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Impact of micro nutrients on growth attributes of transplanted rice (*Oryza sativa* L.)

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Abstract

A research was done to ascertain its impact of various nutrient treatments in rice crop at Crop Research farm, Maharishi Markandeshwar (deemed to be university) Mullana, Ambala, Haryana during *kharif* 2022 on sandy loam soil, low levels of accessible nitrogen and organic carbon, phosphorous, zinc as well as iron likewise, medium to high in available potassium and marginally alkaline in reaction. The experiment was conducted in Randomized block design comprising 10 treatments (T_1: Control, T_2: 100% NPK, T_3: 100% NPK + 25 kg $ZnSO_4$, T4: 100% NPK + 25 kg $FeSO_4$, T_5: 100% NPK + 25 kg $ZnSO_4$ + 25 kg $FeSO_4$, T_6: 100% NPK + 12.5 kg $ZnSO_4$ + 12.5 kg $FeSO_4$ + VAM (5 kg mixed in 50 kg FYM and broadcasted), T_7: 100% NPK + Zn EDTA + Fe EDTA, T_8: 100% NPK + 0.5% $ZnSO_4$ at Tillering and panicle initiation, T_9: 100% NPK + 0.5% $FeSO_4$ at Tillering and panicle initiation and T_{10}: 100% NPK + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at Tillering and panicle initiation. From this investigation it was observed that maximum plant growth and its attributes *viz.* Plant height, No. of tillers, Dry matter accumulation and Leaf area index was observed under T_{10}: 100% NPK + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at Tillering and panicle initiation.

Keywords: Rice, Zn, Fe, VAM, NPK

Introduction

India's diverse climate, soils, vegetation, and fauna present both opportunities and obstacles for the growth of agriculture. India's population is projected to reach 1.53 billion by the year 2030, with a population growth rate of 1.58%, surpassing China as the world's most populous country by 2030, despite China having held the title for many years. (Pratiyogita and Darpan, 2012) [3]. The majority of Indian soils have low levels of readily Medium quantities of K but readily available nitrogen and phosphorus (Jena *et al.*, 2008) [8]. In order to increase productivity and profitability, it is crucial to apply nutrients in paddy-wheat cropping systems based upon specific to the location soil tests, comprised of micronutrients as well as main nutrients (Mauriya *et al.*, 2013) [10]. Soil productivity has declined, and it is now necessary to replace chemical fertilizers with organic fertilizers in order to keep soil fertile and productivity (Behera *et al.*, 2007) [2]. Integrated nutrient management (INM) is a viable choice because it makes use of available both natural and chemical substances nutrients to create an ecologically sound and economically sustainable farming system. Inorganic sources of plant nutrients provide one or more essential plant nutrients which the soil cannot supply in ample quantities, depleting the soils of secondary and micro-nutrients. In rice production, micronutrients that play an important role Zn, Mn, Fe, B, Cu, and Mo all play essential roles in yield improvement. Micronutrients account for a significant amount because they are required for plant growth and yield. Their significance grows as a result of Their influence in soil productivity and plant nutrition. Farmers tend to use excessive chemical fertilizers to get more and more yield, but the decision on use of fertilizers demands understanding of the predicted crop production response to fertilizer application, which depends on the crop's nutrient needs, the soil's ability to naturally provide nutrients as an indigenous source, and the short- and long-term fate of the fertilizers used.

Soil productivity is maintained through the careful blending of organics, bio-fertilizers, and chemical fertilizers. The urgent requirement of the hour is to find a solution to the aforementioned issue. These many difficulties must be addressed. In addition to enhancing soil composition, water retention potential, and other physico-chemical characteristics, organic manures stimulate soil biological activities.

With the combination of organic and mineral fertilisation, Micronutrients including Zn, Cu, Fe, and Mn, as well as OM-bound portions of micronutrients, should become more widely available, according to recommendations (Herencia *et al.*, 2008) [6].

Materials and Methods

The research was conducted at Agriculture Research Farm, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana, India. The soil in the experimental plot had a sandy loam texture. Each plot of the experimental field had soil samples obtained from a depth of 0 to 15 cm prior to transplantation. The experimental soil index contained low amounts of organic carbon, accessible nitrogen, phosphorus, Sulphur, zinc, boron, copper, and iron, as well as medium to high levels of available potassium. Three replications of the Randomized Block Design were used to test the treatments. Therefore, each treatment was carried out in the appropriate plots. Ten treatments comprising T_1: Control, T_2: 100% NPK, T_3: 100% NPK + 25 kg $ZnSO_4$, T4: 100% NPK + 25 kg $FeSO_4$, T_5: 100% NPK + 25 kg $ZnSO_4$ + 25 kg $FeSO_4$, T_6: 100% NPK + 12.5 kg $ZnSO_4$ + 12.5 kg $FeSO_4$ + VAM(5 kg mixed in 50 kg FYM and broadcasted), T_7: 100% NPK + Zn EDTA + Fe EDTA, T_8: 100% NPK + 0.5% $ZnSO_4$ at Tillering and panicle initiation, T_9: 100% NPK + 0.5% $FeSO_4$ at Tillering and panicle initiation and T_{10}: 100% NPK + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at Tillering and panicle initiation. Row to plant spacing was kept at (20 × 10 cm). For each treatment, the appropriate amounts of N, P, K, Zn, and Fe were added using urea, diammonium phosphate, muriate of potash, zinc sulphate, ZnEDTA, iron sulphate, FeEDTA, and VAM, respectively. Half dose of nitrogen and full dose of phosphorus, potassium, $ZnSO_4$, ZnEDTA, $FeSO_4$, FeEDTA and VAM (5 kg mixed in 50 kg FYM and broadcasted) were applied as a base dose and the remaining nitrogen was evenly divided into two applications at the Tillering and panicle initiation stages of the soil (according to treatments).According to the treatments, ZnSO4 and FeSO4 were applied to the leaves at the Tillering and panicle initiation stages.

Results

Growth studies

Plant height

The plant height at 30, 60, 90 DAT and at Harvest has been found maximum in T_{10}: 100% NPK + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at Tillering and panicle initiation was significantly higher than the control treatment. Similarly, findings have been reported by (Sharma, 2014) [12], (Manzoor, 2006) [9] and (Diwakar, 2014) [4].

Table 1: impact of various nutrients treatments on plant height (cm) at different stages of rice

Symbol	Treatments	Plant height (cm)			
		30 DAT	60 DAT	90 DAT	At harvest
T_1	Control	45.4	68.7	78.2	80.3
T_2	100% NPK	46.5	87.2	94.4	96.5
T_3	100% NPK + 25 kg $ZnSO_4$	49.0	93.6	99.3	103.0
T_4	100% NPK + 25 kg $FeSO_4$	47.9	91.4	96.6	99.6
T_5	100% NPK + 25 kg $ZnSO_4$ + 25 kg $FeSO_4$	50.0	95.4	104.6	107.7
T_6	100% NPK + 12.5 kg $ZnSO_4$ + 12.5 kg $FeSO_4$ + VAM	48.6	93.0	98.5	102.4
T_7	100% NPK + Zn EDTA + Fe EDTA	49.3	94.3	101.6	105.0
T_8	100% NPK + 0.5% $ZnSO_4$ at Tillering and panicle initiation	49.5	94.7	102.8	106.0
T_9	100% NPK + 0.5% $FeSO_4$ at Tillering and panicle initiation	48.2	92.0	97.2	100.3
T_{10}	100% NPK + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at Tillering and panicle initiation	49.3	96.6	106.2	109.4
SEm ±		1.2	2.6	2.9	3.1
CD at 5%		3.5	7.7	8.6	9.2

Tillers

The control plot had the fewest tillers among the various nutrient treatments at 30, 60, 90, and harvest, respectively. At 30, 60 90 DAT and at Harvest, 100% NPK + 0.5% ZnSO4 + 0.5% FeSO4 panicle initiation and Tillering had the highest number of tillers which was significantly greater than 100% NPK and the control treatment.

Table 2: Effect of different nutrients treatments on number of tillers (m^{-2}) at different stages of rice

Symbol	Treatments	Number of tillers (m^{-2})			
		30 DAT	60 DAT	90 DAT	At harvest
T_1	Control	115	230	217	192
T_2	100% NPK	132	286	274	247
T_3	100% NPK + 25 kg $ZnSO_4$	141	316	301	278
T_4	100% NPK + 25 kg $FeSO_4$	136	289	280	253
T_5	100% NPK + 25 kg $ZnSO_4$ + 25 kg $FeSO_4$	146	352	340	312
T_6	100% NPK + 12.5 kg $ZnSO_4$ + 12.5 kg $FeSO_4$ + VAM	140	310	297	273
T_7	100% NPK + Zn EDTA + Fe EDTA	144	324	304	280
T_8	100% NPK + 0.5% $ZnSO_4$ at Tillering and panicle initiation	145	342	331	310
T_9	100% NPK + 0.5% $FeSO_4$ at Tillering and panicle initiation	138	307	292	270
T_{10}	100% NPK + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at Tillering and panicle initiation	149	372	362	338
SEm ±		4.9	11.2	10.8	9.9
CD at 5%		14.3	32.5	31.2	28.7

Dry matter accumulation: The combination of 100% NPK + 0.5% ZnSO4 + 0.5% FeSO4 at Tillering and panicle initiation produced the highest dry matter readings, which were 299.8, 739.9, 1130.5, and1326.5 g m-2 at 30, 60, 90, and harvest, respectively. These results corroborated with (Haefele *et al.*, 2005) [5] and (Pal *et al.* 2008) [11].

Table 3: Effect of different nutrients treatments on dry matter accumulation (g m^{-2}) at different stages of rice

Symbol	Treatments	Dry matter accumulation (g m^{-2})			
		30 DAT	60 DAT	90 DAT	At harvest
T_1	Control	233.3	516.6	766.5	929.9
T_2	100% NPK	281.6	673.2	983.2	1153.2
T_3	100% NPK + 25 kg $ZnSO_4$	290.5	699.9	1054.5	1233.3
T_4	100% NPK + 25 kg $FeSO_4$	284.6	679.9	1025.8	1173.2
T_5	100% NPK + 25 kg $ZnSO_4$ + 25 kg $FeSO_4$	298.3	729.9	1102.7	1303.2
T_6	100% NPK + 12.5 kg $ZnSO_4$ + 12.5 kg $FeSO_4$ + VAM	289.3	696.5	1048.2	1223.4
T_7	100% NPK + Zn EDTA + Fe EDTA	293.3	709.9	1061.8	1256.5
T_8	100% NPK + 0.5% $ZnSO_4$ at Tillering and panicle initiation	295.3	716.5	1067.2	1269.8
T_9	100% NPK + 0.5% $FeSO_4$ at Tillering and panicle initiation	286.6	686.6	1033.2	1193.2
T_{10}	100% NPK + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at Tillering and panicle initiation	299.8	739.9	1130.5	1326.5
SEm ±		8.2	21.4	32.1	36.7
CD at 5%		24.4	63.9	96.1	109.8

Leaf Area Index

LAI at 30 DAT was found statistically identical among different nutrients treatments except in case of control treatment. However, numerically highest leaf area index was recorded in 100% NPK + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at Tillering and panicle initiation (2.50). Significant difference in LAI at 60 DAT was observed in different nutrients treatment and highest was found in 100% NPK + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ when the panicle began to tiller (4.75), which was noticeably higher than 100% NPK (4.20) and control treatment (3.47) while at par with rest treatments. At 90 DAT significantly highest LAI was found in 100% NPK + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at Tillering and panicle initiation (4.58), which was comparable to the other treatments and much greater than 100% NPK (4.06) and the control treatment (3.20). The similar result has been reported by (Jat *et al.* 2013) [7] and (Abbas, 2013) [1].

Table 4: Effect of different nutrients treatments on leaf area index (LAI) at different stages of rice.

Symbol	Treatments	Leaf Area Index		
		30 DAT	60 DAT	90 DAT
T_1	Control	2.10	3.47	3.20
T_2	100% NPK	2.28	4.20	4.06
T_3	100% NPK + 25 kg $ZnSO_4$	2.34	4.52	4.30
T_4	100% NPK + 25 kg $FeSO_4$	2.26	4.40	4.18
T_5	100% NPK + 25 kg $ZnSO_4$ + 25 kg $FeSO_4$	2.42	4.67	4.51
T_6	100% NPK + 12.5 kg $ZnSO_4$ + 12.5 kg $FeSO_4$ + VAM	2.32	4.45	4.26
T_7	100% NPK + Zn EDTA + Fe EDTA	2.38	4.56	4.36
T_8	100% NPK + 0.5% $ZnSO_4$ at Tillering and panicle initiation	2.40	4.63	4.46
T_9	100% NPK + 0.5% $FeSO_4$ at Tillering and panicle initiation	2.28	4.43	4.23
T_{10}	100% NPK + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at Tillering and panicle initiation	2.50	4.75	4.58
SEm ±		0.08	0.16	0.15
CD at 5%		0.24	0.46	0.44

Conclusion

From the present research and its findings it can be concluded that combining 100% NPK + 0.5% $ZnSO_4$ + 0.5% $FeSO_4$ at Tillering and panicle initiation gave the highest values for growth attributes thus, it can be said that micro nutrients have high impact for plant growth and development.

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