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Effect of Organic and Inorganic Nutrient Sources on the Availability of Micronutrients in Inceptisols of Agra Region

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Abstract

A field experiment was conducted at the Agricultural Research Farm, R.B.S. College, Bichpuri, Agra, during the rabi seasons of 2023–24 and 2024–25 to evaluate the effect of integrated application of organic and inorganic nutrient sources on the availability of micronutrients (Zn, Mn, Fe, and Cu) in soil. The experiment was laid out in a randomized block design with eleven treatments and three replications: T_1 (control), T_2 (100% NPK), T_3 (75% NPK), T_4 (50% NPK), T_5 (50% NPK + 20 kg $ZnSO_4$ ha^{-1}, T_6 (50% NPK + 5 t FYM ha^{-1} + 20 kg $ZnSO_4$ ha^{-1}, T_7 (75% NPK + 20 kg $ZnSO_4$ ha^{-1}, and T_8 (75% NPK + 5 t FYM ha^{-1}+ 20 kg $ZnSO_4$ ha^{-1}. Combined data of two years revealed that treatment T^ (75% NPK + 5 t FYM ha^{-1} + 20 kg $ZnSO_4$ ha^{-1} was significantly superior and recorded the highest available Zn (0.71 mg kg^{-1}, Mn (16.5 mg kg^{-1}, Fe (11.46 mg kg^{-1}, and Cu (1.65 mg kg^{-1} in soil. Compared to the control, T^ increased available Zn, Mn, Fe, and Cu by 36.5%, 42.2%, 50.0%, and 33.1%, respectively. The results highlight the beneficial role of integrated nutrient management in enhancing micronutrient availability in calcareous Inceptisols.

Keywords: Integrated nutrient management, Zinc, Manganese, Iron, Copper, FYM, Inceptisols

Introduction

Continuous use of only chemical fertilizers often leads to deterioration of soil health and micronutrient deficiencies, particularly in calcareous soils of semi-arid regions. Integrated use of organic manures (FYM, vermicompost, poultry manure, etc.) along with inorganic fertilizers not only reduces environmental pollution but also sustains soil fertility by improving physical, chemical, and biological properties. Farmyard manure (FYM) is a valuable source of both macro- and micronutrients and helps maintain soil productivity for a longer period compared to sole inorganic fertilizers. The organic matter in FYM enhances chelation of micronutrients, thereby increasing their availability in soil. The present investigation was therefore undertaken to study the effect of combined application of inorganic fertilizers and FYM on the status of available Zn, Mn, Fe, and Cu in Inceptisols of the Agra region.

Materials and Methods

The field experiment was conducted during the kharif seasons of 2023–24 and 2024–25 at the Agricultural Research Farm, R.B.S. College, Bichpuri, Agra (Uttar Pradesh), India. The experimental soil was sandy loam (Typic Ustochrept) with initial available Zn, Mn, Fe and Cu of 0.82, 9.86, 8.75 and 064 mg kg^{-1}, respectively. The experiment was laid out in a randomized block design with three replications and eight treatments viz. T_1 (control), T_2 (100% NPK), T_3 (75% NPK), T_4 (50% NPK), T_5 (50% NPK + 20 kg

$ZnSO_4$ ha^{-1}, T_6 (50% NPK + 5 t FYM ha^{-1} + 20 kg $ZnSO_4$ ha^{-1}, T_7 (75% NPK + 20 kg $ZnSO_4$ ha^{-1}, and T_8 (75% NPK + 5 t FYM ha^{-1} + 20 kg $ZnSO_4$ ha^{-1}. Combined data of two years revealed that treatment T_8 (75% NPK + 5 t FYM ha^{-1} + 20 kg $ZnSO_4$ ha^{-1}. Nitrogen, phosphorus, potassium and zinc were applied through urea, diammonium phosphate, muriate of potash and zinc sulphate ($ZnSO_4$) accordance with treatments at the time of sowing respectively.

Soil Sampling and Analysis

Soil Sampling and Analysis Post-harvest soil samples (0–20 cm depth) were collected in March 2025 from each plot, air-dried, ground, and passed through a 2-mm sieve. Available micronutrients (Zn, Mn, Fe, and Cu) were extracted using DTPA extractant (Lindsay and Norvell, 1978) and determined by atomic absorption spectrophotometer (AAS).

Results and discussion

Available Zinc (Zn)

Application of integrated nutrient management practices significantly influenced available Zn in soil (Table 1). The highest available Zn (0.71 mg kg^{-1} was recorded with T_8 (75% NPK + 5 t FYM ha^{-1} + 20 kg $ZnSO_4$ ha^{-1}, which was significantly superior to all other treatments. It was followed by T_2 (0.66 mg kg^{-1} and T_6 (0.64 mg kg^{-1}. Compared to control (0.52 mg kg^{-1}, the increase in available Zn ranged from 5.8% (T_4) to 36.5% (T_8). The higher Zn availability under combined application of FYM and $ZnSO_4$ may be attributed to the chelating effect of organic matter, which reduces Zn fixation in calcareous soils. These findings are in close agreement with Singh and Chauhan (2020), Munna et al. (2020), and Sharma et al. (2022, 2024).

Available Manganese (Mn)

All treatments significantly increased available Mn over control (11.6 mg kg^{-1}. Treatment T_8 recorded the highest value (16.5 mg kg^{-1}, representing a 42.2% increase over control. The beneficial effect of FYM on Mn availability is due to the reduction of Mn oxides to more soluble Mn^{++} forms under the influence of organic acids released during decomposition. The results corroborate the findings of Pandey et al. (2020) and Sharma et al. (2022, 2024).

Available Iron (Fe)

The highest available Fe (11.46 mg kg^{-1} was observed in T_8, which was 50.0% higher than control (7.64 mg kg^{-1}. Organic matter forms stable complexes with Fe, preventing its precipitation as insoluble oxides/hydroxides in high-pH soils. Similar positive effects of integrated nutrient management on Fe availability have been reported by Sharma et al. (2022, 2024).

Table 1: Effect of organic and inorganic nutrient sources on available Zn, Mn, Fe, and Cu (mg kg^{-1}) in soil after harvest of crop (pooled data of 2023–24 and 2024–25)

Treatments	Zn (mg kg^{-1})	Mn (mg kg^{-1})	Fe (mg kg^{-1})	Cu (mg kg^{-1})
T1	0.52	11.6	7.64	1.24
T2	0.66	15.4	10.66	1.60
T3	0.61	13.5	8.86	1.46
T4	0.55	12.5	8.03	1.31
T5	0.58	13.1	8.43	1.38
T6	0.64	14.8	10.17	1.55
T7	0.62	14.1	9.49	1.51
T8	0.71	16.5	11.46	1.65
SEm±	0.039	1.11	1.02	0.055
CD @ 5%	0.084	2.37	2.19	0.117

Available Copper (Cu)

Treatment T_8 registered the maximum available Cu (1.65 mg kg^{-1}, which was 33.1% higher than control. Organic matter enhances Cu solubility by forming organo-metallic complexes. These results are consistent with Sharma et al. (2022, 2024).

Conclusion

Integrated application of 75% recommended NPK along with 5 t FYM ha^{-1} and 20 kg $ZnSO_4$ ha^{-1} (T_8) proved most effective in enhancing the availability of Zn, Mn, Fe, and Cu in calcareous Inceptisols. This practice can be recommended for sustainable crop production and preventing micronutrient deficiencies in the Agra region.

References

Lindsay, W.L. and Norvell, W.A. (1978). Development of a DTPA soil test for zinc, iron manganese and copper. *Soil Science Society of American Journal*, 42: 421–428.

Lal, Munna; Sharma, K.L.; Indoria, A.K.; Sammi Reddy, K.; Ravindra Charry, G.; Srinivas, K.; Prabhakar, M.; Parmar, Brajendra; Suma Chandrika, D.; Vasavi, M.; Haindavi, P. and Gayatri, D.L.A. (2020). Long-term effects of soil management practices on soil Zn chemical fractions and their availability to grain sorghum (*Sorghum vulgare* (L.)) grown in a yearly rotation with castor (*Ricinus communis*) in rainfed red Alfisol soils, Communications in Soil Science and Plant Analysis,51:2, 276-287, DOI: 10.1080/00103624.2019.1705326

Pandey, Manoj; Kumar, Surjeet and Singh, U.N. (2020). Effect of integrated nutrient management on productivity of oat (Avena sativa L.) and soil fertility Annals of Plant and Soil Research 22(2): 151- 155

Sharma, K.L.; Lal, Munna; Indoria, A.K.; Ch. Chandra Sekhar, Singh, Vinod Kumar; Sammi Reddy, K.; Srinivas, K.; Asewar, B.V.; Narkhede, W.N.; Gore, A.K. Gaikwad, G.K.; Hanwate, G.R. and Pendke, M.S. (2024). Influence of Integrated Nutrient Management (INM) Practices on Soil Quality Indicators and Indices Under Cotton (Gossypium Spp.) + Black Gram (Vigna Mungo (L.) Hepper) and Green Gram (Vigna Radiata (L.) R. Wilczek) + Rabi Sorghum (Sorghum Bicolor (L.) Moench) Inter Cropping Systems in Rainfed Vertisols of Western India, Communications in Soil Science and Plant Analysis, 55:9, 1258-1273, DOI: 10.1080/00103624.2024.2303124

Sharma, K.L.; Lal, Munna; Ravindra Chary, G.; Sammi Reddy, K.; Indoria, A.K.; Srinivas, K.; Singh, Vinod Kumar; Ch. Chandra Sekhar, Singh, A.P.; Abrol, Vikas; Sharma, Anil; Dadhich, Hemant; Gopinath, K.A. and Lakshmi Aruna Gayatri, D. (2022). Long Term Effects of Conjunctive Nutrient Management Practices on Soil Quality in Maize (*Zea* m*ays*) – Mustard (*Brassica campestris* var. *sarson*) Rotation under Rainfed Hill Inceptisol Soils, Communications in Soil Science and Plant Analysis, 53:4, 439-452, DOI: 10.1080/00103624.2021.2017448

Singh U.N. and Chauhan, T.M. (2020). Soil zinc status and response of barley (Hordeum vulgare) to zinc application in alluvial soil Annals of Plant and Soil Research 22(3): 281- 284.