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Response of mothbean (*Vigna aconitifolia* L.) to different levels of zinc and iron in inceptisol under Northern dry zone of Karnataka

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Abstract
A field experiment was conducted during 2022-23 *Kharif* season at Regional Agricultural Research Station, Vijayapura to study the influence of zinc and iron on growth and yield of mothbean. The experiment was laid out in a split plot design with four levels of zinc in main plot (0, 2.5, 5 and 7.5 kg ha^{-1}) and four levels of iron in sub plot (0, 2.5, 5, 7.5 kg ha^{-1}) with one absolute control. Application of zinc sulphate alone @ 7.5 kg ha^{-1} and iron sulphate alone @ 7.5 kg ha^{-1} recorded maximum plant height, dry matter accumulation, number of pods per plant, pod length, test weight, grain and straw yield of mothbean. The combined application of zinc sulphate and iron sulphate each @ 7.5 kg ha^{-1} recorded no significant difference however, numerically higher values of growth parameters and yield parameters of mothbean was noted. All the growth and yield parameters increased with increase in zinc sulphate and iron sulphate levels.

Keywords: Growth, iron, mothbean, yield, zinc

Introduction

Moth bean, scientifically known as *Vigna aconitifolia* L., belongs to the legume genus *Vigna* and possesses remarkable adaptability to arid and semi-arid regions. Its ability to thrive across diverse eco-geographical zones as well as harsh climatic conditions, particularly in the Indian subcontinent, highlights its significant importance. This legume goes by several names, like mat bean, math, mattenbohne, matki, dew bean, Turkish gram, and haricot papillon. Moth bean takes center stage primarily for its protein-rich seeds, sprouts, and edible green pods, which serve as a valuable source of nutrition. Moth bean [*Vigna aconitifolia* (Jacq)], is believed to have originated in the regions of India, Pakistan, Myanmar, and Sri Lanka, according to De Candolle (1986) [2]. Moth bean's cultivation is particularly concentrated in arid and semi-arid regions, with a majority taking place in the North-Western states of India like Rajasthan, Maharashtra, Gujarat, Punjab, Haryana, Jammu and Kashmir, Madhya Pradesh, and Uttar Pradesh. Among these, Rajasthan stands out as the top contributor in terms of moth bean production. (Gupta *et al.*, 2016; Viswanatha *et al.*, 2016) [5, 16].

Micronutrient deficiency is a severe problem in soil and plants worldwide (Imtiaz *et al.*, 2010) [6]. Micronutrients like iron (Fe), zinc (Zn), boron (B), and molybdenum (Mo) exert the most significant influence on pulse crop production. Up until the 1980's, zinc deficiency was the primary micronutrient limitation affecting crop production. However, as high yielding crop varieties were developed, chemical fertilizers gained attention, and cultivation practices became more intensive and deficiencies in other micronutrients started to emerge vaguely. Among the cationic micronutrients, zinc (Zn) remains the most deficient, with approximately 49% of soils showing this deficiency. Following closely behind are iron (Fe), manganese (Mn), and copper (Cu), which are currently deficient in 12 per cent, 4 per cent, and 3 per cent of soils, respectively. Micronutrients are those vital elements required by plants in very minimal quantities, these play a pivotal role in overall plant development. Inadequate supplies of these nutrients can result in micronutrient deficiency, which is a severe problem in soil and plants worldwide. Consequently, gaining a thorough understanding of micronutrient deficiencies and exploring methods to rectify them becomes of paramount importance. Identifying deficiencies in soil is the first step, and rectifying the micronutrient balance is crucial. Various nutrient management practices come into play, aiding in the restoration of soil equilibrium and the enhancement of micronutrient levels. These practices pave the way for healthier plants and improved agricultural yields. The deficiency of Zn and Fe is most commonly observed in Northern Dry Zone of Karnataka. Keeping in view the important role of zinc and iron in crop production, current study was carried out with chelated application of Zn and Fe to overcome the micronutrient deficiencies in soil and help the increase in crop growth and yield.

Methodology

The field experiment was carried out at Regional Agricultural Research Station (RARS), Vijayapura during *kharif* 2022, under Northern Dry Zone of Karnataka (Zone 3), located at a latitude 16^0 49^1 North, longitude $75^0 43^1$ East and an altitude of 593.8 m above mean sea level (MSL). The experiment was carried out by adopting split plot design with four main plots which consisted different levels of zinc sulphate *viz.*, MP_1- 0 kg ha^{-1} $ZnSO_4$, MP_2- 2.5 kg ha^{-1} $ZnSO_4$, MP_3- 5 kg ha^{-1} $ZnSO_4$ and MP_4- 7.5 kg ha^{-1} $ZnSO_4$ and four sub plots which consisted of different levels of iron sulphate *viz.*, SP_1- 0 kg ha^{-1} $FeSO_4$, SP_2- 2.5 kg ha^{-1} $FeSO_4$, SP_3- 5 kg ha^{-1} $FeSO_4$ and SP_4- 7.5 kg ha^{-1} $FeSO_4$ replicated thrice and one absolute control. Zinc sulphate and iron sulphate were chelated with vermicompost in 1:1 ratio and applied 15 days before sowing. Seeds of KBMB-1 variety at a seed rate of 15 kg ha^{-1} was used. The observations related to growth and yield parameters were recorded at regular interval of time during the crop growth period and data were subjected to standard statistical analysis. The experimental site consisted of shallow *Inceptisol* having clay texture, with a pH of 8.31, low in available nitrogen (175 kg ha^{-1}), medium in available phosphorus (31.05 kg ha^{-1}), and high in potassium (362.0kg ha^{-1}). The soils were deficient in DTPA extractable micronutrients *viz.*, zinc (0.48 mg kg^{-1}) and iron (2.78 mg kg^{-1}). The analysis and interpretation of data were carried out using the Fischer's method of analysis of variance technique as described by Gomez and Gomez (1984) [4]. The level of significance used in 'F' test was P = 0.05. Critical difference values were calculated wherever the 'F' test was found significant. In case of non-significant effects, values of standard error of mean are presented in tables.

Results and discussion

Plant height

The results pertaining to plant height at harvest is presented in Table 1. It was evident from the results that plant height was significantly influenced by the application of zinc sulphate and iron sulphate. The application of zinc sulphate @ 7.5 kg ha^{-1} alone, recorded highest plant height of 46.81 cm. Similarly, application of iron sulphate @ 7.5 kg ha^{-1} alone recorded a plant height of 45.02 cm. The combined application of zinc sulphate and iron sulphate @ 7.5 kg ha^{-1} each did not show any significant differences, however numerically higher values of plant height were recorded with combined application of zinc sulphate and iron sulphate @ 7.5 kg ha^{-1}. This increase in plant height might be due to the key role of zinc in various metabolic activities, cellular growth, differentiation, chlorophyll synthesis and maintenance of chlorophyll structure and also the supremacy of chelated zinc sulphate in balanced supply of zinc to the crop, which might have contributed for the vigorous growth of plants and also helped in developing extensive root system leading to enhanced uptake of nutrients and thus increasing in plant height. Similar findings were also reported by Gidaganti *et al.* (2019) [3] who revealed that zinc and iron application @ 25 kg ha^{-1} and 20 kg ha^{-1} in green gram crop recorded higher plant height.

Dry matter accumulation (g $plant^{-1}$)

The data regarding dry matter accumulation at harvest is presented in Table 2. The application of zinc sulpahte and iron sulphate significantly influenced the dry matter accumulation in mothbean crop. Among the different zinc sulphate levels, application of zinc sulphate @ 7.5 kg ha^{-1} recorded higher dry matter accumulation of 19.33 g $plant^{-1}$. Similarly, among the different iron sulphate levels, application of iron sulphate @ 7.5 kg ha^{-1} recorded significantly higher dry matter accumulation of 18.79 g $plant^{-1}$. The interaction effect did not record any significant differences among the various interactions. This notable increase in dry matter accumulation with increase in dosage of zinc sulphate and iron sulphate may be attributed to the fact that these micronutrients promotes plant growth and its influence on stimulating enzyme activity, metabolism which in turn increase in protein synthesis and starch accumulation in the beginning of crop growth period. Higher dry matter accumulation was recorded due to higher rate of photosynthesis owing to stable chlorophyll structure as influenced by iron. Similar trend of results was also noticed by Singh *et al.* (2016) [13].

Table 1: Influence of different levels of zinc sulphate and iron sulphate on growth and yield attributes of mothbean

Treatments	Plant height (cm)	Dry matter accumulation (g $plant^{-1}$)	Number of pods per plant	Pod length (cm)	Test weight 1000 seeds (g)
Zinc sulphate levels (M)					
$ZnSO_4$ @ 0 kg ha^{-1} (MP_1)	32.13	16.49	18.99	6.22	18.61
$ZnSO_4$ @ 2.5 kg ha^{-1} (MP_2)	39.72	17.43	21.77	6.52	19.84
$ZnSO_4$ @ 5 kg ha^{-1} (MP_3)	42.64	18.29	22.86	6.82	20.12
$ZnSO_4$ @ 7.5 kg ha^{-1} (MP_4)	46.81	19.33	24.01	7.30	21.42
S. Em.±	1.15	0.54	0.62	0.17	0.42
C.D (0.05)	3.99	1.87	2.15	0.57	1.47
Iron sulphate levels (S)					
$FeSO_4$ @ 0 kg ha^{-1} (SP_1)	34.88	16.87	20.02	6.28	18.95
$FeSO_4$ @ 2.5 kg ha^{-1} (SP_2)	38.68	17.49	21.58	6.56	19.52
$FeSO_4$ @ 5 kg ha^{-1} (SP_3)	42.72	18.37	22.65	6.82	20.42
$FeSO_4$ @ 7.5 kg ha^{-1} (SP_4)	45.02	18.79	23.39	7.20	21.10
S. Em.±	1.10	0.42	0.48	0.15	0.54
C.D (0.05)	3.22	1.23	1.39	0.43	1.57
Interactions (M×S)					

MP_1SP_1	30.08	16.29	18.54	6.20	18.13
MP_1SP_2	31.13	16.37	18.66	6.21	18.27
MP_1SP_3	32.77	16.60	18.97	6.22	19.00
MP_1SP_4	34.53	16.69	19.82	6.24	19.03
MP_2SP_1	35.30	16.70	20.19	6.26	19.03
MP_2SP_2	39.29	17.27	21.95	6.47	19.46
MP_2SP_3	41.00	17.67	22.27	6.59	19.85
MP_2SP_4	43.28	18.08	22.66	6.77	21.02
MP_3SP_1	36.00	17.20	20.32	6.33	19.20
MP_3SP_2	40.14	17.28	22.17	6.50	19.41
MP_3SP_3	46.27	19.10	24.18	7.10	20.42
MP_3SP_4	48.15	19.58	24.77	7.34	21.44
MP_4SP_1	38.14	17.30	21.03	6.34	19.43
MP_4SP_2	44.15	19.07	23.55	7.06	20.92
MP_4SP_3	50.82	20.11	25.17	7.36	22.41
MP_4SP_4	54.13	20.82	26.30	8.45	22.91
S. Em.±	2.21	0.84	0.95	0.29	1.08
C.D (0.05)	NS	NS	NS	NS	NS
Absolute control	22.4	13.4	15.7	5.2	17.0
S. Em.±	2.18	0.88	0.99	0.33	1.01
C.D (0.05)	6.29	2.54	2.85	0.96	2.90

Yield parameters

The various yield parameters of mothbean as influenced by different levels of zinc sulphate and iron sulphate alone and their combinations are presented in Table 2. The yield parameters such as number of pods per plant, pod length and test weight (1000 seeds) showed significant difference with the application of different levels of zinc sulphate and iron sulphate alone. The application of zinc sulphate @ 7.5 kg ha^{-1} recorded higher number of pods per plant (24.01), greater pod length (7.30 cm), and test weight (21.42 g). Similarly, iron sulphate application @ 7.5 kg ha^{-1} alone recorded significantly higher number of pods per plant (23.39), pod length (7.20 cm) and test weight (21.10 g). The interaction effect was found to be non-significant. This marked advancement in yield contributing parameters might be due to enhanced growth parameters *viz.*, plant height and dry matter accumulation as zinc has a major role in auxin production as well as a component of carbonic anhydrase and several dehydrogenase enzymes and also due to the application of iron sulphate in chelated form which has enhanced the plant development through proper balanced nutrition and also improving the availability of both macro and micronutrients throughout the growth period, especially during the reproductive phase which might have contributed in increasing the yield stimulating parameters.. Boradkar *et al*., 2023 [1] reported that the enhanced performance of various yield attributes, including pod quantity, seeds per pod, pod length, and 1000 seed test weight, can be attributed to the increased transport of photosynthetic products from the source to developing seeds. This improved transport is a direct outcome of micronutrient application, which may also explain the augmented seed weight. Similar research findings were recorded by Misal (2018) [10], Gidaganti *et al.* (2019) [3], Kuldeep *et al.* (2018) [8] and Vinodkumar *et al.* (2020) [15] in greengram.

Grain and Straw yield

The application of different levels of zinc sulphate and iron sulphate significantly influenced the the grain and straw yield of mothbean. Significantly higher grain yield of 721 kg ha^{-1} and straw yield of 2119 kg ha^{-1} was recorded with application of zinc sulphate @ 7.5 kg ha^{-1} alone. Among the different iron sulphate levels, application of iron sulphate @ 7.5 kg ha^{-1} recorded significantly higher grain yield of 696 kg ha^{-1} and straw yield of 2063 kg ha^{-1}. However, among the different combinations of zinc sulphate and iron sulphate, grain and straw yield was found to be non-significant. The increase in the grain and staw yield of mothbean crop is due to application of optimum dose of zinc sulphate and iron sulphate after chelation with vermicompost. Also the proper channelization of photosynthates during the reproductive stage of crop might have been influenced by zinc, since it is involved in electron transport system. Zinc application induced better root growth and increased sink pool (pod numbers plant^{-1}) and ultimately achieved higher seed yield in chickpea (Krishna and George, 2017) [7]. The enhanced iron accessibility to the plant could have potentially activated several enzymatic and metabolic processes, consequently enhancing the crop's yield. Similar findings were also reported by Trivedi *et al.* (2011) [14].

Table 2: Influence of different levels of zinc sulphate and iron sulphate on grain and straw yield of mothbean

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
Zinc sulphate levels (M)		
$ZnSO_4$ @ 0 kg ha^{-1} (MP_1)	571	1764
$ZnSO_4$ @ 2.5 kg ha^{-1} (MP_2)	651	1963
$ZnSO_4$ @ 5 kg ha^{-1} (MP_3)	684	2030
$ZnSO_4$ @ 7.5 kg ha^{-1} (MP_4)	721	2119
S. Em.±	15.57	48.61
C.D (0.05)	53.87	168.22
Iron sulphate levels (S)		
$FeSO_4$ @ 0 kg ha^{-1} (SP_1)	602	1840
$FeSO_4$ @ 2.5 kg ha^{-1} (SP_2)	648	1947

$FeSO_4$ @ 5 kg ha^{-1} (SP_3)	682	2026
$FeSO_4$ @ 7.5 kg ha^{-1} (SP_4)	696	2063
S. Em.±	15.72	38.61
C.D (0.05)	45.89	112.70
Interactions (M×S)		
MP_1SP_1	562	1737
MP_1SP_2	565	1749
MP_1SP_3	575	1776
MP_1SP_4	583	1792
MP_2SP_1	594	1822
MP_2SP_2	654	1972
MP_2SP_3	670	2004
MP_2SP_4	687	2053
MP_3SP_1	616	1869
MP_3SP_2	661	1985
MP_3SP_3	721	2104
MP_3SP_4	741	2163
MP_4SP_1	637	1930
MP_4SP_2	711	2083
MP_4SP_3	763	2220
MP_4SP_4	774	2243
S. Em.±	31.44	77.22
C.D (0.05)	NS	NS
Absolute control	320	1390
S. Em.±	30.57	94.34
C.D (0.05)	88.06	271.76

Conclusion

- All the growth and yield parameters increased with increase in zinc sulphate and iron sulphate levels. The application of zinc sulphate @ 7.5 kg ha^{-1} alone and iron sulphate @ 7.5 kg ha^{-1} alone resulted in increased growth parameters and enhanced the yield parameters.
- Zinc and iron play vital roles in a plant's ability to resist stress such as disease, drought, and temperature fluctuations. Applying these micronutrients can help make the mothbean crop more resilient to adverse growing conditions.

References

1. Boradkar SG, Adsul PB, Shelke MS, Khule YR. Effect of iron and zinc application on soil properties, nutrient uptake and yield of green gram (*Vigna radiata* L.) in *Inceptisol*. The Pharma Innovation Journal. 2023;12(3):1663-1669.
2. De Candolle A. Origin of Cultivated Plants. Edn 2, Reprinted by Hafner Publication Company, New York, 1986, 259-369.
3. Gidaganti A, Tarence T, Smriti R, David AA. Effect of different levels of micronutrients on crop growth and yield parameters of green gram (*Vigna radiata* L.). International Journal of Chemical Studies. 2019;7(3):866-869.
4. Gomez KA, Gomez AA. Statistical Procedure for Agricultural Research. Ed 2, A Willey International Science publication, New York, United States of America; c1984. p. 657.
5. Gupta N, Shrivastava N, Singh PK, Bhagyawant SS. Phytochemical evaluation of moth bean (*Vigna aconitifolia* L.) seeds and their divergence. Biochemistry Research International. 2016;8(3):128-133.
6. Imtiaz M, Rashid A, Khan P, Memon MY, Aslam M. The role of micronutrients in crop production and human health. Pakistan Journal of Botany. 2010;42(4):2565-2578.
7. Krishna KSSR, George PJ. Effect of levels of phosphorus and zinc on growth and yield of Kabuli chickpea (*Cicer kabulium* L.). Journal of Pharmacognosy and Phytochemistry. 2017;6(4):1013-1016.
8. Kuldeep, Kumawat PD, Bhadu V, Sumeriya HK Kumar V. Effect of iron and zinc nutrition on growth attributes and yield of chickpea (*Cicer arietinum* L.). International Journal of Current Microbiology and Applied Sciences. 2018;7(8):2837-2841.
9. Kumawat, Khangarot. Response of sulphur, phosphorus and rhizobium inoculation on growth and yield of cluster bean (*Cymopsis tetragonoloba* L.) Annals of Biology. 2001;17(2): 189-191.
10. Misal BD. Response of macro and micro nutrient priming on growth, yield and quality of green gram (*Vigna radiata* L.). (Master's Thesis). Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India; c2018
11. Patel MM, Patel IC, Patel PH, Patel AG, Acharya S, Tikka SBS. Impact of foliar nutrition of zinc and iron on the productivity of cowpea (*Vigna unguiculata* L.) under rainfed condition. Journal of Arid Legumes. 2009;6(1):49-51.
12. Rajendar G, Kumar HS, Mehera B. Effect of bio-fertilizer and zinc levels on growth and yield of green gram (*Vigna radiata* L.). The Pharma Innovation Journal. 2022;11(3):1483-1485.
13. Singh O, Kumar S, Dwivedi A, Dhyani BP, Naresh RK. Effect of sulphur and iron fertilization on performance and production potential of urdbean (*Vigna Mungo* L.) and nutrients removal under *Inceptisols*. Legume Research: An International Journal. 2016;39(6):946-954.
14. Trivedi AK, Hemantaranjan A, Pandey SK. Iron application may improve growth and yield of soybean. Indian Journal of Plant Physiology. 2011;16(3-4):309-313.
15. Vinodkumar HV, Channakeshava S, Basavaraja B, Ananatha Kumar. Effect of soil and foliar application of

zinc on growth and yield of greengram (*Vigna radiata* L.). International Journal of Current Microbiology and Applied Sciences. 2020;9(4):501-512.

16. Viswanatha KP, Kumar D, Sharma R, Durgesh K. Improvement of minor pulses and their role in alleviating malnutrition. Indian Journal of Genetics and Plant Breeding. 2016;76(04):593-607.