Asian Journal of Plant Sciences

ISSN 1682-3974

Asian Journal of Plant Sciences
Volume 1 Number 5: 519-521, 2002

Chemical Composition of Canola as Affected by Nitrogen and Sulphur

[1]Amanullah Jan, [1]Noorullah Khan, [2]Naeem Khan, [2]Ijaz Ahmad Khan and [3]Baharullah Khattak
[1]Department of Agronomy, [2]Department of Weed Sciences, [3]Department of Plant Pathology,
NWFP Agricultural University, Peshawar, Pakistan

Abstract: The research was conducted to study the effect of nitrogen (0, 40, 80 and 120kg ha^{-1}) and sulphur (0, 30, 60 and 90kg ha^{-1}) on the yield and oil contents of canola (Dunkled vareity). The effect of nitrogen was significant on grain yield, oil content erucic acid, but had not significantly affected glucosinolate content. Plots that received highest dose of N (120kg ha^{-1}) had maximum grain yield (2653kg ha^{-1}) but minimum oil content (42.10%) and erucic acid (0.31%). Different doses of sulphur had significantly increased grain yield (1683kg ha^{-1}), oil content (44%) and erucic acid (0.50%) but had not significantly affected glucosinolate content. Grain yield was significantly higher at the highest levels of both the nutrients applied while oil contents decreased with increase in level of sulphur to 90kg ha^{-1} (43.19%) and nitrogen to level of 120kg ha^{-1} (42%). The result indicated that glucosinolate is not effected by the two nutrients i.e., N and S.

Key words: Canola, erucic acid, glucosinolate, oil contents, S and N

Introduction

The major factors controlling crop quality are genetically fixed, however exogenous factors like environment and nutrition can considerably influence the level of some organic compounds in plants. Increasing the level of nitrogen, nutrition for (*Brassica napus* L.), crude protein were also enhanced but fat contents were reduced in study conducted by Appellquist (1968). The same worker reported higher oil contents at low nitrogen nutrition but both seed yield and seed size were depressed. High rate of nitrogen fertilizer increase erucic acid and thus have negative effect (Hermann, 1977). Decrease in oil contents with increase in nitrogen rates have been reported by Nuttal *et al.* (1987). However lower levels (upto 60kg ha^{-1}) may increase oil yield of toria (*Brassica napus*) and mustard (*Brassica juncea*) under rianfed condition (Giri *et al.*, 1989). There are also reported that high rates of nitrogen decreases glucosinolate content (Arora and Bhatia, 1970).

Sulphur also play an important role in the chemical composition of seed. Sulphur increases the percentage of oil content of the seed (Saron and Giri, 1990; Chaudhry *et al.*, 1992), glucosinolate content (Marscher, 1986) and erucic acid (Babuchowski, 1971). Although the variation in erucic acid and glucosinolate contents is low. Sulphur is the fourth major nutrient in crop production. Most crops require as much sulphur as phosphorus. The nitrogen and sulphur requirements of crops are closely related because both nutrients are required for protein synthesis. Sulphur is a component of the amino acid, cystein, and methionine needed for protein synthesis. Sulphur is involved in the synthesis of chlorophyll and is also required in cruciferae for the synthesis of volatile oil which accumulates as glucosinolate (Marscher, 1986). The experiment was designed to study the magnitude of changes in chemical composition of canola with various levels of N and S on important constituents of organic compounds of plant.

Materials and Methods

Experiment to study the effect of nitrogen and sulphur on the yield and oil content of canola was conducted at NWFP Agricultural University, Peshawar, during the year 1999-2000. Treatments consisted of four nitrogen levels (0, 40, 80 and 120kg ha^{-1}) and four sulphur levels (0, 30, 60 and 90kg ha^{-1}) applied as a whole at the time of sowing. The experiment laid out in a randomized complete block (RCB) design. There were 16 subplots in one replications. The size of the subplot was 4x4 m^2. Each subplot had 10 rows with row to row distance 40 cm. The plant to plant distance was maintained at 15 cm within the row. At the time of sowing K_2SO_4 was used as sulphur source. In case of zero sulphur KCl was used in order to balance K in all the plot. Urea was used as nitrogen source. A basal dose of phosphorus (60kg ha^{-1}) was applied at the time of sowing. The Dunkled variety of canola was seeded at the rate of 5kg ha^{-1}. Data were recorded on grain yield kg ha^{-1}, oil content (%), erucic acid (%) and glucosinolates content (μmole g^{-1}). For oil content determination samples of 100 g of sun dried and clean seeds were taken from all the treatments. These samples were further dried in an oven for six hours at Oil Quality Laboratory, National Agricultural Research Centre, Islamabad. Then from each of the oven dried samples 20g were taken in a glass tube and the oil content were determined with the help of Newport 4000 NMR (Nuclear Magnetic Resonance) analyzer at Oil Quality Laboratory, NARC, Islamabad. Glucosinolates content and erucic acid percentage of the samples were determined at Oil Quality Laboratory, NARC, Islamabad.

The data recorded was statistically analyzed according to RCB design and LSD test was applied at 0.05 level of probability for statistical interpretation. Statistical methods were performed by the method given by Gomez and Gomez (1976).

Results and Discussion

Nitrogen and sulphur had significantly affected grain yield and maximum grain yield of 2653 was produced by those plots which received maximum nitrogen (120kg ha^{-1}) while minimum grain yield of 681kg ha^{-1} was produced by those plots which received no nitrogen (control) (Table 1). Grain yield increased significantly with increase in nitrogen levels and indicated that nitrogen was not super optimal. The increase in grain yield with increase in nitrogen are in agreement with those reported by Rathore and Manohar (1989), who observed that grain yield increased significantly when nitrogen was increased from 0 to 180kg ha^{-1}. Similar finding have been reported by Uddin *et al.* (1992) and Qayyum *et al.* (1998). Mean value for sulphur (Table 1) showed that sulphur had also significant effect on grain yield. Maximum grain yield of 1683kg ha^{-1} was produced by those plots which received maximum sulphur i.e., 90kg S ha^{-1}, while minimum grain yield of 1376kg ha^{-1} was produced by those plots which received no sulphur (control plots). The increase in grain yield with increase in sulphur may be due to the fact that sulphur is also necessary for the growth and development of seed as a food nutrient. These results are in agreement with those reported by Rathore and Manohar (1989), who stated that grain yield increased significantly when sulphur rate increased from 0-90kg S ha^{-1} Nepalia and Saroha (1992), Withers (1992), and Zhao *et al.* (1993) all showed increasing trends in grain yield with increase in sulphur rate.

Different levels of nitrogen and sulphur had significantly affected the percentage of oil contents of the seed (Table 2). The mean value of the data showed that the application of nitrogen upto 120kg N ha^{-1}) had no significant effect on the oil content but oil content decreased significantly (42.62-42.10%), when the level of nitrogen increased to 120kg N ha^{-1}. The possible reason for the decrease in oil content with increase in nitrogen may be due to the fact that nitrogen is the major constituent of protein so it might increased the percentage of protein of the seed as a result there

Table 1: Grain yield (kg ha^{-1}) as affected by different doses of nitrogen and sulphur

Nitrogen (kg ha^{-1})	Sulphur (kg ha^{-1}) Control	30	60	90	Mean
Control	559	572	635	958	681d
40	923	1101	1231	1333	1147c
80	1541	1657	1763	1710	1668b
120	2481	2655	2745	2731	2653a
Mean	1376 c	1496 b	1593 b	1683 a	

LSD for nitrogen and sulphur = 93

Means of each category followed by different letters are significantly different at P≤0.05

Table 2: Oil contents (%) as affected by different doses of nitrogen and sulphur

Nitrogen (kg ha^{-1})	Sulphur (kg ha^{-1}) Control	30	60	90	Mean
Control	40.85	42.67	44.72	43.32	42.89a
40	40.04	43.03	44.67	43.26	42.75a
80	40.19	43.46	43.45	43.38	42.62a
120	39.68	42.77	43.17	42.78	42.10b
Mean	40.19c	42.75b	44.00a	43.19b	

LSD for nitrogen and sulphur = 0.3055

Means of each category followed by different letters are significantly different at P≤0.05

Table 3: Glucosinolate content of the seed (μmole g^{-1}) as effected by different doses of nitrogen and sulphur

Nitrogen (kg ha^{-1})	Sulphur (kg ha^{-1}) Control	30	60	90	Mean
Control	9.90	9.48	12.84	12.42	11.16
40	7.38	8.64	8.64	9.80	8.41
80	6.96	8.64	9.80	9.90	8.83
120	6.96	12.00	12.74	12.84	11.12
Mean	7.80	9.69	11.01	11.24	

Non Significant

Table 4: Percentage of erucic acid of the seed as effected by different doses of nitrogen and sulphur

Nitrogen (kg ha^{-1})	Sulphur (kg ha^{-1}) Control	30	60	90	Mean
Control	0.35	0.69	0.72	0.80	0.64 a
40	0.31	0.24	0.43	0.48	0.37 b
80	0.30	0.22	0.31	0.33	0.29 b
120	0.29	0.21	0.36	0.38	0.31 b
Mean	0.31b	0.33ab	0.45ab	0.50a	

LSD for nitrogen and sulphur = 0.1783

Means of each category followed by different letters are significantly different at P≤0.05

might be a decrease in the percentage of oil content as it has inverse relationship with protein. The results are in agreement with those documented by Augustinussen *et al.* (1983), who reported that seed oil content decreased from 46.3% with PK alone to 42.5 percent with 130kg N ha^{-1} and 41.7% with 260Kg N ha^{-1}. Hamid (1986), Kumar and Shaktawat (1992) and Zhao *et al.* (1993) all reported decreasing trends in oil contents with increase in nitrogen rate. The data regarding effect of sulphur showed that sulphur had significantly increased percentage of oil contents (Table 2). Maximum oil percentage (44%) was recorded in those plots which received 60kg S ha^{-1} while minimum of 40.19% was recorded in those plots which received no sulphur (control plots). The data also showed that there was a decreased in oil percent (43.19%) with increase in sulphur level beyond 60kg S ha^{-1}. The maximum oil contents at 60kg S ha^{-1} are in agreement with those reported by Saron and Giri (1990) and Chaudhary *et al.* (1992), who reported that seed oil contents increased from 41.19 to 44.00% with increase in sulphur rates from 0-60kg S ha^{-1}.

Mean value for glucosinlate content was not significantly affected by the application of nitrogen and sulphur (Table 3). Glucosinlate were generally higher at either zero nitrogen or higher dose of nitrogen i.e., 120kg N ha^{-1}. These results are in agreement with those reported by Herrmann (1978), who stated that nitrogen had a variable effect on glucosinlate content. The effect of sulphur on glucosinlate was not statistically significant, however it can be seen from the table that it increased with increase in sulphur doses from 0 to 90kg ha^{-1}. The non significant increases in glucosinlate with increase in sulphur are in agreement with those reported by Wither (1992), who reported sulphur application improved quality, increased oil contents but slightly increased glucosinlate contents. Different doses of nitrogen had significantly affected erucic acid percentage (Table 4). Those plots which received no nitrogen had significantly higher erucic acid content (0.64%) against those plots which received either dose of nitrogen. The difference among the nitrogen levels i.e 40, 80 and 120kg ha^{-1} was not statistically significant. The possible reason may be the dilution effect of nitrogen i.e., the nitrogen might have increased the protein contents of the seed as a result there might be decrease in the percent of erucic acid.

Mean value of the data for sulphur showed that sulphur had significant effect on the percent of erucic acid. The maximum erucic acid (0.5%) was recorded in those plots which received maximum sulphur (90kg S ha^{-1}) although it was at par with 30 and 60kg ha^{-1}, while minimum (0.31%) erucic acid was recorded in those plots which received no sulphur (control).

A combination of 120 x 60 N and S seems to be an appropriate dose in the present experiment as grain yield has increased by 159% with 1 % reduction in oil contents at 120kg ha^{-1} and 2 % increase in oil contents with 5 % decrease in grain yield with increase in S beyond 60kg ha^{-1}. As for as erucic acid and glucosinolate content are concerned is quite below the dangerous level.

References

Appellquist, L.A., 1968. Lipids in cruciferae. II Fatty acid composition in *Brassica napus* seed as affected by nitrogen, phosphorus, potassium and sulphur nutrition of plants. Physiol. Plant, 21: 455-465.

Arora, S.K. and I.S. Bhatia, 1970. Chemical composition of *Brassica juncea* as affected by nitrogen application. Agrochemica, 14, 198-201.

Augustinussen, E.A., Nordestgard and Flengranark, 1983. Influence of N, P and K fertilizer on seed quality of oil seed rape. Tidsskrifts for Plant Eavl., 87: 465-475.

Babuchowski, K., 1971. The processing value of rapeseed, cooking oil and oil cake meal as affected by sulphur nutrition. Zeszyty Noukow Wyzsej Rolniezejw Otz Olsztynie, Seria A (supplement 5), 3-51.

Chaudhary, S.K., N.M. Gogulwar and A.K. Singh, 1992. Effect of sulphur and nitrogen on seed yield and oil content of mustard (*Brassica juncea*). Indian J. Agron., 37: 839-840.

Giri, A.K., P.K. Jana, B.B. Mandal and A. Barik, 1989. Effect of nitrogen on yield consumptive use and water use efficiency of toria (*B. napus*) and Indian mustard. (*B. juncea*) under rainfed conditions. Indian J. Agric. Sci., 59: 791-794.

Gomez, K.A. and A.A. Gomez, 1976. Statistical procedure for Agricultural Research. 2nd Edition, Publuishers John Wiley & Sons, New York.

Hamid, A.K., A.H. Sheikh., A. Hussain and S.A. Khan, 1986. Effect of fertilization on autumn sown mustard. Pak J. Agric. Res., 7: 37-40.

Herrmann, B., 1977. Fatty acid composition of the crude fat fraction of winter rape seed as influenced by nitrogen fertilizer. Arch. Acker und Pflanzenbau und Bodenk, 21: 141-148.

Herrmann, B., 1978. Relationship between nitrogen application and glucosinolate content in winter oil seed rape. Arckiv Fur Ackerund Pflanzebau and Bodenkunde, 20: 817-824.

Kumar, R. and M.S. Shaktawat, 1992. Effect of limited water supply, nitrogen and time of sowing on production of rape (*Brassica napus*). Agron. J., 37: 853-855.

Marscher, A., 1986. Mineral nutrition of higher plants. Academic Press Inc., London, UK.

Nepalia, V. and M.S. Sarhoa, 1992. Interactive effects of nitrogen, Sulphur and row spacing on the grain and oil yield of Toria. Indian Ann. Arid Zone, 81: 77-78.

Nuttal, W.F., H. Ukraina, J.W.B. Stewart and D.T. Spurr, 1987. The effect of nitrogen, sulphur and boron on yield and quality of rapeseed (*Brassica napus* L. and *Brassica compestris* L.) Can. J. Soil Sci., 67: 545-559.

Qayyum, S.M. A.A. Kakar and M.A. Naz, 1998. Influence of nitrogen levels on the growth and yield of rape (*Brassica napus* L.). Sarhad J. Agric., 15: 263; 1999.

Rathore, P.S. and S.S. Manohar, 1989. Response of mustard to nitrogen and sulphur. Indian J. Agron., 34: 336-336.

Saron, G. and G. Giri, 1990. Influence of nitrogen, phosphorus and sulphur on mustard under semi-arid rainfall conditions of North-West India. Indian J. Agron., 35: 131-136.

Uddin, M.K., M.N.H. Khan, A.S.M. Mahbub and M.M. Hussain, 1992. Growth and yield of rape seeds as affected by nitrogen and seed rate. Bangladesh J. Sci. and Ind. Res., 27: 30-38.

Withers, P.J.A., 1992. Winter Oilseed rape: effects of sulphur on seed glucosinolate content and seed yield. London UK; Home-Grown Cereals Authority Oil Seed Project Report, No.OS2, pp: 21.

Zhao, F.J., Evans, P.E. Bilsborrow and J.K. Syers, 1993. Influence of sulphur and nitrogen on seed yield and quality of low glucosinolate oil seed rape. *Brassica napus* L. J. Sci. Food and Agric., 63: 29-37.