Effect of Sulphur and Zinc on Growth and Yield of Indian Mustard [*Brassica juncea* (L.)]."

Abstract

A field experiment was conducted at experimental farm, Department of Agronomy, Faculty of Agriculture and Veterinary Sciences, Mewar University Gangrar, Chittorgarh (Rajasthan) during Rabi season of 2023-24 to effect of ~~sulphur~~ Sulphur and ~~zinc~~ Zinc on growth and yield of mustard, variety "Bio-902" was used in this study. The required quantities of fertilizers as per treatments were applied. The experiment was laid out in factorial randomized block design with three replications. ~~The data recorded maximum~~ Maximum growth attributes like, plant height (146.30 and 143.90 cm), number of branches per plant (8.28 and 8.05) and dry matter accumulation (326.17 and 324.32 g/plant) and yield attributes such as number of seed per siliqua (285.20 and 282.49 g/plant), number of seed per siliqua (13.20 and 13.10 g/plant), seed yield (20.40 and 20.18 q/ha), stover yield (69.84 and 69.58 q/ha) and maximum net return (66449.75 and 66557.00 Rs/ha) was recorded with combined application of ~~60 kg/ha S~~sulphur @ 60 kg/ha and ~~7.5 kg/ha~~ Zn @ 7.5 kg/ha. Therefore, it ~~was~~ is concluded that application of ~~40 kg sulphur~~Sulphur @ 40 kg ha^{-1} -and ~~7.5kg zinc~~ Zinc @ 7.5kgha^{-1} found suitable to produce good yield of Indian mustard. Maximum values of growth parameters and ~~,~~ yield also recorded with application ~~60 sulphur~~ Sulphur @ 60 kg ha^{-1} and ~~7.5 zinc~~ Zinc @ 7.5 kg ha^{-1}.

Key words: - Sulphur; Zinc; Mustard; Yield; Profitability

1. Introduction

Rapeseed and mustard belong to family Cruciferae family, which is grown in northern India comprising traditionally grown indigenous species namely Indian mustard (*Brassica juncea*), It is the most important group of Rabi oilseed crop and contribute a major share to the vegetable fat. In India the area under mustard crop is 6.86 million ha producing about 9.12 million tonnes of seeds with an average productivity of 1331 kg ha^{-1} and Area under cultivation in Rajasthan was 3.08 million ha, having production of 4.20 million tones and productivity of 1366 kg ha^{-1} (Anonymous, 2021). The oil content in mustard seeds varies from 37-49 per cent (Bhowmik *et al*., 2014), the seeds are highly nutritive containing 38-57 per cent eruric acid, and 27 per cent oleic acid.

Oilseed crop (Indian mustard) is highly sensitive to sulphur (S), zinc (Zn), iron (Fe)

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and nitrogen (N) deficiency, thereby resulting in small leaves, chlorosis and dwarfing, leading to a decline in its productivity. Micronutrients hold a dominant and significant role in the growth and metabolic operations of oilseed crops. Zinc and Fe are important micronutrients required in trace amounts by humans, animals, and plants (Kobrai *et al.* (2011). Zinc being one of the essential micro-nutrients, 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 (Kumar *et al.* 2016).

Sulphur are most vital nutrients for growth and development oil seeds. Sulphur is considered to be the fourth important essential nutrient after nitrogen, phosphorus and potassium for the plant growth. In order to develop a sound fertilizer recommendation for better prediction of mustard yield as well as to achieve the above objectives, it is necessary to find out Sulphur and zinc requirements of mustard crop (Mohiuddin *et al.* 2011).

2. Materials and Methods

A field experiment was conducted during Rabi season of 2023-24 at experimental farm, Department of Agronomy, Faculty of Agriculture and Veterinary Sciences, Mewar University Gangrar, Chittorgarh (Rajasthan). Soil of the experimental field was sandy loam intexture, saline in reaction with a pH value of 7.6, poor in organic carbon (0.16%), deficient inavailable zinc (0.48 ppm) and iron (1.2 ppm) low in available nitrogen (176 kg/ha) and phosphorus (20.2 kg/ha) but medium in available potassium (320 kg/ha). The experiment waslaid out in factorial randomized block design with three replications ~~which~~ with treatment level-I, S_1- 0 kg/ha, S_2- 20, S_3- 40 and S_4- 60 kg/ha sulphur and level second Zn_1-0, Zn_2- 0.25, Zn_3- 5.0 and Zn_4- 7.5 kg/ha Zn. The required quantities of fertilizers as per treatments were applied. The doses of NPK were applied in the form of urea, diammonium phosphate, murate of potash respectively. The half dose of nitrogen gives basal dose and remain two split doses after irrigation and full dose of phosphorus and potassium at basal dose. The yield parameters were calculated from output from the field. The profitability and productivity of mung bean was calculated from cost of field preparation to harvesting and threshing cost and out pot from straw yield and grain yield as per market rate.

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3. Results and Discussion

3.1 Growth attributes

Data pertaining to plant height of mustard as affected by different levels of sulphur and zinc presented in Table 1.0. It is clear from the data that plant height increased as the dose of sulphur increased up to 60 @ kg ha^{-1} and Zn @ 7.5 kg/ha at all growth stages. Plant height of mustard was maximum with application of 60 kg sulphur ha^{-1} being at par with 40 kg sulphur ha^{-1} at 60 DAS and with 40 and 20 kg sulphur ha^{-1} at 90 DAS. The minimum value of plant height was observed with no sulphur application. Response regarding plant height was higher with 7.5 kg zinc ha^{-1} being at par with 5 kg and 2.5 kg zinc ha^{-1} and found significantly superior over control at 60 and 90 DAS. The results of present investigation are in agreement with the finding of Singh *et al*. (2012); Rajput *et al.* (2018). Number of branches plant^{-1} of mustard was maximum with application of 60 kg sulphur ha^{-1}. The magnitude changes the number of branches plant^{-1} in terms of percentage of 44.89 and 47.56 % at 60 DAS and 14.02 and 30.90 % at harvest, to 20 kg sulphur ha^{-1} and control respectively. Number of branches plant^{-1} due to application of 7.5 kg zinc ha^{-1} in the tuning of percentage *viz.* 25.71 and 10.00 % at 60 DAS and 34.07 and 36.71 % at 90 DAS over control. Dry matter accumulation was maximum with application of 60 kg sulphur ha^{-1} in mustard being at par with 40 kg sulphur ha^{-1} and found significantly superior 20 kg sulphur ha^{-1} and control at 60 and 90 DAS. The percentage increment in dry matter accumulation due to application of 60 kg sulphur ha^{-1} was 20.61 at 60 DAS, 10.89% at DAS by control. Response regarding of dry matter accumulation was higher with 7.5 kg zinc ha^{-1} being at par with 5 kg zinc ha^{-1} and found significantly superior 2.5 kg ha^{-1} and over control at 60 and 90 DAS. In respect to percentage dry matter accumulation changes with the application of 7.5 kg zinc ha^{-1} as 19.39% at 60 DAS and 19.34% at harvest over control. Dubey *et al.* (2013), Kobrai *et al.* (2011), Rabari *et al.* (2018), Rajput *et al.* (2018), Mathpal *et al*. (2023) also reported the similar results.

3.2 Yield attributes and yield

The by different levels of sulphur and zinc presented in table- 2.0 and graphically illustration in fig- 1.0. The highest number of siliquee plant^{-1} (285.2) was recorded with application of 60 kg sulphur ha^{-1} being at par with 40 kg sulphur ha^{-1} and 20 kg sulphur ha^{-1} and minimum value of number of siliquee plant^{-1} (246.0) was observed with no sulphur application. The maximum number of silique plant^{-1} (282.49) was observed with 7.5 kg zinc ha^{-1} being at par with 5 kg and 2.5 kg zinc ha^{-1} and found significantly superior over control. The number of seeds silique^{-1} of mustard was maximum with application of 60 kg sulphur ha^{-1} being at par with 40 kg sulphur ha^{-1} and found superior 20 kg sulphur ha^{-1}and over control. The maximum number of seeds silique^{-1} was observed with 7.5 kg zinc ha^{-1} being at par with 5 kg and 2.5 kg zinc ha^{-1} and found significantly superior over control. The result revealed that the seed yield increased

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as the doses of sulphur increased up to 60 kg sulphur ha^{-1}. The seed yield of mustard was maximum (20.40 q ha^{-1}) with application of 60 kg sulphur ha^{-1}. The minimum seed yield (16.50 q ha^{-1}) was noticed with control. The maximum yield (20.18 q ha^{-1}) obtained with the application of 7.5 kg zinc ha^{-1}. The data that stover yield increased as the dose of sulphur increased up to 60 kg sulphur ha^{-1}. The stover yield of mustard was maximum (69.84 q ha^{-1}) with application of 60 kg sulphur ha^{-1} being at par with 40 kg sulphur ha^{-1} and found significantly superior over 20 kg sulphur ha^{-1} and control. The Stover yield higher with 7.5 kg zinc ha^{-1} being at par with 5 kg zinc ha^{-1} and found significantly superior over 2.5 kg ha^{-1} and control.The number of siliquee plant^{-1}, number of seed siliquee^{-1}, test weight, seed yield, and stover yield and harvest index were increased with increasing rate of sulphur from control to45 kg sulphur ha^{-1} in mustard Debnath *et al.* (2014), Rabari *et al.* (2018). Jat *et al.* (2015), Gour *et al.* (2017), Ray *et al.* (2015), Bhagwat *et al.* (2018), Kumar *et al*. (2019) also reported the similar results.

3.3 Economics

The economics of mustard as influenced by different levels of sulphur and zinc presented in table- 3.0 and graphically illustration. The cost of cultivation was calculated for all the treatment combinations. The maximum cost of cultivation of `31063 ha^{-1} was noted with 60 kg sulphur ha^{-1} and 7.5 kg zinc ha^{-1}. The maximum gross return of 103492 ha^{-1} was also noted with 60 kg sulphur ha^{-1} and 7.5 kg zinc ha^{-1}. However, the maximum benefit cost ratio of 2.42 was recorded with treatment combination of 40 kg sulphur ha^{-1} and 7.5 kg zinc ha^{-1}. This is due to the increased net return in corresponding to the cost of cultivation under the treatment combination. The finding are in close conformity with findings of Verma *et al.* (2012), Dubey *et al.* (2013), Chaurasiya *et al*. (2019) and Komatineni, (2023).

Conclusion

The findings of present investigation revealed 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 parameters, yield also recorded with application 60 sulphur kg ha^{-1} and 7.5 zinc kg ha^{-1}. On the basis of economics, it may be concluded that application of 40 kg sulphur and 7.5 kg zinc ha^{-1} in mustard was found more remunerative which recorded the Benefit cost ratio of 2.31 and 2.32, respectively.

Table.1.0 Effect of sulphur and zinc levels on growth attributes of mustard.

Treatments	Plant height (cm)			Number of branches per plant			Dry matter accumulation/plant (g)		
	30 DAS	**60 DAS**	**90 DAS**	**30 DAS**	**60 DAS**	**90 DAS**	**30 DAS**	**60 DAS**	**90 DAS**
Levels of sulphur (kg ha^{-1})									
0	15.2	84.3	127.7	2.04	5.00	5.75	14.56	121.40	269.79
20	19.1	90.8	139.0	2.06	6.20	7.13	15.00	133.31	296.48
40	20.5	94.2	145.9	2.08	7.00	8.05	15.45	144.46	321.28
60	20.8	96.5	146.3	2.09	7.20	8.28	15.73	146.78	326.17
S. Em. ±	0.53	1.85	2.89	0.06	0.12	0.14	0.37	2.77	7.76
CD (P=0.5) %	NS	5.35	8.34	NS	0.36	0.41	NS	8.01	22.41
Levels of zinc (kg ha^{-1})									
0	16.8	84.9	122.2	2.04	5.20	5.98	14.73	122.29	271.75
2.5	19.6	88.1	136.3	2.06	6.30	7.25	14.91	133.70	297.62
5.0	20.7	90.9	140.3	2.08	6.90	7.94	15.27	144.01	320.03
7.5	20.8	91.0	143.9	2.09	7.00	8.05	15.83	145.94	324.32
S. Em. ±	0.53	1.85	2.89	0.06	0.12	0.14	0.37	2.77	7.76
CD (P=0.5) %	NS	5.35	8.34	NS	0.36	0.41	NS	8.01	22.41

Table 2.0 Effect of sulphur and zinc levels on yield attributes and yield of mustard

Treatments	Number of siliquae per plant	Number of seed per siliquae	Seed yield 9q/ha)	Stover yield (q/ha)
Levels of sulphur (kg ha^{-1})				
0	246.0	11.20	16.5	58.19
20	268.0	12.40	18.2	63.76
40	281.2	13.00	19.9	68.91
60	285.2	13.20	20.4	69.84
S. Em. ±	6.17	0.25	0.36	1.53
CD (P=0.5) %	17.82	0.71	1.06	4.45
Levels of zinc (kg ha^{-1})				
0	251.00	11.25	16.7	58.48
2.5	269.00	12.60	18.3	63.9
5.0	278.00	12.85	19.8	68.74
7.5	282.49	13.10	20.18	69.58
S. Em. ±	6.17	0.24	0.37	1.54
CD (P=0.5) %	17.82	0.71	1.06	4.45

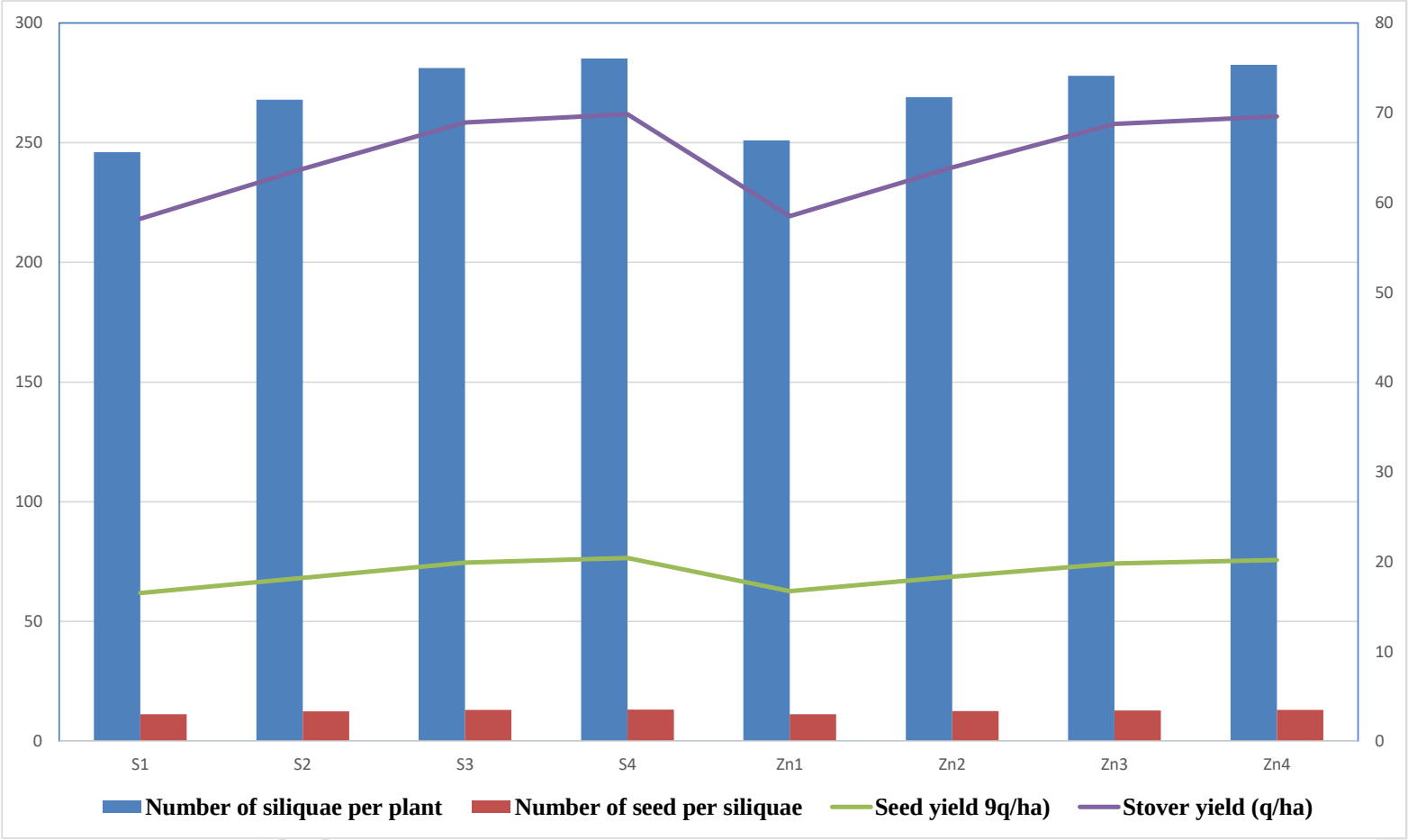

Figure 1.0 Effect of sulphur and zinc levels on yield attributes and yield of mustard

Table-3.0 Effect of sulphur and zinc levels on Economics of mustard

Treatments	Economics	
	Net returns (₹ ha^{-1})	B:C
Levels of sulphur (kg ha^{-1})		
0	53000.00	2.10
20	59409.00	2.21
40	65183.50	2.31
60	66449.75	2.32
Levels of zinc (kg ha^{-1})		
0	52908.5	2.02
2.5	59500.5	2.20
5.0	65076.25	2.31
7.5	66557.00	2.32

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