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Short Note

Influence of nitrogen and sulphur application on seed quality of low glucosinolate oilseed rape (*Brassica napus* L.)

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Abstract

Influence of N and S application on glucosinolate content, seed protein, total sugars and phenols of a double low variety (GSC 5A) of rapeseed (*Brassica napus* L.) was examined. Application of N significantly increased seed protein content. Seed protein was increased by 22.7 per cent in response to 60 kg ha^{-1} of S at maximum N rate (N_{120}). A significant interaction between N and S on seed protein was observed. Increasing N rate from 0 to 40 and 60 kg ha^{-1} decreased the glucosinolate content by 8.0 and 7.2 per cent respectively, with S_0 treatment. In contrast to this, increase in N-rate from 0 to 120 kg ha^{-1} increased the glucosinolate content from 23.60 to 25.57 μ moles g^{-1} defatted seed meal (8.3 % increase as compared to control) with S_0 treatment. Increasing the N rate from 0 to 120 kg ha^{-1} increased the total phenolic content with the S_0 treatment but decrease in phenolic content was observed at S_{60} treatment. Maximum total soluble sugar content was observed in treatment combination $N_{80}S_{60}$. The effect of N and S levels as well as the interaction effect (NxS) on total sugar content was found to be non significant.

Key words: Nitrogen, sulphur, *Brassica napus* L., glucosinolate content, seed protein, phenols, total sugars.

The yield responses of double low varieties to S application have been reported to be much greater than those of single low variety (Booth *et al.*, 1991). This has been attributed to the fact that S and N assimilation are related interdependently (Duke and Reisenauer, 1986). Crop requirement for S is strongly influenced by N supply. Increased levels of N can influence or aggravate S deficiency of plants on both N and S deficient soils. Maximum yield responses to N and S are achieved only when N and S are in approximate balance (Zhao *et al.*, 1993). S supply has been reported to be the most important factor influencing the glucosinolate content of rapeseed for a given variety. Although an insufficient S supply can reduce seed yield, an excessive supply of S can result in a poor seed meal quality by enhancing the glucosinolate content (Zhaou *et al.*, 1993). Where S supply is adequate, increasing N has been reported to increase glucosinolate content in double low varieties (Bilsborrow *et al.*, 1993).

A field experiment was conducted during winter of 2002-2003 at CSK H.P. Krishi Vishvavidyalaya Research Sub-Station, Akrot, District Una, Himachal Pradesh to examine the effect of N and S and interaction between them on yield and quality *Brassica napus* L. The soil was sandy loam in texture, having 136.0, 12.0, 226.0 and 12 kg ha^{-1} available N, P, K and S, respectively. The experiment was laid out in randomized block design with three replications. The treatments consisted of four levels of N (0, 40, 80 and 120 kg ha^{-1}) and four levels of S (0, 20, 40 and 60 kg ha^{-1}). Urea was used as a source of N and S was applied through gypsum. Seeds of

variety 'GSC-5A' of gobhi sarson were sown on 25th October, 2002 at the rate of 120 seeds/ m^2. Two irrigations were given, one at flower initiation and second at pod filling stage. The seed samples were oven dried at 70 ± 5°C till constant weight was achieved. N of seed samples was determined by Kjeldahl procedure (Jackson, 1967). Crude protein content of seed was calculated as 5.73 times the N concentration (%). Seed glucosinolate content was determined using thymol reagent (Tholen *et al.*, 1989). Defatted rapeseed meals were also analysed for total phenolic and total sugar content. Total soluble sugar content in defatted seed meal was estimated according to Dubois *et al.* (1956) whereas total phenolic content was determined as per method of Swain and Hillis (1959). Total soluble sugar and phenolic content were expressed on the basis of dry defatted seed meal. The data so obtained were subjected to analysis of variance.

Seed protein: The influence of N on seed protein content was dependent on the rate of S applied (Table 1). Seed protein was increased by 14.5 per cent from N_0 to N_{40}, 24.0 per cent from N_0 to N_{80} and 36.6 per cent from N_0 to N_{120} for the average of four S-rates. Seed protein was increased by 22.7 per cent in response to 60 kg ha^{-1} of S at maximum N rate (N_{120}). A significant interaction between N and S on seed protein was observed. These results corroborate the findings of Narang and Singh (1985) who reported increase in protein content with each successive increase in nitrogen level. Similarly, Biswas *et al.* (1995) found that increasing availability of nitrogen increased the proportion of proteinaceous substances in seeds of *Brassica napus* on a sandy loam soil. Present results are also in conformity with the findings of Zhao *et al.* (1993) who reported that sufficient supply of sulphate could lead to enhanced protein synthesis.

Glucosinolate content: Glucosinolates are sulphonated oxime thioesters, predominantly of glucose. Intact glucosinolates have generally been considered to be innocuous. Hydrolysis products, on the other hand produce several physiological effects when they are present in large quantities in animal feeds. The presence of glucosinolates in Brassica oilseeds has hindered the use of the meal in animal feed. The influence of N on seed glucosinolates content was dependent on the rate of S applied (Table 1). Increasing the N rate from 0 to 40 and 80 kg ha^{-1} decreased the glucosinolate content by 8.0 and 7.2 per cent, respectively with S_0 treatment. In contrast to this, increase in N rate from 0 to 120 kg ha^{-1} increased the glucosinolate content from 23.60 to 25.57 µ moles g^{-1} defatted seed meal (8.3 % increase as compared to control) with S_0 treatment. Also decrease in glucosinolate content was observed from 22.18 to 21.43 µ moles g^{-1} defatted seed meal when N rate was increased from 0 to 120 kg ha^{-1} at S_{60} treatment. The present results suggest that in sandy loam soil, N can either increase or decrease the glucosinolate content of rapeseed depending upon the S supply. Further the balance between N and S regulate the synthesis/accumulation of glucosinolates in seed. Similar results have been reported by Zhao *et al.* (1993) who mentioned that increasing the N rate from 0 to 300 kg ha^{-1} decreased the glucosinolate content from 12.6 to 7.2 µ moles g^{-1} defatted seed meal with S_0 treatment, but increased glucosinolate content

from 16.6 to 22.6 moles g^{-1} defatted seed meal with S_{100} treatment.

Total soluble sugars: The carbohydrate content of Brassica oilseeds can be conveniently divided into soluble carbohydrates (monosaccharides and oligosaccharides), insoluble carbohydrates (polysaccharides) and fibre. Variable content of soluble carbohydrates has been reported for Brassica seed meals. The effect of N and S application and interaction (NxS) was found to be non-significant on the total sugar content in *B. napus* (Table1).

Total phenols: The influence of N on total phenolic content was dependent on the rate of S applied (Table 1). Increasing the N rate from 0 to 120 kg ha^{-1} increased the total phenolic content from 7.27 to 7.53 mg/g with S_0 treatment but decreased it from 7.2 to 6.89 mg/g at S_{60} treatment. The effect of N and S interaction on phenolic content was found to be non significant. The content of phenolics in Brassica oilseeds is higher than in other oilseeds. Phenolics limit the utilization of the seed and meal not only as an animal feed but also as a source of food grade-protein. Phenolic compounds may contribute to the dark colour, bitter taste and astringency of Brassica seed meal. These and/or their oxidized products can also form complexes with essential amino acids, enzymes and other substances .Thus, it is concluded that in oilseed rape, seed quality parameters *viz.* seed protein, glucosinolate content, total soluble sugars and total phenols content are influenced greatly by the application of either N or S. Therefore, right dose of N and S fertilizers should be applied for harvesting better quality seeds of the crop.

Table 1. Effect of N and S application on biochemical constituents in *Brassica napus* L. cv."GSC5A"

Rate (kg ha^{-1})		Seed protein (mg 100mg^{-1})	Glucosinolates (μ moles g^{-1} defatted seed meal)	Total soluble sugars (mg 100 mg^{-1} defatted seed meal)	Total phenols (mg 100 mg^{-1} defatted seed meal)
N	S				
0	0	12.73	23.60	14.61	7.27
0	20	13.94	19.86	12.59	6.95
0	40	14.90	22.25	14.95	6.82
0	60	15.70	22.18	12.95	7.02
40	0	13.54	21.70	13.19	6.94
40	20	17.41	22.46	13.80	7.07
40	40	18.01	22.37	14.15	6.98
40	60	16.62	24.40	13.14	6.97
80	0	15.87	21.89	13.03	6.78
80	20	17.53	23.09	13.53	6.80
80	40	18.45	22.63	13.91	6.93
80	60	19.15	21.94	14.59	7.25
120	0	17.51	25.57	12.36	7.53
120	20	18.77	17.02	13.83	7.11
120	40	20.49	20.56	12.34	7.02
120	60	21.48	21.43	12.04	6.89
Significance[a]	N	*	NS	NS	NS
	S	*	NS	NS	NS
	NxS	*	NS	NS	NS

[a]Levels of significance: NS, not significant; *, $P<0.05$

References

Bilsborrow PE, Evans EJ and Zhao FJ 1993. The influence of spring nitrogen on yield, yield components and glucosinolate content of autumn-sown oilseed rape (*Brassica napus*). Agric. Sci. **120**: 219-24.

Biswas DR, Ali SA and Khera MS 1995. Response of gobhi sarson to nitrogen and sulphur. J. Indian Soc. Soil Sci. **43**: 220-23.

Booth EJ, Walker KC and Schnug E 1991. The effect of site, foliar nitrogen and sulphur application on glucosinolate content and yield of oilseed rape (*Brassica napus* L.). In: Proc. 8th International Rapeseed Congress. GCIRC, Sakatoon, Canada.pp. 567-72.

Dubois M, Willers KA, Hamilton JK, Robbers PA and Smith F 1956. Colorimetric method for determination of sugars. Analyt. Chem. **28**: 350-56.

Duke SH and Reisenauer HM 1986. Role and requirement of sulphur in plant nutrition. In: Sulphur in Agriculture, Agronomy Monograph No. 27, ed. Tabatabai, M.A. Agronomy Society of America, WI, USA., pp. 123-68.

Jackson ML 1967. *Soil Chemical Analysis*. Prentice-Hall of India, Ltd., New Delhi..

Narang RS and Singh S 1985. Influence of irrigation and nitrogen management on the oil quality of Indian mustard. J. Res. Punjab Agric. Univ. **22**: 229-34.

Subbiah BV and Asija GL 1956. A rapid procedure for the estimation of available nitrogen in soil. Curr. Sci. **25**: 259-60.

Swain T and Hillis WE 1959. The quantitative analysis of phenolic constituents. J. Sci. Food Agric. **10**:63-68.

Tholen JT, Shiefeny S, Truscott RJW and Rogger JW 1989. The thymol method for glucosinolate determination. J. Sci. Food Agric. **49**: 157-65.

Zhao FJ, Evans EJ, Bilsborrow PE and Syers JK 1993. Influence of sulphur and nitrogen on seed yield and quality of low glucosinolate oilseed rape. J. Sci. Food Agric. **63**: 29-37.

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