarson 'GSC-5' was sown in a plot size measuring 3.1 x 3 m during the fourth week of October, 2002 after presowing irrigation at a row to row spacing of 45 cm using 5 kg seed/ ha. The required quantities of S, P_2O_5 and K_2O as per the treatment were applied as basal along with half dose of N. When the seedlings were about 10 to 15 cm of height, the crop was resorted to thinning and gap filling within treatment after irrigating the field to obtain the desired stand keeping intra row spacing of about 20 cm. Top dressing of remaining dose of N was done during flower initiation stage, before irrigating the field by border strip method. The spray of insecticide (Metasystox 25 EC @ 2 ml/ lit) was done to control the aphid attack on crop.

The grain and straw yield was recorded after the crop harvest. The seed and straw samples of Gobhi sarson were collected and dried in an oven at 70 ±

5°C. Nitrogen in seed and straw samples was determined by the micro- Kjeldahl's method, whereas S was determined colorimetrically by turbidimetric method of Tabatabai and Bremner (1970). The oil content was determined by NMR Spectrophotometer, Model Newport Analyser. MK III A. The oil content was determined by multiplying percent oil in Gobhi sarson with respective seed yield.

Results and Discussion

Grain and straw yield

Seed and straw yield increased significantly with fertilizer N applied at 40 to 120 kg/ ha which gave 21- 93 % and 30- 72 % higher seed and straw yield, respectively over control (Table 1). The grain and straw yield of the crop increased due to application of N because plants supplied with adequate N had more number of functional leaves and photosynthesizing area leading to better growth and development of plants. Such an improved plant growth resulted in production of more seed and straw yield. These results are in conformity with those of Dubey *et al.* (1994) and Biswas *et al.* (1995).

Sulphur application ranging from 20 to 60 kg/ ha enhanced the grain and straw yield of Gobhi sarson by 32 to 92 and 13 to 47 percent, respectively. The increased dry matter production due to S fertilization may be because of higher rate in protein synthesis and enhanced photosynthetic activity of the plant with increased chlorophyll synthesis.

Significant interaction between N and S was observed in both seed and straw yield of Gobhi sarson. The highest seed yield (16.4 q/ ha) and straw yield (45.8 q/ ha) at 120 kg N and 60 kg S / ha can be attributed to the synergistic effect of S on N for the formation of more metabolites. Such type of synergistic results were also reported earlier by Narang and Singh (1985) and Biswas *et al.* (1995).

Nitrogen uptake

The total uptake of N increased by 61, 118 and 236 % over control with N applied at 40, 80 and

Table 1. Effect of nitrogen and sulphur on the yield (q/ ha) of Gobhi sarson

Nitrogen levels (kg/ ha)	Sulphur levels (kg/ ha)				
	0	20	40	60	Mean
			Seed yield		
0	4.16	6.26	7.73	7.96	6.53
40	5.27	7.26	8.70	10.56	7.93
80	6.80	8.53	10.20	12.70	9.58
120	8.59	10.64	14.76	16.41	12.60
Mean	6.20	8.17	10.35	11.89	
CD (P=0.05)			Seed : N and S=0.57; (N x S)=1.14		
			Straw yield		
0	17.56	20.24	23.17	26.26	21.81
40	23.10	26.40	30.60	33.70	28.45
80	24.46	29.36	33.26	38.06	31.79
120	30.43	34.26	39.56	45.76	37.50
Mean	24.39	27.57	31.65	35.95	
CD (P=0.05)			Straw: N and S=1.01; (N x S)=2.03		

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120 kg/ ha, respectively. Such increase in N uptake may be attributed to the readily available nature of urea- N applied which increased the concentration of N in seed and straw. Nitrogen fertilization is also known to increase root cation exchange capacity which resulted in higher N absorption in plant and grain (Elgabaly, 1962). Likewise, significant increase in N uptake was observed with increasing levels of S from 20 to 60 kg S/ ha. The maximum uptake of N was observed with combined application of 120 kg N and 60 kg S/ ha. This may be due to the synergistic uptake mechanism of N and S. The other possible reason for improved N uptake due to N and S fertilization could invariably be increased dry matter yield and higher nutrient demand for plant growth. These results corroborate the earlier findings of Rathore and Manohar (1990) on loamy sand soil of Rajasthan on mustard and Biswas *et al.* (1995) on ustochrept sandy loam soil of Delhi on Gobhi sarson.

Sulphur uptake

The combined application of N and S (120 kg and 60 kg/ha), respectively increased sulphur uptake in seed and straw by 170% and 221% when compared with control (Table 2). Increased uptake of sulphur by Gobhi sarson due to S application could be attributed to a higher demand of the crop for sulphur (Aulakh *et al.* 1995). Perceptible influence of combined application of N and S was also observed by Biswas *et al.* (1995) on sulphur uptake by Gobhi sarson. The highest sulphur uptake (29.27 kg/ ha) was obtained using 120 kg/ ha N and 60 kg/ ha S. The stimulatory effect of N and S fertilization on the concentration of these nutrients in plant was a consequence of higher SO_4- S uptake resulting more N uptake to maintain the ionic balance. These results are in conformity to those obtained by Janzen and Bettany (1984).

Table 2. Effect of nitrogen and sulphur applications on total uptake by Gobhi sarson (kg/ ha)

Nitrogen levels (kg/ ha)	Sulphur levels(kg/ ha)				
	0	20	40	60	Mean
			Nitrogen		
0	11.23	17.57	23.82	26.47	19.77
40	17.34	28.43	35.89	45.96	31.82
80	28.62	37.79	47.21	58.76	43.09
120	43.00	57.91	80.21	92.29	66.35
Mean	25.04	35.42	46.78	55.79	
CD (P=0.05)			Nitrogen: N and S= 1.51; (N x S) =3.02		
			Sulphur		
0	3.35	6.25	8.89	9.98	7.12
40	5.39	9.49	13.60	18.13	11.65
80	7.26	12.32	16.65	22.67	14.72
120	8.96	15.70	22.98	29.27	19.22
Mean	6.24	10.94	15.34	20.01	
CD (P= 0.05)			Sulphur: N and S= 0.86; (N x S)=1.72		

Oil yield

The oil content of Gobhi sarson seed was not affected with N application. However, the oil yield increased significantly from 2.82 q/ ha without N application to 5.51 q/ ha at 120 kg N/ ha (Table 3), indicating that oil yield was governed by the seed yield rather than its per cent oil content.

The sulphur application at 60 kg/ ha increased oil content by 4% over no Sulphur application. The maximum oil yield of 7.28 q/ ha was obtained with the combined application of 120 kg N and 60 kg S/ ha.

These results are in conformity with those obtained by Jain *et al.* (1996) and Raut *et al.* (2000) who reported significant increase in oil yield in mustard crop. Though the interaction effect of N and S on the oil content was however, non-significant, it was significant in case of oil yield.

From the study, it can be concluded that the combined application of N and S to Gobhi sarson is important for getting higher seed straw and oil yield as well as higher, uptake of N and S by crop. The combined application of 120 kg N/ ha and 60 kg S/ ha was found the most appropriate dose for Gobhi sarson.

Table 3. Effect of nitrogen and sulphur on oil content (%) and oil yield (q/ ha) of Gobhi sarson

Nitrogen levels (kg/ha)	Sulphur levels (kg/ha)				
	0	20	40	60	Mean
			Oil content (%)		
0	41.73	43.16	43.56	43.86	43.07
40	42.50	42.73	42.70	43.96	42.97
80	42.30	44.16	43.36	43.36	43.30
120	42.50	43.30	44.03	44.36	43.55
Mean	42.25	43.34	43.41	43.89	
CD (P=0.05)			Oil content: S=0.66; N and (N x S)= Non significant		
			Oil yield (q/ha)		
0	1.73	2.69	3.63	3.49	2.82
40	2.24	3.10	3.71	4.60	3.41
80	2.87	3.76	4.42	5.50	4.13
120	3.65	4.62	6.49	7.28	5.51
Mean	2.62	3.54	4.49	5.21	
CD (P=0.05)			Oil yield: N and S=0.24; (N x S) = 0.49		

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