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Effect of N, P, K, Zn, Fe and FYM on Nutrient Uptake and Yield of Rice (*Oryza sativa* L.)

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Abstract

A field experiment was conducted on rice (var NDR-359, HUBR2-1) during *kharif* season of 2006-2007 and 2007-2008 consisting of two main plot treatments varieties (V_1-NDR-359 and V_2-HUBR2-1) and fertilizers (F_1-100% recommended fertilizer doses (RDF), F_2-75% RDF) and 9 sub plot treatment combinations M_0 (control), M_1 (Zn as soil application through Zn-EDTA 1.00 kg/ha), M_2 (Zn as foliar application through Zn-EDTA 0.5 kg/ha), M_3 (Fe as soil application through Zn-EDTA 1.00 kg/ha), M_4 (Zn as foliar application through Fe-EDTA 0.5 kg/ha), M_5 (Zn as soil application through Zn-EDTA 1.00 kg/ha+Fe as soil application through Fe-EDTA 1.00 kg/ha), M_6 (Zn as foliar application through Zn-EDTA 0.5 kg/ha + Fe as foliar application through Fe-EDTA 0.5 kg/ha), M_7 (Zn as foliar application through Zn-EDTA 1.00 kg/ha + Fe as foliar application through Fe-EDTA 0.5 kg/ha), M_8 (Fe as soil application through Fe-EDTA 1.00 kg/ha + Zn as foliar application through Zn-EDTA 0.5 kg/ha) arranged in split plot design and replicated three times. Among varieties and fertilizer level V_1 treatment recorded significantly higher NPK uptake, grain and harvest index than V_2 while in fertilizer levels F_2 treatment recorded significantly higher N, P, K, Zn and Fe uptake, grain and harvest index than F_1. Among the different micronutrient treatments M_7 recorded significantly higher N, P, K, Zn and Fe uptake, grain yield and harvest index over other treatments.

Key words : NPK, Zn, Fe uptake, Grain yield , Harvest index.

India is the seventh largest country in the world by area, with 329 million hectares (M ha). It is also the second largest producer of rice amongst 112 countries of the world, covering every continent. It is consumed by 2500 million people of developing countries. In Asia it produced and consumed (90%) and rest (10%) in USA, Africa, Australia and Europe (1). Out of many factors fertilizer will continue to be an important and inescapable input in increasing the production of rice. However, increasing cost of fertilizers has necessitated improving the efficiency of applied fertilizers. Which depends on the response to applied fertilizer is the adequate availability of most essential plant nutrients in a balanced proportion throughout the crop growth period. In recent years use of fertilizers coupled with intensive cropping have accelerated the exhaustion of micro-nutrient reserves of soils. It has thus become imperative to use the matching doses of required micro-nutrients along with NPK. Besides, increasing the productivity of rice, supplementation of micro-nutrients in fertilizer schedule also in a significant factor to improve the quality of grain to overcome certain malnutritional problems in dietary system of human beings. Accordingly its productivity, quality and profitability have become an integral part of national food system. The micro-nutrient malnutrition in rice is a common phenomena due to deficiency of iron, zinc, iodine and vitamin A. Rice is an especially poor sources of two important minerals, calcium and iron which one known to play significant role in formation of hemoglobin and transport of oxygen in human body. Micro-nutrients have attained a greater significance in intensive forming system with increased crop productivity for nutritional security. Increased demand of micronutrients has also emerged due to the cultivation of high yielding crop varieties under high intensity cropping system. In India, among micro-nutrients, Zn deficiency is the most wide spread under the area of high yielding crop varieties (2). Particularly in low land rice Zn-efficient varieties should sown with higher dose of Zn applied to pronounced potentiality of higher yield in Zn-deficient soils.

Table 1. Effect of the N, P, K, Fe, Zn and FYM on the nutrient uptake and yield of rice (pool data of two years).

Treatments	Nutrient uptake (kg/ha) N	P	K	Zn	Fe	Grain yield (q/ha)	HI (%)
Main plot							
A. Varieties							
V_1 - NDR-359	123.74	29.79	171.15	2.49	1.59	56.03	42.73
V_2 -HUB2-1	110.86	27.55	161.22	2.62	2.15	49.64	39.47
SE ±	1.84	0.44	0.49	0.02	0.01	1.09	0.71
CD (P = 0.05)	6.37	1.54	1.70	0.09	0.03	3.76	2.44
B. Fertilizers							
F_1-100% RFD (120 : 60 : 60 kg N, P_2O_5 & K_2O/ha through inorganic sources	110.02	24.50	155.95	2.38	1.67	49.79	40.23
F_2 - 75% RFD (90, 45, 45 kg N, P_2O_5 & K_2O/ha through inorganic fertilizers + 25% N, through FYM	124.58	32.83	176.42	2.73	2.07	55.88	41.96
SE ±	1.84	0.44	0.49	0.02	0.01	1.09	0.71
CD (P = 0.05)	6.37	1.54	1.70	0.09	0.03	3.76	2.44
Sub-Plot							
Mo-Control	98.10	21.79	142.35	1.88	1.25	47.27	40.52
M_1- Zn as soil application through Zn EDTA 1.00 kg/ha	119.21	29.63	169.93	2.83	1.70	53.59	41.35
M_2 - Zn as foliar application through Zn EDTA 0.5 kg/ha	110.17	27.18	157.71	2.56	1.55	51.56	41.08
M_3 - Fe as soil application through Fe EDTA 1.00 kg/ha	108.23	26.20	155.10	2.37	1.84	50.94	40.95
M_4-Zn as foliar application through Fe EDTA 0.5 kg/ha	118.55	28.95	167.35	2.40	2.37	53.20	41.15
M_5 - Zn as soil application through Zn EDTA 1.00 kg/ha + Fe as soil application through Fe EDTA 1.00 kg/ha	120.96	29.46	171.24	2.69	1.85	53.78	41.19
M_6 - Zn as foliar application through Zn EDTA 0.5 kg/ha + Fe as foliar application through Fe EDTA 0.5 kg/ha	127.37	31.92	178.71	2.80	2.13	54.39	40.95
M_7 - Zn as soil application through Zn EDTA 1.00 kg/ha + Fe as foliar application through Zn EDTA 0.5 kg/ha	134.54	33.66	185.07	2.92	2.21	57.39	41.61
M_8 - Fe as soil application through Fe EDTA 1.00 kg/ha + Zn as foliar application through Zn EDTA 0.5 kg/ha	118.52	29.21	168.22	2.52	1.93	53.41	41.06
SE ±	1.46	0.34	0.32	0.02	0.01	0.85	0.60
CD (P = 0.05)	4.11	0.95	0.91	0.05	0.02	2.39	1.71

Methods

A field trial was conducted with rice (var NDR-359, HUBR2-1) was carried out at the agricultural research farm, Institute of Agricultural Science, Banaras Hindu University Varanasi. During *kharif* season of 2006-07 and 2007-08. The soil of experimental field was alluvium neutral having pH (7.3), low in available N (187.47kg/ha) medium in available P (20.58 kg/ha) and exchangeable K (223.76 kg /ha) while Zn (0.89 kg/ha), Fe (20.67 kg/ha) was deficient. The treatments consisting of two main plot treatments, varieties (V_1- NDR-359 and V_2 - HUBR2-1) and fertilizers (F_1 - 100% recommended fertilizer doses (RDF), F_2 - 75% RDF) and nine sub-plot treatment combinations M_0 (control), M_1 (Zn as soil application through Zn-EDTA

1.00 kg/ha), M_2 (Zn as foliar application through Zn-EDTA 0.5 kg/ha), M_3 (Fe as soil application through Fe-EDTA 1.00 kg/ha), M_4 (Zn as foliar application through Fe-EDTA 0.5 kg/ha), M_5 (Zn as soil application through Zn-EDTA 1.00 kg/ha + Fe as soil application through Fe-EDTA 1.00 kg/ha), M_6 (Zn as foliar application through Zn-EDTA 0.5 kg/ha + Fe as foliar application through Fe-EDTA 0.5 kg/ha), M_7 (Zn as foliar application through Zn-EDTA 1.00 kg /ha + Fe as foliar application through Fe- EDTA 0.5 kg/ha), M_8 (Fe as soil application through Fe- EDTA 1.00 kg/ha + Zn as foliar application through Zn-EDTA 0.5 kg/ha) arrange in split plot design replicated with three times. The duration of NDR-359 and HUBR2-1 was 130-135 days and 125-130 days respectively which was taken as a test crop and planted on a spacing of 20 × 10 cm with 2 seedling /hill.

Results and Discussion

Effect of Varieties

The varieties was significantly affect the nutrient uptake and yield of rice. Table 1 shows that among the varieties V_1 treatment recorded significantly higher N (123.74 kg/ha), P (29.79 kg/ha), K (171.15 kg/ha) over the V_2 which was N (110.86 kg/ha), P (27.55 kg/ha) and K (161.22 kg/ha) while the Zn and Fe uptake was significantly higher under V_2 which was Zn (2.62 kg/ha,) and (2.15 kg/ha) respectively. The grain yield (56.05 kg/ha) and harvest index (42.73%) was also found significantly higher under the V_1 over V_2. This was due to higher nutrient uptake. Similar result was also recorded by Sarangi et al. (3).

Effect of Fertilizers

Table 1 shows that among fertilizer levels F_2 treatment recorded significantly higher N (124.58 kg/ha), P (32.83 kg/ha), K (176.42 kg/ha), Zn (2.73 kg/ha) and Fe (2.07 kg/ha) uptake over the F_1 treatment which was N (110.02 kg /ha), P (24. 50 kg/ha, K (155.95 kg/ha), Zn (2.38 kg/ha) and Fe (1.67 kg/ha), respectively. The grain yield and harvest index was found significantly higher under F_2 treatment which was 55.88 q/ha and 41.96%, respectively over the F_1 treatment which was 49.79 q/ha and 40.23% because of higher nutrient uptake. Mishra et al. (4) evaluated the different source of N in the form of FYM and reported that highest grain yield of aromatic (Pusa basmati-1) due to incorporation of 25% nitrogen through farm yard manure and 75% nitrogen through urea.

Effect of Micronutrients

The yield of rice increased significantly under all the treatments over control. Table 1 shows that among micro nutrients M_7 treatment recorded significantly higher nutrient uptake N (134.54 kg/ha), P (33.66 kg / ha), K (185.09 kg/ha) and Zn (2.92 kg/ha) as compared to other treatments and M_6, M_2, M_5, M_4, M_1, M_2, M_3, and M_0. The treatment M_6 was found to be statistically at par with M_7. While M_6 was found to be significantly superior over all treatments except M_7. The uptake of Zn by rice grain was (2.92 kg/ha) higher with application of Zn - EDTA was also reported by (5) . The grain yield was also found significantly higher under M_7 (57.39 q/ha) treatment as compared to other treatment, this is due to higher micronutrient uptake under M_7 treatment. The based application of Zn-EDTA resulted in a 3.8% increase in grain yield also resulted in a 37.5% increase in yield over that of control was reported (5). Swarup (6) also reported that Zn and Fe application significantly enhanced the rice yield and nutrient uptake in grain. Application of $FeSO_4$ had positive influence on Zn uptake and similarly application of $ZnSO_4$ increased the Fe uptake and yield of rice as reported by Kulandaivel et al. (7). Foliar spray of 0.1% Fe-EDTA enhanced grain yield and Fe uptake by grain as reported by Sarangi et al. (3).

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