The Journal of Rural and Agricultural Research Vol. 21 No. 2, 75-78 (2021)
Received November 2021; Acceptance December 2021

Effects of sulphur application on yield, nutrient content and uptake by mustard crop (*Brassica Juncea* L.)

SAURABH SINGH*, JAGANNATH PATHAK, J.K. TIWARI AND DEO KUMAR
Department of Soil Science and Agricultural Chemistry, Banda University of Agriculture & Technology, Banda, 210001
**Corresponding Author Email* – saurabhsingh7081@gmail.com

Abstract

*A field experiment was conducted during Rabi season in 2020-2021 at Integrated Farming System (IFS) unit of Banda University of Agriculture and Technology, Banda to assess the effects of sulphur application on yield, nutrient content and uptake by Indian mustard crop (*Brassica juncea *L.). The experiment was carried out in Randomized Block Design (RBD) with seven treatments and four replications. Two sources of sulphur* i.e. *elemental sulphur (0, 15, 30, 45 kg ha^{-1}) and 80% WDG sulphur (15, 30, 45 kg ha^{-1}) were applied. It was observed that increasing application of sulphur increases the yield, nutrient content and uptake of sulphur up to the dose of 45 kg S ha^{-1}. Comparison among the different doses of sulphur indicated that significant increased in the yield, sulphur content and uptake was found only up to 30 kg S ha^{-1} applied either through elemental sulphur or through 80% WDG sulphur. Application of 30 and 45 kg S ha^{-1} were numerically different but statistically at par with each other.*

Key words: Indian mustard, Sulphur, Yield, Nutrient, content & uptake

Introduction

Mustard (*Brassica juncea* L.) is an important rabi oilseed crop of India. It occupies about 24.70 per cent of area and 48.28 per cent of production of the total oilseed production in India. In India rapeseed and mustard production was recorded 72.41 mt in (2018-19) (Anonymous 2020b) that accounts 12.1% share of the global oilseed production (597.27 mt). In India, rapeseed and mustard are mainly grown in Rajasthan, Uttar-Pradesh, Haryana, Madhya-Pradesh, West-Bengal, Assam and Gujarat. These states have India's total area and production of rapeseed and mustard 92.7% and 95.8% respectively. Among the rapeseed and mustard cultivating states, Rajasthan is the largest producer with 36.6% area and 40.9% production of the India (Anonymous 2019a). In India during 2008-09 to 2018- 19 rapeseed and mustard production increased up to 28.6%. In the country area and production is fluctuating and it was 6.30 mha and 7.20 mt respectively in 2008-09, while it was 6.12 mha and 9.26 respectively in 2018-19. (Anonymous 2019a, 2020a).

Rapeseed & mustard is the third largest oilseed crop of India after groundnut and soybean. India occupies one fifth of global area of mustard and one tenth of production (Jat *et al*., 2019). Area, production and productivity of mustard in India are 6.3 million hectares, 8.0 million tonnes and 1324 kg ha^{-1} respectively. While in case of Uttar Pradesh area under mustard is 6.79 lakh hectares and production is 9.45 lakh tonnes (DOAC, 2017). India ranks third in rapeseed and mustard production in the world after China and Canada.

Mustard crop belongs to the genus brassica under the family cruciferae. Mustard seeds have different names in different places e.g sarson, rai, toria, lahi while sarson and toria are generally termed as rapeseed and rai is termed as mustard. Oil content varies from 37 to 49 percent and mustard seed contain 30-45% protein. The seed and oil are used in the preparation of pickles and for flavoring curries and vegetables. Mustard oil cakes used as feed for cattle and manure. The young plant leaves are used as green vegetables and provided adequate sulphur mineral in the diet. Mustard oil is also used for preparation of hair oil and medicine.

Plant absorbs sulphur in the form of sulphate ions (SO_4^{-2}). Sulphur is involved in formation of chlorophyll and activation of the enzyme sulphydryl (SH). Mustard oil has pungency due to presence of sulphur compound glucosinolates and glucosides. Sulphur application significantly influenced the seed and stover yield of mustard (Sharma *et al*., 2009).

Sulphur requirement is the highest for oilseed crop followed by pulses and least for cereals. As a thumb rule, kg S uptake t^{-1} grain can be taken as 3-4 (range 1-6) kg for cereals, 8 kg (range 5-13) for pulse and 12 kg (range 5-20) for oilseed crops (Tandon, 1991). Further percentage of S absorbed by the plant that moves into grain is the highest for rapeseed and mustard 17-20 per cent as compared to 11.7 per cent in sesamum and 8.7 per cent in soybean and 8.5-8.7 per cent in chickpea and black gram (Aulakh *et al*., 1985). Sulphur is a secondary plant nutrient and it is important element for oilseed crops. Because it is directly involved in synthesis of sulphur containing amino acids like methionine, cystine and cysteine. It played vital role in oil formation in oilseed crops.

Materials and Methods

The field experiment was conducted on Indian mustard (variety NRCHB-101) during rabi seasons of 2020-21 at IFS unit of Banda University of Agriculture and Technology, Banda. The experiment was comprised of seven treatments and laid out in randomized block design with two sources (elemental sulphur and 80% WDG sulphur) and three levels of sulphur 15, 30 and 45 kg ha^{-1}. The climate of Banda region is semi- arid characterized by aridity of atmosphere, scarcity of water with extremity of summer. Temperature ranges from 50^0C (during summer) to 4^0C (during winter). The average annual rainfall received about 850 mm and most of which occurred during monsoon season.

Indian mustard variety 'NRCHB-101' was sown manually on 22 .11. 2020 with seed rate of 5.0 kg ha^{-1} at 5 cm depth and harvested on 20th of March 2021. As per treatment, fixed amount of sulphur was applied through elemental sulphur (90% S) and WDG sulphur (80%S) at sowing time, other nutrients fertilizers were applied as per recommendation of crop under irrigated condition or rainfed condition and well decomposed farmyard manure was applied 2-3 weeks before sowing and incorporated into the soil. Basal application of half dose of nitrogen and full dose of phosphorus and potash and remaining nitrogen was top dressed after 30 DAS and after first irrigation. Other cultural practices such as weeding, plant protection measures etc. were done as and when required. Data obtained from crop was statistically analyzed by using the F-test as per the procedure given by Gomez and Gomez (1984), CD at P=0.05 were used to determine the significance differences between treatment means.

Results and Discussion

Yield

The data on the effects of different treatment on seed yield have been presented in table 1. Data showed that seed yield varied from 1617 to 2104 kg ha^{-1}. The effects of different doses and sources of sulphur resulted in significant increase in seed yield. However, the differences between 30 and 45 kg S ha^{-1} for seed yield were non-significant. Significance response of S application was observed up to the 30 kg S ha^{-1}. Application of 45 kg S ha^{-1} numerically has higher yield over the 30 kg S ha^{-1} but statistically these levels of S at par with each other. In general, the yield levels under different treatments were fairly high which was higher than the control. Sulphur had acidifying effects on soil and therefore regulates the pH and augments the availability of nutrients. Sulphur offers

Table 1: Effect of Sulphur Levels on Yield of Mustard

Treatment	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})
T_1, Omission S	1617	4252
T_2, 15 kg S ha^{-1} through elemental S	1863	4848
T_3, 30 kg S ha^{-1} through elemental S	2075	5434
T_4, 45 kg S ha^{-1} through elemental S	2104	5571
T_5, 15 kg S ha^{-1} through 80%WDG	1860	4842
T_6, 30 kg S ha^{-1} through 80%WDG	2070	5427
T_7, 45 kg S ha^{-1} through 80%WDG	2099	5551
SEm±	56	143
C.D.(0.05)	173	440
CV (%)	5.0	4.8

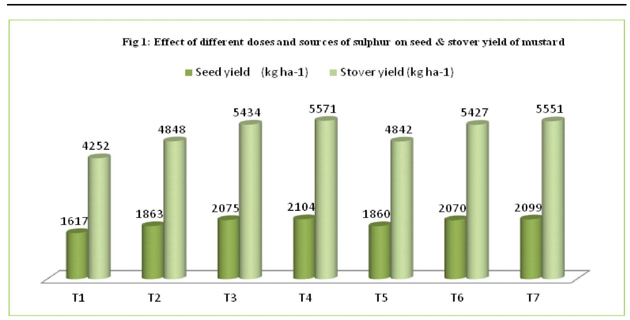

Table 2: Effect of Sulphur Levels on Content and Uptake of Mustard

Treatment	S Content in Seed (%)	S Content in Stover (%)	S uptake by Seed (kg ha^{-1})	S uptake in Stover (kg ha^{-1})	Total uptake S
T_1	0.70	0.38	11.37	16.15	27.52
T_2	0.76	0.43	14.10	20.68	34.78
T_3	0.81	0.50	16.81	27.07	43.88
T_4	0.85	0.54	17.95	29.86	47.81
T_5	0.77	0.44	14.38	21.15	35.53
T_6	0.82	0.52	16.89	28.39	45.28
T_7	0.86	0.56	18.15	31.08	49.23
SEm±	0.01	0.01	0.59	1.11	1.29
C.D.(0.05)	0.04	0.04	1.81	3.42	3.97
CV (%)	2.9	5.2	6.5	7.7	5.5

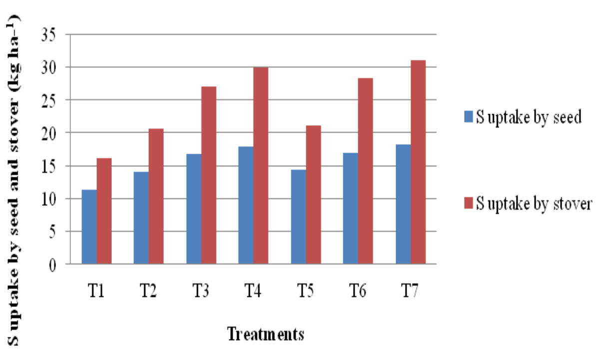

Fig 2: Effect of different doses and sources of sulphur on uptake of S by seed and stover of mustard

resistance to plants against drought, pest and diseases. The enhancement of the seed yield in mustard due to the application of S had also been reported by Mohiuddin *et al.* (2011), Kumar and Trivedi (2012), Zizala *et al.* (2008), Piri (2012). This improvement might be due to the translocation of photosynthesis leading to improvement of higher seed yield.

Data related to stover yield presented in table 2. Stover yield was in general about 2.4 times higher than the seed yield. However, the trends of variation under different treatment were almost similar to those described for seed yield the results were significant. Stover yield varied from 4252 to 5571 kg ha^{-1}. Application of 30 kg S ha^{-1} through elemental sulphur or 80 % WDG sulphur was the best. Higher dose of Sulphur i.e. 45 kg ha^{-1} did not achieve the level of significance among the different doses of sulphur. Several investigators have also reported the significant increase in Stover yield due to sulphur application Donarkar *et al.* (2005) and Khan *et al.* (2006).

Content and uptake of sulphur by mustard

Sulphur concentration in seed and stover, sulphur uptake by seed and stover as well as total uptake of sulphur significantly influenced by sulphur application (Table 2 & Fig. 2). Sulphur concentration in mustard seed and stover varied from 0.70 to 0.86, and 0.38 to 0.56 % respectively. Application of increasing levels of sulphur significantly increased sulphur concentration in seed and stover and 30 kg S ha^{-1} through elemental sulphur or 80% WDG sulphur was the best treatment followed by other treatments further increase in S levels, 45 kg S ha^{-1} was at par with 30 kg S ha^{-1}. Mustard crop requires considerably higher amount of S in nutrition of brassica crops. The response of sulphur is further revealed when it is applied with other nutrients in balanced manner. Thus, balancing of sulphur with nitrogen, phosphorus and potassium might be further useful. The results are in conformity with those of Zizala *et al.* (2008), Sharma *et al.* (2018).

Total uptake of S (uptake in seed + uptake in stover) varied from 27.52 to 49.23 kg ha^{-1}. The trends of variation of uptake under different treatments were almost similar to sulphur concentration in seed and stover. The significant increase in sulphur uptake in treatment T_3 (30 kg S ha^{-1} through elemental sulphur) and T_6 (30 kg S ha^{-1} through 80% WDG sulphur) was mainly due to the better nutrition, which resulted in better growth and yield, ultimately in higher uptake of nutrients. The increased uptake of sulphur may also due to mutually competitive effect of adsorption sites and resultant increase in sulphur concentration in soil solution. The results also confirmed by the findings of Shaoo *et al.* (2018) and Suman *et al*. (2018).

References

Anonymous (2019a). Agricultural Statistics at a Glance 2018. Directorate of Economics and Statistics, Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi, p. 468.

Anonymous (2020a). Third Advance Estimates of Production of Food Grains and Oilseeds andCommercial crops for 2019-20 as on May 15, 2020. Agricultural Statistics Division. Directorate of Economics and Statistics. Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi. (www.agricoop.nic.in)

Anonymous (2020b). Oilseeds: World Markets and Trade. Foreign Agricultural Service, United States Department of Agriculture. p. 39 (April 2020).

Aulak, M.S., Sindhu, B.S., Arora, B.R. and Singh, B. (1985). Content and uptake of nutrients by pulse and oilseed crops, Indian Journal of Ecology 12 (2): 238-242.

DOAC. (2017). Agricultural Statistices at a Glance, Directorate of Economics and Statistices, Department of Agriculture and Cooperation. Ministry of Agriculture, Government of India.

Dongarkar, K. P., Pawar, W. S., Khawale, V. S., Khutate, N. G. and Gudadhe, N. N. (2005). Effect of nitrogen and sulphur on growth and yield of mustard (*Brassica juncea* L.). *Journal of Soils and Crops*, **15**(1): 163-167.

Gomez, K.A. and Gomez, A.A.(1976). Statistical procedures for agricultural research, (2nd Ed. 1984), *John Willey and Sons Inc*. New York, USA.

Khan, M. J., Khan, M. H., Khattak, R. A. and Jan, M. T. (2006). Response of maize to different levels of sulfur. *Communications in Soil Science and Plant Analysis*, **37**(1-2): 41-51.

Kumar, R. and Trivedi, S. K. (2012). Effect of levels and sources of sulphur on yield, quality and nutrient uptake by mustard (Brassica juncea). *Progressive Agriculture*, **12**(1): 69-73.

Mohiuddin, M., Paul, A.K., Sutradhar, G.N.C., Bhuiyan, M.S.I. and Zubair, H.M. (2011). Response of nitrogen and sulphur fertilizer on yield, yield components and protein of oilseed mustard (*Brassica spp*.) *International Journal of Bio-resource and Stress Management*, **2**(1):93-99.

Piri, I. (2012). Study of yield and yield components of black mustard (*Brassica nigra*) in condition of sulphur application and water stress. *Annals of Biological Research*, **3**(5): 2074-2077.

Sharma, A., Sharma, P., Brar, M.S. and Dhillion, N.S. (2009). Comperative response to sulphur application in raya (*Brassica juncea*) and wheat (*Triticum aestivum*) grown on light textured alluvial soil. *Journal of Indian Society of Soil Science*, **57**(1): 62-66.

Sharma, V., Sharma, B.L., Sharma, G.D., Porte, S.S. and Dubey, A. (2018). Studies on Impact of sulphur with and without FYM on yield, Uptake and Methionine Content in mustard.

Tendon, H. L. S. (1991). *Sulphur- Research and* Agricultural Production in India. 3rd edition. The Sulphur Institute, Waashington, D. C., 144.

Zizala, V. J., Jadav, N. B. and Gorfad, P. S. (2008). Effect of sulphur and zinc on yield, quality and its concentration on mustard. *Asian Journal of Soil Science*, **3**(1): 173-177.