To Study the Effect of Sulphur and Zinc Level on Growth and Yield of Indian Mustard

Maina Kumari *, Dr. P.K. Sharma[1], Dr. Hoshiyar Singh[1], M.L. Meena, R. Suthar[2]
Department of Agriculture, Vivekananda Global University- Jaipur[1]
Department of Agronomy, Shri Karan Narendra Agriculture University- Jobner[2]

Abstract

A field experiment was conducted at Research Farm of Vivekananda Global University, Jaipur (Rajasthan) during *Rabi*, 2023-24 on loamy sand soil, which consisted of four levels of sulphur (0, 20, 40, 60 kg ha^{-1}) and four levels of zinc (0, 2.5, 5.0 and 7.5 kg ha^{-1}). The experiment laid out in factorial randomized block design (FRBD) and variety "BIO-902" was used in experiment.

The results of one year study clearly showed that combination of sulphur and zinc application brought an additive effect in increasing growth and yield parameters of mustard as compared to control. Maximum plant height, dry matter accumulation, number of silique $plant^{-1}$, number of seeds $silique^{-1}$, seed yield, stover yield and biological yield of mustard was significantly obtained due to application of sulphur 60 kg and zinc 7.5 kg ha^{-1} over rest of the treatments. The plant population, test weight and harvest index of mustard was remained unchanged under phosphorus and sulphur applications. Therefore, application of sulphur 60 kg and zinc 7.5 kg ha^{-1} were found most profitable as it gave highest seed yield. There were no found any significant interaction between sulphur and zinc.

Keywords: Indian mustard, Sulphur, Zinc, Sarson, Treatment.

Introduction

Rapeseed and mustard belong to family *Cruciferae,* which is grown in India comprising indigenous species namely Indian mustard (*Brassica juncea*), brown sarson (*Brassica compestris* var. brown Sarson), Yellow sarson (*Brassica compestris* var. yellow Sarson), Toria (*Brassica compestris* var .toria) and Taramira (*Eruca sativa*) along with nontraditional species like Gobhi sarson (*Brassica napus*), White mustard (*Brassica alba*) and Ethiopian mustard (*Brassica carinata*). It is the most important group of Rabi oilseed crop and contribute a major share to the vegetable fat economy of the country.

The oil content in mustard seeds varies from 37-49 percent (Bhowmik *et. al*., 2014), the seeds are highly nutritive containing 38-57 % eruric acid, and 27% oleic acid. The oil cake left after extraction is utilized as cattle feed and manure containing 5.1 % N, 1.8% P_2O_5 and 1.1 % K_2O. The seed is used as a condiment in the preparation of pickles and for flavouring curries and vegetables. The oil is utilized for human consumption throughout the northern India for cocking purpose. This is a potential crop in winter (*Rabi*) season due to its wider adaptability and suitability to exploit residual moisture (Mukherjee, 2010). Oil and fats comprise a vital component of human diet as these are good source of energy and act as carriers of fat soluble vitamins. Oil cake or meal has high nutritional values in animal diet. Seed sowing to its high content of good quality protein. In general 55g edible oil per day per head is essential for human diet.

Amongst the required essential nutrients sulphur (S), being crucial element for optimum growth and yield of oil crops (Ryan *et al*., 2001) throughout the world. Sulphur is considered to be the fourth important essential nutrient after nitrogen, phosphorus and potassium for the plant growth. Sulphur performs many physiological functions like synthesis of cysteine, methionine, chlorophyll and oil content of oil seed crops. It is also responsible for synthesis of certain vitamins (B, Biotin and Thiamine), metabolism of carbohydrates, proteins and oil formation of flavor compounds in crucifers. In recent years, sulphur deficiency has been aggravated in the soil due to continuous removal by crops and use of high analysis sulphur devoid coupled with intensive cropping with high yielding varieties and reduction in use of organic manure and sulphur containing fungicides and insecticides resulted in sulphur deficiency in soils. Zinc being one of the essential micro-nutrient, plays significant role in various enzymatic and physiological activities of the plant system. It is also essential for photosynthesis and N-metabolism. It is important for the stability of cytoplasmic ribosomes, cell division, dehydrogenase, proteinase and peptidase enzymes and also helps in the synthesis of protein and carotene. Lakshman *et al*. (2017).

Materials and methods

The field experiments were carried out during *Rabi* season (2023-24) to study the "To Study the Effect of Sulphur and Zinc Level on Growth, Yield and Quality of Indian Mustard" in factorial randomized block design (FRBD) with consisted of four levels of sulphur (0, 20, 40, 60 kg ha^{-1}) and four levels of zinc (0, 2.5, 5.0 and 7.5 kg ha^{-1}) at Research Farm, Vivekanada Global University- Jaipur, Rajasthan. The experimental farm is geographically located at 75° 51'44" E longitude, 26°48'35" N latitude and an altitude of 432 m above mean sea level (AMSL). The experimental fields were clay loam and the soil fertility status contained available nitrogen (137.8 kg ha^{-1}) by Subia and Asija 1996, available phosphorus (16.3 kg ha^{-1}) by Olsen *et al*. 1954 and available potassium (250.12 kg ha^{-1}) by Jackson, 1973. The organic carbon content was from 0.34-0.38 per cent. The weekly mean maximum and minimum temperatures were of temperature during both summers (40.6° C) and winters (2.7° C). The mean relative humidity fluctuated from 63.50 to 91 per cent during the crop season. The average rainfall is 557 mm per annum, which is mostly received during july to september. The sporadic showers during winters are also common, which are probably observed during this period. The experiments were laid out in factorial randomized block design (FRBD) with three replications. The observation were recorded at harvest was analysed by statistical methods (Fisher, R.A. 1950).

Result and Discussion

It is clear from the result of present study that, sulphur and zinc applications had significantly affected the growth and yield parameters of Indian mustard at harvest. Results clearly showed that the significantly higher growth attributes *viz*. plant height (146.3 cm), dry matter accumulation (326.17 g m^{-2}), number of branches plant^{-1} (8.28) at harvest was obtained due to application of sulphur @ 60 kg ha^{-1} over control which was remained statistically at par with sulphur @ 40 kg ha^{-1} , whereas; dose of zinc @ 7.5 kg ha^{-1} recorded higher plant height (143.09 cm), dry matter accumulation (324.32 g m^{-2}), number of branches plant^{-1} (8.05) at harvest superior to rest of the treatments, which was remained statistics at par with dose of zinc @ 5.0 kg ha^{-1} (Table-1). The increase in plant height due to adequate availability of zinc and sulphur attributed to better nutritional environment for plant growth at active vegetative stages as result of enhancement in root growth, energy providing, multiplication, cell elongation and cell expansion in the plant body which ultimately increased the height of plant. The results of present investigation are in agreement with the finding of Khanpara *et al.* (2020) and Kumar and Kumar (2021). Dry matter production successively increased till maturity due to favorable effect of zinc and sulphur on the growth and development of plants. Increase in number of branches plant^{-1} and plant height is directly responsible for increasing the dry matter accumulation in plants at higher levels of sulphur and zinc. Singh and Dhiman (2005), Potdar *et al.* 2019 and Sahoo *et al*. 2021 also reported the similar results. Further, yield attributes and yields like number of silique plant^{-1} (285.2), number of seeds silique^{-1} (13.20), seed yield (20.4 q ha^{-1}), stover yield (69.84 qha^{-1} kg ha^{-1}) and biological yield (90.24 q ha^{-1}) was significantly higher obtained due to application of sulphur @ 60 kg ha^{-1} which was remained statistically at par with 40 kg sulphur ha^{-1} and superior over rest of the treatments whereas; number of silique plant^{-1} (282.49), number of seeds silique^{-1} (13.10), seed yield (20.18 q ha^{-1}), stover yield (69.58 ha^{-1} q ha^{-1}) and biological yield (89.72 q ha^{-1}) significantly higher obtained with the application of zinc @ 7.5 kg ha^{-1} which was remained statistics at par with dose of zinc @ 5.0 kg ha^{-1} ond superior over rest of the treatments presented in table 2. However, test weight and harvest index (Singh and Stoskopt, 1971) was found non significant by sulphur and zinc application in Indian mustard. Yield components by enhancing cell division, cell elongation process and photosynthetic activity leading to production and accumulation of more carbohydrates and auxins which favours retention of more flowers ultimately leading to more number of reproductive parts plant^{-1}.

Table: 1 Effect of sulphur and phosphorus fertilizers on growth attributes of Indian mustard

ISSN: 2278-4632
Vol-14, Issue-9, September: 2024

Treatments	Plant height (cm)	Plant dry matter (g m^{-2})	Number of branches $plant^{-1}$
Levels of sulphur (kg ha^{-1})			
0	127.7	269.79	5.75
20	139.0	296.48	7.13
40	145.9	321.28	8.05
60	146.3	326.17	8.28
SEm±	3.89	7.76	0.14
CD (P=0.5%)	8.34	22.41	0.41
Levels of zinc (kg ha^{-1})			
0	122.2	271.75	5.98
2.5	136.3	297.62	7.25
5	140.3	320.03	7.94
7.5	143.9	324.32	8.05
SEm±	3.89	7.76	0.14
CD (P=0.5%)	8.34	22.41	0.41
CV (%)	7.28	6.47	6.91

Fig: 1 Effect of sulphur and phosphorus fertilizers on growth attributes of Indian mustard

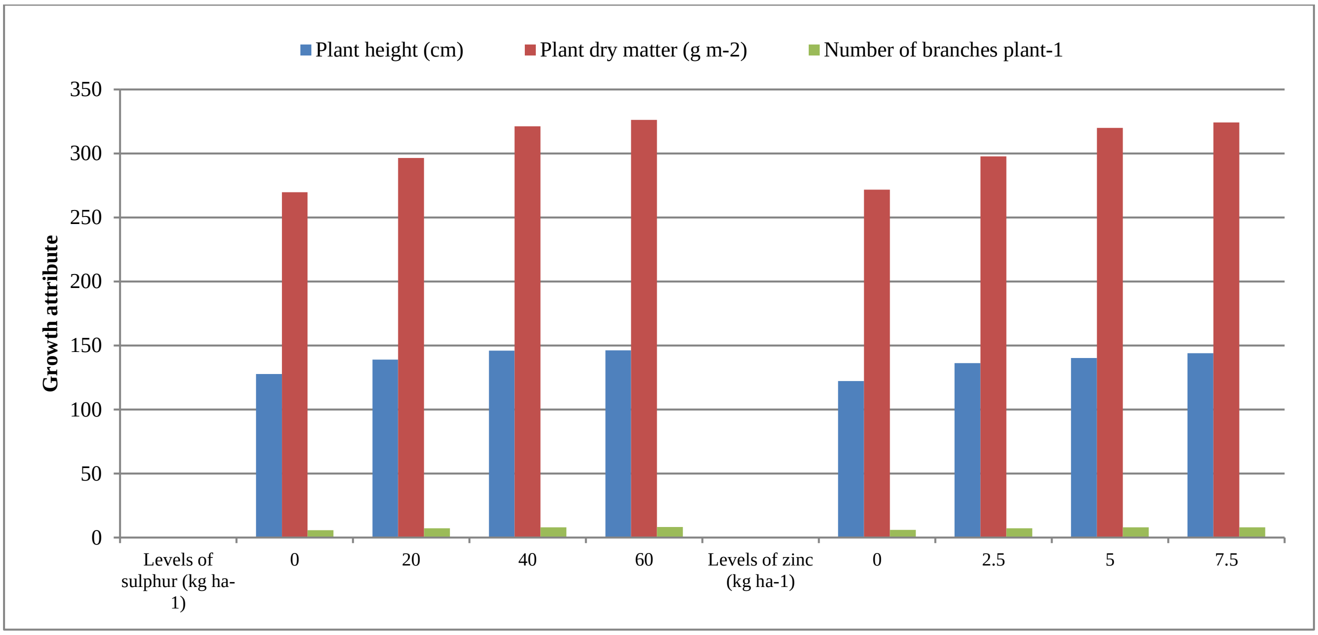
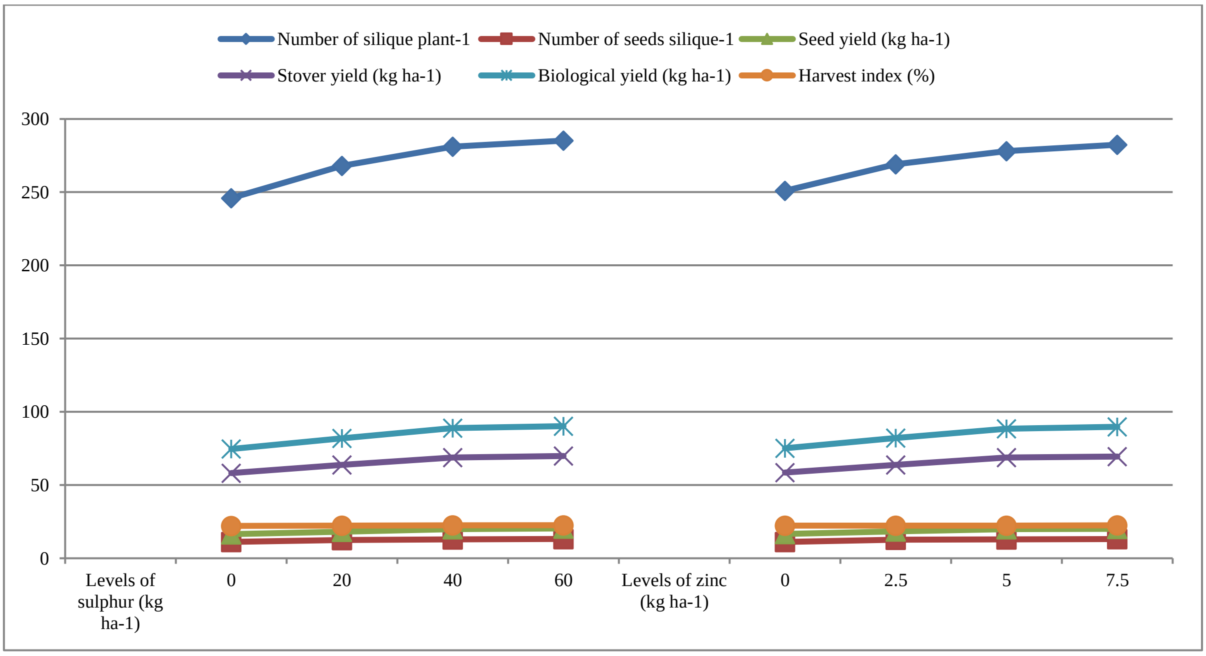


Table: 2 Effect of sulphur and phosphorus fertilizers on yield attributes and yields of Indian mustard

Treatments	Number of silique plant^{-1}	Number of seeds silique^{-1}	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest index (%)
Levels of sulphur (kg ha^{-1})						
0	246.0	11.20	16.5	58.19	74.64	22.10
20	268.0	12.40	18.2	63.76	81.96	22.22
40	281.2	13.00	19.9	68.91	88.81	22.42
60	285.2	13.20	20.4	69.84	90.24	22.60
SEm±	6.07	0.24	0.36	1.53	1.7	0.54
CD (P=0.5%)	17.82	0.71	1.06	4.45	4.92	NS
Levels of zinc (kg ha^{-1})						
0	251.00	11.25	16.7	58.48	75.18	22.20
2.5	269.00	12.60	18.3	63.9	82.2	22.29
5	278.00	12.85	19.8	68.74	88.54	22.35
7.5	282.49	13.10	20.18	69.58	89.72	22.50
SEm±	6.07	0.24	0.37	1.54	1.7	0.54
CD (P=0.5%)	17.82	0.71	1.06	4.45	4.92	NS
CV (%)	6.79	7.35	6.21	6.78	6.81	6.08

Fig: 2 Effect of sulphur and phosphorus fertilizers on yield attributes and yields of Indian mustard



Conclusion: -

Based on one-year experimentation it may be concluded that application of 40 kg sulphur and 7.5kg zinc ha^{-1} found suitable to produce good yield of Indian mustard. Maximum values of growth and yield parameters. These results are only indicative and require further experimentation for some more years to derive credible conclusion.

Acknowledgments:-

A feeling of sincere and heartfelt gratitude envelops me as I draft this acknowledgement. I acknowledge my esteemed Major Advisor, advisory committee, Head, Department of Agronomy, faculty members and non-teaching staff of Department of Agriculture, Vivekananda Global University, Jaipur for providing me the necessary help and suggestions during the course of the study.

References:-

Bhowmik, B., Mitra, B. and Bhadra, K. (2014). Diversity of insect pollinators and their effect on the crop yield of *Brassica juncia* L., NPJ-93, from Southern West Bengal. *International Journal of Recent Scientist Research*, 5(6): 1207-1213.

Fisher, R.A. 1950.Statistical methods for research workers. *Pub.Oliver and Boyd, Edinburgh, London.*

Gidago, G., S. Beyene and W. Worku. 2012. Re-sponse of haricot bean (*Phaseolus vulgaris* L.) to phosphorus application on Ultisols at Areka, Southern Ethiopia. *Journal of Biology, Agriculture and Healthcare*. **1**(3): 38-49.

Jackson, M.L. 1973. Soil chemical analysis, Prentice Hall of India Pvt. Ltd., New Delhi.

Khanpara, V.D., Porwal, B.L. and Patel, J.C. (2020). Effectof levels and modes of sulphur application on biochemical changes in mustard (*Brassica juncea*) leaves. *Indian Journal of Agronomy*, **38**(3): 410-413.

Kumar, A. and Kumar, S. (2021). Crop growth rate and developmental characteristics of Indian mustard *var*. Vardan to various levels of sulphur. *Indian Journal of Agricultural Research*, **42**(2): 112-115.

Lakshman, K., Vyas, A. K., Shivakumar, B.G., Rana, D. S., Layek, J. and Munda, S. (2017). Direct and residual effect of sulphur fertilization on growth, yield and quality of mustard in a soybean–Mustard cropping system. *International Journal of Current Microbiological and Applied Science*, **6**(5): 1500-1512.

Mukherjee, D. (2010). Productivity, profitability and apparent nutrient balance under different crop sequence in mid- hill condition. *Indian Journal of Agricultural Sciences*, **80**(5): 420-22.

Olsen, S.R., Cole, C.V., Wataonable, F.S. and Dean, L.A. 1954. Estimation of available phosphorus in soils by extraction with sodium carbonate. *Circular USDA*. 939.

Olsen, S.R., Cole, C.V., Watnable, F.S and Dean, L.A. 1954. Estimation of available phosphorus in soil by extraction with sodium bicarbonate *Circular* 939, USDA, Washington, DC, USA.

Potdar, D.S., Purohit, H.S., Meena, R.H., Kaushik, M.K., Jain, H.K. and Ameta. K.D. (2019). Effect of integrated phosphorus management on growth, yield and quality of mustard (*Brassica juncea* L.). *Journal of Pharmacognosy and Phytochemistry*, **8**(4): 1700-1704.

Ryan, J., Estefan, G. and Rashid, A. 2001. Soil and Plant Analysis Laboratory Manual. In: Jointly published by the International Centre Agricultural Research in Dry Areas (ICARDA), Aleppo, Syria and National Agriculture Research Centre (NARC), Islamabad.

Sahoo, R., Singh, V., Tiwari, D. & Scholar, M. (2021). Effect of phosphorus and sulphur levels on growth and yield of yellow mustard (*Brassica campestris* L.). 10. 1988-1991.

Singh, I.D. and Stoskopt, N.C. 1971. Harvest index of cereals. *Agronomy Journal*, **63** : 224-226.

Singh, R.B. and Dhiman, O.P. (2005). Effect of sulphur and zinc on Indian mustard (*Brassica juncea*). *Indian Journal of Agricultural Science*, **75**(14):826-829

ISSN: 2278-4632
Vol-14, Issue-9, September: 2024

Subbiah, B.V. and Asija, G.L. 1956. A rapid procedure for estimation of available nitrogen in soils. *Current Science* **25** : 259-260.