

Yield and Economics of Rice (*Oryza sativa* L.) as Affected by Varieties Fertilizers and Micronutrients

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Abstract

A field trial were conducted on rice during *kharif* seasons of 2006-2007 and 2007-2008 consisting of two varieties (V_1 -NDR-359 and V_2 -HUBR 2-1) and two fertilizer levels (F_1 -100% recommended fertilizer doses (RDF), F_2 -75% RDF) as main plot treatment and nine treatment combinations i.e. 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 (Fe as foliar application through Fe-EDTA 0.5 kg/ha), M_5 (M_1+M_3), M_6 ($M_2 + M_4$), M_7 ($M_1 + M_4$), M_8 ($M_3 + M_2$) as sub-plot treatments arranged in split plot design with three replications. Among varieties and fertilizer levels, V_2 treatment recorded significantly higher gross return (Rs 84,890.08 / ha) net return (Rs 55, 312.55 / ha), B : C ratio (1.87) than V_1 . While, the grain yield was found significantly higher under V_1 (55.05 q/ha). Among the fertilizer F_2 treatment recorded higher net return (Rs 4, 252.47/ha), B : C ratio (1.55), grain (54.12 q/ha) and straw yield (75.10 q/ha) than F_1 . Among micronutrient M_7 treatment recorded significantly higher gross return (Rs 79,090.17 / ha), net return (Rs 49,120.43/ha) and B : C ratio (1.64) over other treatments.

Key words : NPK, Micronutrients, Varieties, Rice, Grain yield.

Rice (*Oryza sativa* L.) is the most important food grain that is produced and consumed all over the world. It is especially important in Asia, where more than 90% of world's rice is produced and consumed. In India rice is grown in about 45 million hectare and the production of rice was 99.15 million tones in 2009-10. Keeping in view the annual population growth of around 25%, per capita consumption is 235 g/day, it is estimated that the rice demand in 2025, will be 140 million tonnes. The price of inputs, mainly inorganic fertilizers is increasing gradually, therefore emphasis is needed to maximize the nutrient use efficiency, gross return, grain yield, and minimize the cost of production. The efficiency of nutrient use may be raised by the combined use of organic and inorganic source including micronutrients. Continuous use of high analysis fertilizers without application of organic manures in soil manifest the occurrence of wide spread zinc deficiency. Mandal et al. (1) reported that zinc deficiency in rice soils exists since long time, hence blanket soil application of 5—20 kg/ha of $ZnSO_4$ has been recommended for most of the field crops to cor-

rect the deficiency. Zn deficiency is usually corrected through the application of inorganic salts, mainly $ZnSO_4$, other sources are the chelated forms of Zn, ethylene diamine tetra-acetic acid (EDTA), which supplies a substantial amount of Zn to the plant without interacting with soil components because central metal ion (Zn^{2+}) is surrounded by chelate legends. Realising the importance of Zn and Fe in plant growth and its deficiency in soils and plants, a study was made to assess the relative performance of chelated Zn and Fe as soil and foliar applications on yield of rice and economics of its production.

Methods

A field trial was conducted on rice at the agricultural research Farm, Institute of Agricultural Sciences, BHU, Varanasi, during *kharif* seasons of 2006-07 and 2007-08. The soil of experimental field was alluvium neutral having pH (7.3), low in available N (187.47 kg/ha), medium in available P (20.58 kg/ha) and exchangeable K (223.76 kg/ha) while Zn (0.89 kg/

Table 1. Effect of different treatment on cost of cultivation (Rs/ha), gross return (Rs/ha), net return (Rs/ha) and B : C ratio (pooled data of two years).

Treatments	Cost of cultivation	Gross return	Net return	B : C ratio	Grain yield (q/ha)	Straw yield (q/ha)
Main Plot						
A. Varieties						
V ₁ -NDR-359	29202.43	61108.56	31906.08	1.09	55.05	73.37
V ₂ -HUBR 2-1	29577.54	84890.08	55312.55	1.87	48.75	74.20
SE ±	–	1228.89	1228.89	0.04	1.06	0.70
CD (P=0.05)	–	4252.47	4252.47	0.14	3.66	2.42
B. Fertilizers						
F ₁ -100% RFD (120 : 60 : 60 kg N, P ₂ O ₅ & K ₂ O/ha) through inorganic sources	28960.05	69882.21	40922.15	1.41	49.69	72.07
F ₂ -75% RFD (90,45, 45 kg N, P ₂ O ₅ & K ₂ O/ha) through inorganic fertilizers + 25% N, through FYM	29819.97	76116.44	46296.47	1.55	54.12	75.50
SE ±	–	1228.89	1228.89	0.04	1.06	0.70
CD (P = 0.05)	–	4252.47	4252.47	0.14	3.66	2.42
Sub-Plot						
Control M ₀	26744.01	61430.02	34686.01	1.29	43.49	65.83
M ₁ -Zn as soil application through Zn EDTA 1.00 kg/ha	29635.76	74754.23	45118.47	1.52	53.25	74.65
M ₂ -Zn as foliar application through Zn EDTA 0.5 kg/ha	29295.76	72578.17	43282.41	1.47	51.60	73.11
M ₃ -Fe as soil application through Fe EDTA 1.00 kg/ha	29635.76	71375.65	41739.89	1.40	50.71	72.28
M ₄ -Fe as foliar application through Fe EDTA 0.5 kg/ha	29295.76	74244.17	44948.41	1.53	52.72	74.39
M ₅ -Zn as soil application through Zn EDTA 1.00 kg/ha+Fe as soil application through Fe EDTA 1.00 kg/ha	30315.76	74281.82	43966.06	1.45	52.85	74.92
M ₆ -Zn as foliar application through Zn EDTA 0.5 kg/ha+Fe as foliar application through Fe EDTA 0.5 kg/ha	29635.76	75210.83	45575.07	1.53	53.48	75.58
M ₇ -Zn as soil application through Zn EDTA 1.00 kg/ha+Fe as foliar application through Zn EDTA 0.5 kg/ha	29975.76	79096.19	49120.43	1.64	56.27	78.52
M ₈ -Fe as soil application through Fe EDTA 1.00 kg/ha+Zn as foliar application through Zn EDTA 0.5 kg/ha	29975.76	74022.84	44047.08	1.47	52.76	74.77
SE ±	–	1170.83	1170.83	0.04	0.83	0.65
CD (P=0.05)	–	3307.80	3307.80	0.11	2.35	1.84

ha), Fe (20.67 kg/ha) was deficient. The treatments consisting of two main plot treatments, varieties (V₁-NDR-359 and V₂-HUBR 2-1) and two level fertilizers (F₁-100%) recommended fertilizer doses (RDF), F₂-75% (RDF) and nine sub-plot treatment combinations M₀ (control), M₁ (Zn as soil application through Zn-EDTA 1.00 kg/ha), M₂ (Zn as foliar application through Zn-EDTA 0.5 kg/ha), M₃ (Fe as soil application through

Fe- EDTA 1.00 kg/ha), M₄ (Fe as foliar application through Fe-EDTA 0.5 kg/ha), M₅ (Zn as soil application through Zn-EDTA 1.00 kg/ha+Fe as soil application through Fe-EDTA 1.00 kg/ha), M₆ (Zn as foliar application through Zn-EDTA 0.5 kg/ha+Fe as foliar application through Fe-EDTA 0.5 kg/ha), M₇ (Zn as soil application through Zn-EDTA 1.00 kg/ha+Fe as foliar application through Fe-EDTA 0.5 kg/ha), M₈ (Fe

as soil application through Fe-EDTA 1.00 kg/ha+Zn as foliar application through Zn-EDTA 0.5 kg/ha) while arrange in split plot design with three replication. The duration of NDR-359 and HUBR 2-1 were 130—135 days and 125—130 days respectively with two seedings/hill⁻¹ having spacing of 20 × 10 cm.

Results and Discussion

Grain and Straw Yield

Table 1 shows that the varieties, fertilizers and micronutrients significantly affected the grain and straw yield of rice. Among varieties V₁ (NDR-359) recorded significantly higher grain (55.05 q/ha) and straw yield (73.37 q/ha) than V₂ (HUBR 2-1) which was 48.75 q/ha and 74.20 q/ha grain and straw yield, respectively. Among fertilizers F₂ (75% RFD, 90, 45, 45 kg N, P₂O₅ and K₂O/ha arrange inorganic fertilizers+25% N, through FYM) recorded significantly higher grain (54.12 q/ha) and straw (75.50 q/ha) as compared to F₁ (100% RFD 120 : 60 : 60 kg N, P₂O₅ and K₂O/ha through inorganic sources) which were 49.69 q/ha and 72.01 q/ha grain and straw yield, respectively. The same yield was also reported by Mishra et al. (2). Among the micronutrients M₇ (Zn as soil application through Zn EDTA 1.0 kg/ha+Fe as foliar application through Fe EDTA 0.5 kg/ha treatments was recorded significantly higher grain (56.27 q/ha) and straw yield (78.52 q/ha) than other treatments and control which was 43.49 q/ha and 65.83 q/ha grain and straw yield, respectively. Similar result was also reported by Naik and Das (3). Swarup (4) also reported that Zn and Fe applications significantly enhanced the grain and straw yield of rice. Sarangi et al. (5) also reported that foliar spray of 0.1% Fe chelated like Fe EDTA enhanced grain and straw yield of rice.

Economics

Table 1 shows the variation in grain and straw yields of rice crop due to the treatment effect and differential cost of cultivation. Gross return, net return and B : C ratio were significantly affected by varieties, fertilizers and micronutrients. Among the varieties V₂ (HUBR 2-1) recorded significantly higher gross return (Rs 84,890.08/ha) and B : C ratio (1.87) as compared to V₁ (NDR-359) which was Rs

31,906.08/ha and 1.09 gross returns and B : C ratio respectively. This was due to higher net returns (Rs 31,906.08/ha) and price of produce q/ha. Among the fertilizer levels F₂ (75% RFD, 90, 45, 45 kg N, P₂O₅ and K₂O/ha through inorganic fertilizers + 25% N, through FYM) recorded significantly higher gross returns (Rs 76116.44/ha), net returns (Rs 46296.47/ha) and B : C ratio (1.55) as compared to F₁ (100% RFD, 120, 60, 60 kg N, P₂O₅ and K₂O/ha through inorganic sources) treatments which was Rs 69,882.21/ha, Rs 40,922.10/ha and 1.41 as gross return, net return and B : C ratio respectively. This was due to higher grain yield (54.12 q/ha). The similar result was also reported by Pandey et al. (6). Among the level of micronutrients M₇ (Zn as soil application through Zn EDTA 1.00 kg/ha + Fe as foliar application through Fe EDTA 0.5 kg/ha) treatment recorded significantly higher gross returns Rs 79096.19/ha, net return (Rs 49,120.43/ha) and B : C ratio (1.64) over all treatments while the treatment M₈, M₅ and M₂ were found to be at par to each other. Naik and Das (3) concluded that basal application of 1.0 kg Zn/ha as Zn EDTA resulted in a higher cost-benefit ratio of 1.69 over its corresponding split application.

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