The Pharma Innovation Journal 2022; 11(5): 1817-1820

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(5): 1817-1820

www.thepharmajournal.com
Received: 02-02-2022
Accepted: 08-04-2022

Rahul Kumar Solanki
School of Agriculture, ITM University, Gwalior, Madhya Pradesh, India

Raghvendra Singh
Assistant Professor, School of Agriculture, ITM University, Gwalior, Madhya Pradesh, India

SS Tomar
Dean, School of Agriculture, ITM University, Gwalior, Madhya Pradesh, India

Girish Goyal
Teaching Assistant, School of Agriculture, ITM University, Gwalior, Madhya Pradesh, India

Corresponding Author:
Raghvendra Singh
Assistant Professor, School of Agriculture, ITM University, Gwalior, Madhya Pradesh, India

Effect of various levels of Sulphur and vermicompost on the growth and yield of Indian mustard (*Brassica juncea* L.)

Rahul Kumar Solanki, Raghvendra Singh, SS Tomar and Girish Goyal

Abstract
A field experiment was conducted at instructional farm, Department of Agronomy, School of Agriculture, ITM University, Gwalior (M.P.) during *Rabi* season 2020- 21. A set of 12 treatment combinations including four Sulphur levels *viz*., 0 kg/ha (S_0), 20 kg/ha (S_1), 40 kg/ha (S_2) and 60 kg/ha (S_3) with three vermicompost levels *viz*., 0 t/ha(V_1), 2 t/ha(V_2) and 4 t/ha (V_3) were evaluated. Treatments were replicated thrice as per Randomized Block design with Factorial concept. The significantly higher plant height, number of leaves as well as branches per plant, number of siliquae per plant, length of siliqua, number of seeds per siliqua, test weight, seed and Stover yield per hectare of mustardat harvesting stage was recorded under the application of Sulphur @ 60 kg/ha in combination with application of vermicompost @ 4 t/ha with the respective values of 165.47 cm, 38.40, 20.90, 429.79, 7.72 cm, 17.47, 4.39 g, 21.14 q/ha and62.04 q/ha, respectively proved significantly superior to rest of the treatments. Result showed that mustard variety when sown with application of Sulphur @ 60 kg/ha in combination with application of vermicompost @4 t/harecorded the maximum and significantly higher values of these parameters.

Keywords: Mustard, vermicompost, Sulphur, test weight, Siliqua, Stover yield

Introduction
Mustard (*Brassica juncea* L.) is the third important oilseed crop in the world after soybean and palm oil. It is grown in subtropical and tropical countries in the world comprise eight cultivated crops of tribe Brassiceae within the family Cruciferae (Brassicaceae). In India, it is the second most important edible oilseed after groundnut sharing 27.8% in the India's oilseed economy. The area, production and yield of rapeseed-mustard in the world was 36.59 million hectares (mha), 72.37 million tonnes (mt) and 1980 kg / ha, respectively, during 2018-19. Globally, India account for 21.7% and 10.7% of the total acreage and production (USDA, 2010). Madhya Pradesh produced 1,038.15 million tonnes during 2019- 20 having third ranking. The average productivity of rapeseed and mustard in the Madhya Pradesh is 1252 kg /ha (Anonymous, 2019) [1].

The response of mustard to Sulphur application in alluvial soils of M.P. has been reported. Mustard has highest requirement of Sulphur with optimum level ranging from 20 to 60 kg S/ ha depending on the soil Sulphur status and yield potential (Sarmah and Debnath, 1999) [8]. Indian mustard markedly responded to Sulphur fertilization in oilseeds. Sulphur plays a vital role in quality and development of seed. The chemical fertilizers being used for supplementing the major nutrient are generally either deficient or low in Sulphur content. The importance of Sulphur fertilization for increasing yield and quality of Indian mustard is being increasingly recognized. However, the information regarding optimum level of Sulphur as well as source of Sulphur and its influences on seed yield and quality of mustard is meager. Probably for these reasons mustard crop needs comparatively higher amount of Sulphur for proper growth and development and higher yields. Sulphur levels significantly influenced the seed and Stover yield of mustard (Sharma *et al*., 2009) [9].

Sulphur is also a constituent of vitamins biotin and thiamine (B_1) and also of iron Sulphur proteins called ferredoxins. Sulphur is associated with the production of oilseed crops of superior nutritional and market quality. Sulphur deficiencies in India are widespread and scattered. Deficiency of Sulphur in Indian soils is on increase due to intensification of agriculture with high yielding varieties and multiple cropping coupled with the use of high analysis Sulphur free fertilizers along with the restricted or no use of organic manures have

accrued in depletion of the soil Sulphur reserve. Crops generally absorb Sulphur and phosphorus in similar amounts. On average, the Sulphur absorbed per tonne of seed production is 3-4 kilograms in cereals, 8 kilograms in pulses, and 12 kilograms in oilseeds. Soils, which are deficient in Sulphur, cannot on their own provide adequate Sulphur to meet crop demand resulting in Sulphur deficient crops and sub-optimal yields (Chattopaddhyay *et al*., 2012) [3].

Soil organic matter plays a key role in influencing the nutrient dynamics in soils. It acts as a sink by hoarding the nutrients temporarily through array of biochemical processes ranging from adsorption reactions to organo-nutrient forms. Organically held plant nutrients play a vital role in sustaining plant nutrient availability. It also maintains optimum temperature and moisture in soil. Vermicompost also improves soil aeration, reduces soil erosion and evaporation losses of water, accelerates the process of humification, stimulates the microbial activity, deo-copurification of obnoxious smell, destruction of pathogens, detoxification of pollutant soil etc. (Manna and Hagra, 1996) [5].

Therefore, reaction of mustard crop to Sulphur based on change in crop growth rate, net assimilation rate and yield of their seed will be also different. Keeping these points in view, the present investigations were under taken.

Materials and Methods

Field experiment was conducted at instructional farm, Department of Agronomy, School of Agriculture, ITM University, Gwalior (M.P.) during rabi season 2020- 21. A set of 12 treatment combinations including four Sulphur levels *viz*., 0 kg/ha (S_0), 20 kg/ha (S_1), 40 kg/ha (S_2) and 60 kg/ha (S_3) with three vermicompost levels *viz.*, 0 t/ha (V_1), 2 t/ha(V_2) and 4 t/ha (V_3) were evaluated. Treatments were replicated thrice as per Randomized Block design with Factorial concept.

The crop was sown in furrows 30.0 cm x 10.0 cm spacing using 6 kg seed rate per hectare. The recommended doses of nitrogen (60 Kg N/ha), phosphorus (40 Kg P_2O_5 /ha) and potassium (40 kg K_2O /ha) along with Sulphur were applied. Sulphur was applied as per treatment. Half dose of nitrogen and full dose of phosphorus and potassium was applied as basal dressing at the time of sowing and remaining half dose of nitrogen was top dressed in two equal split doses each after first and second irrigation. As per treatments, total amount of Sulphur was given at the time of sowing through basal application. Two irrigations were given to mustard crop. First irrigation was done at 30 days after sowing and second irrigation was done at flowering stage of the crop.

Results and Discussion

Growth Parameters

Plant height and number of leaves as well as branches per plant are important growth parameters contributing to seed yield of any crop. Plant height and number of leaves as well as branches per plant represents index of growth and development indicating the infrastructure build-up of plants.

It is evident from the data that plant height, number of leaves as well as branches per plant (Table-1) increased successively under higher rate of Sulphur treatments. Among different level of Sulphur, 60 kg/ha (S_3) produced significantly higher plant height, number of leaves as well as branches per plant (160.90 cm, 36.20 and 19.86) than others. Among the organic manure, application of vermicompost @ 4 t/ha, produced significantly higher plant height, number of leaves per plant and number of branches per plant with the respective value of 162.82 cm, 36.62 and 20.34, than others.

Interactions between different levels of Sulphur and vermicompost, application of Sulphur @ 60 kg/ha in combination with application of vermicompost @ 4 t/ha produced significantly highest plant height and number of leaves as well as branches per plant (165.47 cm, 38.40 and 20.90, respectively).

The rate of Sulphur increase in plant height was more at 60 kg S/ ha due to better nutritional environment for plant growth at active vegetative stages as a result of improvement in root growth, cell multiplication, elongation and cell expression in the plant body which ultimately increased the plant height. Increase in growth parameters could be ascribed to the overall improvement in plant growth, vigour and production of sufficient photosynthates through increased leaf area index and chlorophyll content of leaves with s fertilization. It may be attributed to Sulphur's essential role for plant growth through its effect on biochemical functioning related to enzyme activation.

The better nutritional environment in plants under application of 60 kg S/ ha seems to have enhanced metabolic activities in plants resulting in higher meristematic activities leading towards increased division, enlargement and elongation of cells which might have helped in attaining higher plant height under its influence. Likewise, these improvement at cellular level might have enhanced root length and branches formation and later on their growth, consequently leads to attainment of higher leaf number by the crop. Higher Sulphur dose was responsible for increased number of leaves and branches causing higher photosynthesis and assimilates, metabolic activities which were responsible for overall improvement in vigour and many growth characters of mustard. Rao *et al.*, (2013) [6] also reported an increase in growth of mustard due to s application.

The increase in growth attributes with the application of vermicompost might be due to improved photosynthetically active leaf area for longer period during vegetative and reproductive phases, led to more absorption and utilization of radiant energy which ultimately resulted in higher dry matter accumulation and significant increase in plant growth. Thus, the higher values of growth parameters under vermicompost might be due to more availability of plant nutrient and growth promoting hormones (*viz*., Auxins, Cytokinins, and Gibberellins) which ultimately resulted in the higher values of the growth parameters. Growth characters like plant height, number of leaves per plant, number of branches per plant are very important parameters, which directly influence the seed yield. Influence of nutrient management on growth parameter was also reported by Sunil *et al*. (2018a).

Table 1: Effect of Sulphur levels and vermicompost on growth and yield of mustard

Treatment	Plant height (cm)	Number of leaves/plant	Number of branches/plant	Number of siliquae per plant	Length of Siliqua (cm)	Number of seeds per Siliqua	Test weight (g)	Seed yield (q/ha)	Stover yield (q/ha)
	Effect of Sulphur								
S_0	152.87	32.42	17.29	345.62	4.22	11.91	2.96	13.94	52.23
S_1	156.28	33.89	18.89	369.46	5.22	13.62	3.43	15.66	54.35
S_2	159.06	35.13	19.58	387.55	5.81	14.71	3.71	17.44	57.23
S_3	160.90	36.20	19.86	395.82	6.60	15.24	4.06	18.60	58.21
S.Em±	3.53	0.59	0.68	6.13	0.39	0.38	0.31	0.74	1.30
C. D.	10.35	1.73	1.99	17.97	1.15	1.12	0.90	2.17	3.81
	Effect of vermicompost								
V_1	151.50	32.18	17.20	339.02	4.01	11.37	2.78	12.97	50.48
V_2	157.51	34.43	19.17	374.57	5.59	14.00	3.67	16.74	55.55
V_3	162.82	36.62	20.34	410.25	6.78	16.25	4.18	19.53	60.48
S.Em±	4.08	0.68	0.78	7.07	0.45	0.44	0.35	0.85	1.50
C. D.	11.95	2.00	2.30	20.75	1.33	1.29	1.03	2.50	4.40
	Interaction effect between Sulphur and vermicompost								
S_0V_1	147.72	29.73	14.53	320.19	2.88	9.87	2.33	10.67	48.72
S_0V_2	151.82	32.47	17.93	338.65	3.71	11.60	2.68	13.56	50.49
S_0V_3	159.06	35.07	19.40	378.01	6.05	14.27	3.87	17.61	57.50
S_1V_1	149.70	31.13	17.27	329.45	3.17	11.33	2.36	11.42	49.78
S_1V_2	156.82	34.13	19.07	368.83	5.90	13.20	3.76	16.28	52.71
S_1V_3	162.32	36.40	20.33	410.11	6.58	16.33	4.18	19.28	60.56
S_2V_1	152.73	33.33	18.33	348.48	4.41	11.80	2.81	14.06	50.90
S_2V_2	160.02	35.47	19.67	391.08	6.23	15.40	4.04	18.17	58.97
S_2V_3	164.42	36.60	20.73	423.08	6.78	16.93	4.28	20.08	61.83
S_3V_1	155.86	34.53	18.67	357.96	5.58	12.47	3.61	15.72	52.53
S_3V_2	161.37	35.67	20.00	399.72	6.51	15.80	4.18	18.94	60.05
S_3V_3	165.47	38.40	20.90	429.79	7.72	17.47	4.39	21.14	62.04
S.Em±	2.04	0.34	0.39	3.54	0.23	0.22	0.18	0.43	0.75
C. D.	4.23	0.71	0.81	7.33	0.47	0.46	0.37	0.88	1.55

Yield attributes and yield

It is evident from the data that number of siliquae per plant, length of siliqua, number of seeds per siliqua, test weight, seed and Stover yield per hectare (Table-1) increased successively under different treatments. Among different level of Sulphur, 60 kg/ha (S_3) produced significantly maximum number of siliquae per plant, length of siliqua, number of seeds per siliqua, test weight, seed and Stover yield per hectare (395.82, 6.60 cm, 15.24, 4.06 g, 18.60 q/ha and 58.21 q/ha) than others. Application of vermicompost @ 4 t/ha exhibited significantly maximum number of siliquae per plant, length of siliqua, number of seeds per siliqua, test weight, seed and Stover yield per hectare (410.25, 6.78 cm, 16.25, 4.18 g, 19.53 q/ha and 60.48 q/ha). Interactions between different levels of Sulphur and date of sowing, application of Sulphur @ 60 kg/ha in combination with application of vermicompost @ 4 t/ha produced significantly maximum number of siliquae per plant, length of siliqua, number of seeds per siliqua, test weight, seed and Stover yield per hectare with the respective value of 429.79, 7.72 cm, 17.47, 4.39 g, 21.14 q/ha and 62.04 q/ha.

The increasing doses of Sulphur exhibited the increment in seed yield of mustard up to 60 kg S/ ha. Application of 60 kg S/ ha registered maximum seed yield and showed statistical superiority over others which exhibited significant differences in seed yield among themselves. Higher Sulphur dose was responsible for increased leaf area and chlorophyll content of leaves causing higher photosynthesis and assimilation, metabolic activities which were responsible for overall improvement in vigour and yield attributes and finally seed yield of mustard. The increase in seed yield might be attributed to number of leaves per plant, number of siliquae per plant and test weight of seeds.

The plant supplied with Sulphur are expected to have efficient photosynthetic mechanism and better equipped for efficient translocation site consequently resulting into improved seed yield. Sah *et al.* (2013) [7] reported that significant improvement in the number of siliquae per plant, test weight, seed yield and stover yield was recorded with sulfur fertilization as compared to control. Application of 60 kg S/ ha increased all these parameters significantly over others. Beneficial effect of application of Sulphur on yield attributes might be due to better availability of N, K and S and their translocation which is reflected in terms of increased yield attributes of the crop. The improvement in the yield attributes might be due to the fact that mustard is a short duration crop and being indeterminate in nature and the favourable effect of Sulphur in improving nutritional environment extended over a time period. Increase in these parameters might be also ascribed to overall improvement in plant growth and vigour and production of sufficient photosynthates through increased leaf area index and chlorophyll content of leaves with Sulphur fertilization that favoured both the seed formation and seed development which resulted into increase in test weight of mustard seed.

The increase in the yield attributes with the application of vermicompost ascribed to improved physical, chemical and biological properties of soil, direct addition of plant nutrients (macro and micro) and growth regulators and also due to increased microbial population of soil, which accelerated the process of humification, removal of obnoxious smell and detoxification of soil pollutants (Singh *et al.* 2021) [11]. The application of vermicompost to the mustard increased availability of major nutrients to plant due to enhanced early

root growth and cell multiplication leading to more absorption of other nutrients from deeper layers of soil ultimately resulting in increased plant growth attributes and finally increased crop growth rate.

The increased yield attributes and yield might be due the increased supply of the major nutrients (NPK) by translocation of the photosynthates accumulated under the influence of the sources of inorganic nutrients. Further, the translocation and accumulation of photosynthates in the economic sinks resulted in increased seed, straw and biological yields. Similar report has been recorded by Ashok *et al*. (2018) [2], Singh *et al*. (2018) [10], Kumar and Sood (2020) [4].

Conclusion

From the results, it was highlighted that under the agro-climatic condition of Gwalior (M.P.), the sowing of mustard variety with the application of Sulphur @ 60 kg/ha and sown with organic manure of vermicompost @ 4 t/ha found to be the best for growth and yield attributing characters as well as seed yield.

References

1. Anonymous. Annual report, ICAR-Directorate of Rapeseed-Mustard Research, ICAR, Bharatpur, Rajasthan, 2019.
2. Ashok Kumar, Alok Kumar, Pushpendra Kumar, Yogesh, LK, Yadav, Kumar Rajesh. Effect of Organic Management Practices on Growth, Yield Attributes and Grain Yield in Mustard (*Brassica juncea* (L.) Czern and Coss.). Int. J Curr. Microbiol. App. Sci. 2018;7(9):3585-3590.
3. Chattopaddhyay S, Ghosh GK. Response of rapeseed (*Brassica juncea* L.) to various sources and levels of Sulphur in red and lateritic soils of West Bengal, India. *International* Journal of Plant, Animal and Environmental Sciences. 2012;2(4):50-59.
4. Kumar Vipin, Sood Meenu. The performances of *Linumusitatissimum* on different organic manures and fertilizers under peach based horti medicinal system of agroforestry. International Journal of Chemical Studies. 2020;8(5):572-576.
5. Manna M, Hagra JN. Comparative performance of cow dung slurry. Microbial inoculum and inorganic fertilizer on maize. Journal of the Indian Society of Soil Science. 1996;44:526-528.
6. Rao KT, Rao AU, Sekhar D. Effect of sources and levels of Sulphur on groundnut. Journal of Academia and Industrial Research. 2013;2(5):268-270.
7. Sah D, Sewak R, Singh AK, Swami S. Growth, yield and profitability of Indian mustard (*Brassica juncea* (L.) Czern & Coss) with different weed control measures and Sulphur levels. Agricultural Science Digest. 2013;33(1):15-20.
8. Sarmah PC, Debnath MC. Response of toria (*Brassica compestris* sub sp. Oleifera var. toria) to sources and levels of sulphur fertilization. Indian Journal of Agronomy. 1999;44(3):617-620.
9. Sharma A, Sharma P, Brar MS, Dhillion NS. Comparative response to sulphur application in raya (*Brassica juncea*) and wheat (*Triticum aestivum*) grown on light textured alluvial soils. Journal of Indian Society of Soil Science. 2009;57(1):62-66.
10. Singh DP, Upadhyay PK, Srivastava AK. Effect of Phosphorus and Sulphur Level on Nitrogen Uptake by Mustard Crop at Successive Stages of Crop Growth (*Brassica juncea* L). International Journal of Agriculture Sciences. 2018;10(10):6128-6130.
11. Singh L, Sharma R, Singh N. Effect of Foliar Application of Sulphur and Integrated Nutrient Management on Yield, Quality and Economics of Bed Transplanted Canola (*Brassica napus* L.). Indian Journal of Agricultural Research. 2021;55(2):192-196.
12. USDA. United States Department of Agriculture-Rapeseed area, yield and production Table No.15, 2010. (http://www.fas.usda.gov/psdonline/psd report.Asps).