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SK Solanke
M.Sc. (Agronomy) Student, Department of Agronomy, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

DP Pacharne
Associate Professor, Department of Agronomy, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

RM Gethe
Associate Professor, Department of Agronomy, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

PS Bodake
Head, Department, Department of Agronomy, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

YG Ban
Millet Breeder (Assistant professor of Agricultural Botany), AICRP on Small Millets, ZARS, Kolhapur, Maharashtra, India

Corresponding Author:
SK Solanke
Department of Agronomy, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

Response of micronutrient on growth and yield of finger millet (*Eleusine coracana* L. Gaertn.)

SK Solanke, DP Pacharne, RM Gethe, PS Bodake and YG Ban

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Abstract
A field investigation entitled "Effect of micronutrient on growth**,** yield and quality in finger millet (*Eleusine coracana* L. Gaertn)" was conducted in *kharif* season of 2024 at Instructional Farm, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahilyanagar (M.S.). The experiment was laid out in randomized block design (RBD) with ten treatments along withthree replications. The treatments consists of T_1: Absolute Control; T_2: RDF (60:30:30 N, P_2O_5, K_2O kg ha^{-1}); T_3: GRDF (60:30:30 N, P_2O_5, K_2O kg ha^{-1}+FYM @ 5 t ha^{-1}); T_4: GRDF + Soil application of $ZnSO_4$ @ 20 kg ha^{-1}; T_5: GRDF + Soil application of $FeSO_4$ @ 25 kg ha^{-1}; T_6: GRDF + Soil application of Borax @ 5 kg ha^{-1}; T_7: GRDF + Soil application of Multi-Micronutrient Grade I @ 25 kg ha^{-1}; T_8: GRDF + Two Foliar Spray of 0.5% Boric acid at 30 and 45 DAS; T_9: GRDF + Two Foliar Spray of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS; T_{10}: GRDF + Two Foliar Spray of Chelated Zn @ 0.1% + Chelated Fe @ 0.1% at 30 and 45 DAS with three replications. The results indicated that treatment T_7 i.e. GRDF + soil application of Multi-micronutrient Grade I @ 25 kg ha^{-1}exhibited significantly higher growth and yield attributes *viz*., plant height (115.75 cm), number of functional leaves $plant^{-1}$ (45.33), leaf area $plant^{-1}$ (11.45 dm^2), and dry matter $plant^{-1}$ (55.68 g) and number of fingers $earhead^{-1}$than rest of all treatments, but it was at par with treatment T_9 i.e. GRDF + two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS and treatment T_5 i.e. GRDF + soil application of $FeSO_4$ @ 25 kg ha^{-1}. Similarly, Significant effect of growth and yield attributes resulted higher grain (2457 kg ha^{-1}), straw (3930 kg ha^{-1}) and biological yield (6387 kg ha^{-1}) in treatment T_7 i.e. GRDF + soil application of Multi-micronutrient Grade I @ 25 kg ha^{-1} but it was at par with treatment T_9 i.e. GRDF + two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS and treatment T_5 i.e. GRDF + soil application of $FeSO_4$ @ 25 kg ha^{-1}on basis one season experiment, it could be concluded that, application of GRDF (FYM 5 t ha^{-1}+ 60:30:30 N: P_2O_5: K_2O kg ha^{-1}) + soil application of Multi-micronutrient Grade I @ 25 kg ha^{-1}or GRDF (FYM 5 t ha^{-1}+ 60:30:30 N: P_2O_5: K_2O kg ha^{-1}) + two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS to finger millet crop found beneficial for increase in growth and yield.

Keywords: Micronutrient, soil application, foliar sprays, finger millet

Introduction
Mungbean [*Vigna radiata* (L.) R. Wilczek] is a legume crop rich in proteins, amino acids, minerals, dietary fibers, sugars and vitamins. It serves as a vital dietary component for the people in arid and semi-arid regions. The high protein content along with digestibility improves the nutritional intake of vegetarian communities and supports food security. Globally mungbean is grown in 7.3 million hectares with average production of about 721 kg/ha. It plays major role in crop rotation systems due to its commercial value as well as its ability to enrich soil fertility through nitrogen fixation resulting in higher yield of subsequent crops, thus enhancing overall agricultural productivity. Being a short duration crop and its ability to withstand moisture stress, mungbean is a better option in cropping systems, owing to increasing the productivity both as an intercrop and fodder crop. Mungbean is cultivated both as a pulse and vegetable crop.
Despite its commercial value and cultivation, the crop suffers from various biotic and abiotic stresses. Among the biotic stresses, Dry root rot disease caused by *Macrophomina phaseolina* (Tassi.) Goid is becoming an emerging disease in Asia Finger millet (*Eleusine coracana* L. Gaertn) is an important millet crop originally native to the Ethiopian highlands and was introduced to India about 4000 years ago (Dida and Devos 2006) [3]. India is the largest producer

of various kinds of millets. Out of the total minor millets produced, finger millet (*Eleusine coracana* L. Gaertn) (ragi) accounts for about 85 percent of production in India. Finger millet is grown in India, Srilanka, Nepal, parts of Africa, Madagaskar, Malaysia, Uganda and Japan. In India, finger millet is cultivated over an area of 1.04 million hectares with a production of 1.39 million tonne giving an average productivity of 1661 kg ha^{-1} (Anonymous, 2023-2024) [1]. In Maharashtra, it is cultivated over an area 72338 ha, with production 81042 tonnes productivity and average productivity 1120 kg ha^{-1} (Anonymous, 2024) [2].

Finger millet is rich source of essential micro nutrients and minerals. Like iron (3.9 mg), calcium (344 mg), magnesium (287 mg), zinc (2.7 mg) 100 gm^{-1} of millets which are vital for bone health, red blood cell production and muscle functions (Davis *et al.*, 2021) [4] (Shahi *et al.*, 2022) [7]. They contain various vitamins, including B vitamins such as niacin (1.2 mg), riboflavin (0.29 mg) and thiamine (0.33 mg) and dietary fiber (3.6 g) which play critical roles in metabolism and overall health (Johnson and Smith, 2019). Research conducted by (Smith and Brown, 2018) [18] found that low glycemic index which are beneficial for stablilize blood sugar levels in individuals with diabetes. Also contain a variety of antioxidants and phytochemicals that contribute to their health benefits. These compounds, such as phenolic acids (150 mg) and flavonoids (25 mg), tannis (12 mg), quercetin (3.5 mg) and catechins (2 mg) have been shown to possess strong antioxidant properties, helping to combat oxidative stress and reduce the risk of chronic diseases (Robinson *et al.*, 2017) [6]. According to a research project by the Indian Institute of Soil Science, there were deficiencies in India's soils of roughly 48.1 per cent Zn, 11.2 per cent Fe, 7 per cent Cu and 5.1 per cent Mn (Kumar *et al.*, 2018). The soil must be supplemented with micronutrients both through foliage and soil treatment in order to address micronutrient shortages and enhance the soil's micronutrient status. No any specific research of soil and foliar application of micronutrients in finger millet is available to the farmers. For these purpose despite growing interest in millet, the research gaps in understanding of micronutrient requirement, their combination with GRDF and application for which foliar micronutrient grade is useful for production of millets.

Materials and Methods

The experiment consisted of ten treatments *viz.*, T_1: Absolute Control; T_2: RDF (60:30:30 N, P_2O_5, K_2O kg ha^{-1}); T_3: GRDF (60:30:30 N, P_2O_5, K_2O kg ha^{-1}+FYM @ 5 t ha^{-1})); T_4: GRDF + Soil application of $ZnSO_4$ @ 20 kg ha^{-1}; T_5: GRDF + Soil application of $FeSO_4$ @ 25 kg ha^{-1}; T_6: GRDF + Soil application of Borax @ 5 kg ha^{-1}; T_7: GRDF + Soil application of Multi-Micronutrient Grade I @ 25 kg ha^{-1}; T_8: GRDF + Two Foliar Spray of 0.5% Boric acid at 30 and 45 DAS; T_9: GRDF + Two Foliar Spray of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS; T_{10}: GRDF + Two Foliar Spray of Chelated Zn @ 0.1% + Chelated Fe @ 0.1% at 30 and 45 DAS. General Recommended Dose of Fertilizer (GRDF) is common to all except T_1 and T_2. Soil application of micronutrient given at the time of sowing with the basal dose. Foliar spray given at vegetative stage (30 DAS) and flowering stage (45 DAS). The soil texture of the experimental site was found to be clayey in mixture. The chemical composition according to criteria laid out by Muhr *et al.* (1965) The soil texture of experimental field was clay, low in available nitrogen (180.67 kg ha^{-1}), medium in available phosphorus (18.87 kg ha^{-1}) and very high in available potassium (378.51 kg ha^{-1}). The soil in the experimental field was moderately alkaline (pH 8.18) with 0.53 per cent organic carbon, soil electrical conductivity was 0.32 dSm^{-1}. The soil available micronutrients were Fe (4.15 mg kg^{-1}), Mn (3.52 mg kg^{-1}), Cu (0.42 mg kg^{-1}) Zn (0.44 mg kg^{-1}) and B (0.38 mg kg^{-1}). The experiment was laid out in randomized block design (RBD) with three replications. The Phule Kasari variety seeds were line sown at spacing of 30 cm x 10 cm. Periodical observations on the growth character, yield contributing characters, grain yield and straw yield were recorded during investigation.

Results and Discussion

Growth parameters

The growth and yield attributes of finger millet crop i.e. plant height, number of productive tillers plant $^{-1}$, number of functional leaves plant $^{-1}$, leaf area plant $^{-1}$, dry matter accumulation plant $^{-1}$ and with application of GRDF + soil application of Multi-micronutrient Grade I @ 25 kg ha^{-1}(T_7)exhibited significantly higher plant height (115.75 cm), number of leaves $plant^{-1}$ (45.33), leaf area $plant^{-1}$ (11.45 dm^2) and dry matter accumulation $plant^{-1}$ (55.68 g), number of fingers $earhead^{-1}$(8.10)than rest of all treatments but it was at par with the application of GRDF + Two foliar sprays of Phule Liquid Micro Grade- II @ 1% at 30 and 45 DAS(T_9) and GRDF + Soil application of $FeSO_4$ @ 25 kg ha^{-1} (T_5). Similarly, it also recorded maximum thousand seed weight (3.11 g)as compared rest of all treatments. The GRDF was beneficial to provide major nutrients, with all these combinations of major and micronutrients are beneficial for growth of finger millet. Iron plays important role in metabolism of chlorophyll while zinc is involved in carbohydrate metabolism, protein synthesis as well as boron regulate sugar transport through cell membrane, growth and development of cell *etc.* Copper and manganese are essential for energy transfer, photosynthesis activities and protoplast development. The results are in conformity with Chowdary and Patra (2019) [13], Maharana and Singh (2021) [12], Rathnakar *et al.* (2022) [15], Senthamil*et al.* (2021) [16], Krishna and Dawson (2022) [14].

Table 1: Growth and yield attributes of finger millet as influenced by different micronutrient treatments at harvest.

Tr. No.	Treatment	Plant height (cm)	Dry matter $plant^{-1}$ (g)	No. of functional leaves	Leaf area planT1 (dm^2)	Number of fingers $earhead^{-1}$	1000 seed weight (g)
T_1	Absolute control	78.27	38.62	30.40	7.12	5.27	2.77
T_2	RDF(60:30:30 N:P_2O_5:K_2Okgha^{-1})	87.57	41.70	36.33	7.94	6.43	2.82
T_3	GRDF(5 ton FYM+60:30:30 N:P_2O_5:K_2O kg ha^{-1})	92.56	42.90	38.51	8.13	6.47	2.84
T_4	GRDF + Soil application of $ZnSO_4$ @ 20 kg ha^{-1}	103.39	49.93	40.44	9.65	7.51	2.94
T_5	GRDF + Soil application of $FeSO_4$ @ 25 kg ha^{-1}	109.82	51.89	41.60	10.84	7.67	3.06
T_6	GRDF + Soil application of Borax @ 5 kg ha^{-1}	94.00	43.96	38.65	8.76	6.61	2.86
T_7	GRDF + Soil application of Multi-Micronutrient Grade-I @ 25 kg ha^{-1}	115.75	55.68	45.33	11.45	8.10	3.11
T_8	GRDF + Two foliar sprays of 0.5% Boric acid at 30 and 45 DAS	95.75	49.49	39.43	8.40	6.65	2.88
T_9	GRDF + Two foliar sprays of Phule Liquid Micro Grade- II @ 1% at 30 and 45 DAS	110.81	52.75	42.41	10.88	7.91	3.08
T_{10}	GRDF + Two foliar sprays of Chelated Zn @ 0.1% + Chelated Fe @ 0.1% 30 and 45 DAS	100.41	49.71	39.64	8.83	7.39	2.91
	S.E. m ±	3.60	1.41	1.36	0.45	0.24	0.11
	C.D. at 5%	10.71	4.18	4.07	1.34	0.43	NS
	General mean	98.83	51.49	39.27	9.20	7.00	2.92

Note
1. Soil application at the time of sowing as basal dose;
2. Two foliar sprays given at tillering and flowering stage;
3. GRDF is common to all treatments except $T_1$and T_2

Yield parameters and yield
Among different micronutrient sources and different methods of application to finger millet crop recorded significant differences. The GRDF + Soil application of Multi-Micronutrient Grade I @ 25 kg ha^{-1}(T_7) registered significantly higher grain, straw and biological yield (2457, 3930 and 6387 kg ha^{-1}) than rest of all treatments but it was at par with the application of application of GRDF + Two foliar sprays of Phule Liquid Micro Grade- II @ 1% at 30 and 45 DAS(T_9) and GRDF + Soil application of $FeSO_4$ @ 25 kg ha^{-1} (T_5). Similarly, higher yield and yield parameters are resulted into significantly higher harvest index of the treatment T_7 (GRDF + Soil application of Multi-Micronutrient Grade I @ 25 kg ha^{-1}) is 38.46%. The highest grain yield, straw yield, biological yield, harvest index is obtained due to the availability of applied GRDF along with soil application of Multi- Micronutrient Grade I @ 25 kg ha^{-1}which is beneficial for availability of macro and micro essential nutrients and their absorption in higher amount. The efficient utilization of zinc helped in the synthesis of IAA and uptake of water. Boron boosts the salt absorption, hormone movement and carbohydrate metabolism and vegetative growth of plants, which are ultimately resulted into higher straw yield. The same findings were also reported by Prashanta *et al.* (2019) [19] and Vijayakumar *et al.* (2020) [17].

Table 2: Seed yield of finger millet as influenced by different treatments.

Tr. No.	Treatment	Yield studies			
		Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest Index (%)
T_1	Absolute control	1140	2585	3725	30.56
T_2	RDF (60:30:30N:P2O5:K_2O kgha^{-1})	1568	3374	4942	31.70
T_3	GRDF(FYM@5tons+60:30:30N:P_2O_5:K_2O kgha^{-1})	1806	3474	5280	34.16
T_4	GRDF+ Soil application of $ZnSO_4$ @ 20 kg ha^{-1}	2107	3669	5776	36.48
T_5	GRDF + Soil application of $FeSO_4$ @ 25 kg ha^{-1}	2267	3756	6023	37.59
T_6	GRDF+ Soil application of Borax @ 5 kg ha^{-1}	1844	3505	5350	34.41
T_7	GRDF+ Soil application of Multi-Micronutrient Grade-I @ 25 kg ha^{-1}	2457	3930	6387	38.46
T_8	GRDF + Two foliar sprays of 0.5% Boric acid at 30 and 45 DAS	1996	3571	5568	35.85
T_9	GRDF + Two foliar sprays of Phule Liquid Micro Grade- II @ 1% at 30 and 45 DAS	2337	3807	6145	37.99
T_{10}	GRDF + Two foliar sprays of Chelated Zn @ 0.1% + Chelated Fe @ 0.1% 30 and 45 DAS	2084	3596	5681	36.64
	S.E. m ±	92.01	42.03	83.11	1.22
	C.D. at 5%	274.03	125.08	250.33	3.64
	General mean	1960	3527	5487	35.38

Conclusion
Among different micronutrient sources and different methods of application, the application of GRDF (5 ton FYM + 60:30:30 N: P_2O_5: K_2O kg ha^{-1}) + Soil application of Multi-Micronutrient Grade I @ 25 kg ha^{-1} exhibited significantly higher growth and yield of finger millets. Secondly for foliar sprays, application GRDF (5 ton FYM + 60:30:30 N: P_2O_5: K_2O kg ha^{-1})+ Two foliar sprays of Phule Liquid Micro Grade II @ 1% at 30 and 45 DAS is beneficial for higher grain yield of finger millet.

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References
1. Anonymous. IndiStat statistical database; 2023-2024. http://www.indiastat.com
2. Anonymous. Directorate of Millets Development. Government of India; 2024.
3. Dida MM, Devos KM. Finger millet originated and was domesticated in Africa: evidence for ancestry of millet provided by cytological, morphological and molecular data. In: Cereals and millets. 2006. p. 333-343.
4. Davis SL, Kumar A, Patel R, Zhang Y. Mineral content of millets and their nutritional implications. Journal of Agricultural Science. 2021;28(3):189-205.
5. Nayak CB, Parlikar AS, Naik CV. An experimental study on effect of pharmaceutical industrial wastewater on compressive strength of concrete. International Journal of Innovative Research in Science, Engineering and Technology. 2021;10(8):11068-11072.
6. Robinson ML, Smith JA, Kumar R, Lee T. Antioxidant compounds in millets: An overview. Food Chemistry. 2017;12(5):178-190.
7. Shahi S, Singh SK, Jamali MC. The importance of bioinformatics in the field of biomedical science. International Journal of Bioinformatics. 2022;1(1).
8. Smith AB, Brown EF. Millets and their role in diabetes management. Journal of Nutritional Research. 2018;15(2):101-115.
9. Smith AB, Johnson CD. Constraints in millet production and distribution: A review. Agricultural Economics Journal. 2017;14(3):189-201.
10. Green H, Okoro T, Mensah A, Diallo S. Millet cultivation in Africa: A comprehensive analysis. African Agriculture Journal. 2019;25(3):112-128.
11. Kumar GP, Lalitha BS, Murthy KK, Bhavya V. Foliar nutrition: A novel technology to increase growth and yield in baby corn (*Zea mays* L.). International Journal of Current Microbiology and Applied Sciences. 2018;7(4):1136-1148.
12. Maharana S, Singh S. Effect of iron and zinc on growth and yield of pearl millet (*Pennisetum glaucum* L.). The Pharma Innovation Journal. 2021;10(10):546-550.
13. Chowdary KA, Patra BC. Effect of micronutrient application with different sources of NPK on growth and yield of finger millet crop in red laterite zone. Journal of

Agricultural Science and Technology. 2019:413-416.
14. Krishna CH, Dawson J. Effect of zinc levels and plant geometry on growth and yield of kharif finger millet (*Eleusine coracana* L.). International Journal of Plant and Soil Science. 2022;34(16):21-26.
15. Rathnakar P, Mohan N, Aparna B, Ramya P. Effect of zinc fortification on growth and yield of finger millet (*Eleusine coracana* L.). International Journal of Plant and Soil Science. 2022;34(20):71-75.
16. Senthamil E, Kalaiyarasan C, Suseendran K, Muruganandam C, Jawahar S. Effect of VAM, sulphur and boron on growth and yield of ragi (*Eleusine coracana* L. Gaertn.). International Journal of Botany Studies. 2021;6(4):398-401.
17. Vijayakumar M, Sivakumar R, Tamilselvan N. Effect of zinc and iron application on yield attributes, available nutrient status and nutrient uptake of finger millet under rainfed condition. International Journal of Current Microbiology and Applied Sciences. 2020;9(5):3237-3246.
18. Prashantha GM, Prakash SS, Umesha S, Chikkaramappa T, Subbarayappa CT, Ramamurthy V. Direct and residual effect of zinc and boron on yield and yield attributes of finger millet-groundnut cropping system. International Journal of Environmental Science and Technology. 2019;8(1):2477-2451.