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An economics of rice cultivation through appropriate management of zinc under northern gangetic alluvial plain

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Abstract

A field experiment was conducted to study the economics of rice cultivation through appropriate management of zinc at Agricultural Research Farm of Institute of Agricultural Sciences, Banaras Hindu University during the two consecutive kharif (rainy) seasons of 2010 and 2011. The experiment was laid out in randomized block design with three rice varieties (HUR-105, HUBR 2-1 and PHB-71) and seven zinc treatments. The hybrid PHB 71 showed the highest gross return of ₹ 78007 and ₹ 79570, but HUR 105 recorded maximum net return of ₹ 46886 and ₹ 48180 and B: C ratio 2.58 and 2.63 in year 2010 and 2011, respectively. Amongst the zinc treatments, application of Zn (EDTA) 0.25 kg ha-1 at basal + Zn (EDTA) 0.05% sprays at maximum tillering stage resulted in maximum gross return of ₹ 87211 and ₹ 88531), net return of ₹ 57572 and ₹ 58892 and B: C ratio 2.94 and 2.99 and was found economically feasible during both the years of experimentation.

Keywords: Rice, economics, varieties, zinc management

Rice (*Oryza sativa* L) is a principal source of staple food for more than half of the world population and hence becomes a main source of Zinc to human (Fitzgerald *et al*, 2009). It is important energy source of more than half of the world and 65% of the Indian population (Liu *et al*., 2008). It is an important crop in India which occupied 43.50 million hectare with the production of 159.20 million tons and have 3.65 t ha^{-1} productivity which is less than world's average productivity (4.52 t ha^{-1}) (FAO, 2014). To meet the future food requirements of ever increasing population and maintain self sufficiency, the estimated rice production in India targeted at 350 million tonnes by 2020 AD (Veeraputhiran and Balasubramanian, 2013).

Zn is an essential micronutrient for the normal growth, development and health of plants and humans. Currently, millions of hectares of cropland are affected by Zn deficiency and approximately one third of the human population suffers from an inadequate intake of Zn (Alloway, 2008). Zinc deficiency in cereal plants is a well identified problem and leads to reduced productivity of crops. In addition, it causes widespread Zn deficiency in humans, especially in developing countries where cereal based diets are dominant and poor in protein rich products (Cakmak, 2008). This Zn deficiency can be corrected by application of chelated Zn compared to others sources of zinc because of its facilitation, greater absorption and Zn overall availability maintenance in soil at a steady rate (Rakshit *et al*, 2013).

Table: Effect of zinc management and varieties on cost of cultivation (₹ha^{-1}), gross return (₹ ha^{-1}), net return (₹ha^{-1}) and B: C ratio (%)

Treatment		Cost of cultivation (₹ha^{-1})	Gross return (₹ha^{-1})		Net return (₹ha^{-1})		B: C ratio	
			2010	2011	2010	2011	2010	2011
Varieties								
V_1	HUR-105	24159	76340	77633	46886	48180	2.58	2.63
V_2	HUBR 2-1	24059	74449	75978	45096	46625	2.53	2.58
V_3	PHB-71	26959	78007	79570	45754	47317	2.43	2.47
	SEm ±	-	1362	1411	1351	1412	0.05	0.05
	CD (*P*=0.05)	-	NS	NS	NS	NS	NS	NS
Zinc management								
Z_0	Control (no application of zinc fertilizer)	23659	56829	57747	31770	32688	2.26	2.30
Z_1	Zn (EDTA) @ 0.5 kg ha^{-1} at basal	27819	68053	69291	38834	40072	2.33	2.37
Z_2	Zn (EDTA) @ 0.25 kg ha^{-1} at basal + 0.25 kg ha^{-1} at maximum tillering stage	27819	79292	80642	50073	51423	2.72	2.77
Z_3	Zn (EDTA) @ 1.0 kg ha^{-1} at basal	31989	79233	81183	45844	47794	2.38	2.43
Z_4	Zn (EDTA) @ 0.5 kg ha^{-1} at basal + 0.5 kg ha^{-1} at maximum tillering stage	31989	84172	85976	50783	52587	2.53	2.58
Z_5	Zn (EDTA) @ 0.05% 3 spray at 15 days interval (starting with maximum tillering stage)	31159	79066	80721	46507	48162	2.43	2.48
Z_6	Zn (EDTA) @ 0.25 kg ha^{-1} at basal + Zn (EDTA) @ 0.05% spray at maximum tillering Stage	28239	87211	88531	57572	58892	2.94	2.99
SEm ±		-	2081	2155	2064	2157	0.07	0.07
CD (*P*=0.05)		-	5948	6160	5901	6164	0.20	0.21
Interaction (V× Z)		-	NS	NS	NS	NS	NS	NS

In view of the above, an experiment have been designed to examine the economics of rice cultivation through appropriate management of zinc with a objective to find out both suitable variety and zinc management practice which is economically feasible under northern gangetic alluvial plains.

Methodology

The present investigation was conducted during the rainy (kharif) seasons of 2010 and 2011 at the Agricultural Research Farm, Institute of Agricultural Sciences, BHU, Varanasi, Uttar Pradesh at 25^{0}18′ N, 83^0 31′ E and altitude of 75.7 meters above the mean sea level in the Northern Gangetic alluvial plains. The soil was sandy clay loam with pH 7.35, low organic carbon (0.45% and 0.46%), available nitrogen (197.6 and 203.5 kg ha^{-1}), medium available phosphorus (21.22 and 22.53 kg ha^{-1}) and available potassium (220.321 and 223.72 kg ha^{-1}) during 2010 and 2011, respectively. Field experiment was laid out in randomized block design with three replication consists of three varieties *viz.*, HUR 105 (V_1), HUBR 2-1(V_2) and PHB-71 (V_3) and seven zinc management treatments *i.e* Control (Z_0), Zn (EDTA) @ 0.5 kg ha^{-1} at basal (Z_1), Zn (EDTA) @ 0.25 kg h^{-1} at basal + 0.25 kg ha^{-1} at maximum tillering stage (Z_2), Zn (EDTA) @ 1.0 kg ha^{-1} at basal, Z_4- Zn (EDTA) @ 0.5 kg ha^{-1} at basal + 0.5 kg ha^{-1} at maximum tillering stage (Z_3), Zn (EDTA) @ 0.05% 3 spray at 15 days interval (starting with maximum tillering stage) (Z_4) Zn (EDTA) @ 0.05% 3 spray at 15 days interval (starting with maximum tillering stage) (Z_5) and Zn (EDTA) @ 0.25 kg ha^{-1} at basal + Zn (EDTA) @ 0.05% spray at maximum tillering stage (Z_6). The seedlings were transplanted at 20 cm X 10 cm in puddled soil. Half quantity of the total nitrogen (120 kg N ha^{-1}) and full dose of phosphorus (60 kg P_2O_5 ha^{-1}) and potassium (60 kg K_2O ha^{-1}) through urea, diammonium phosphate (DAP) and murate of potash, respectively were applied just before transplanting. The remaining half

quantity of urea was top dressed in two equal splits at active tillering and panicle initiation stage. Zinc fertilizer will be applied according to the treatments through Zn-EDTA. Economics were calculated and compared for the selection of superior treatment combination. The net return was estimated by using formula net return (₹ha^{-1}) = gross return (₹ha^{-1}) – cost of cultivation (₹ha^{-1}). All the data were statistically analysed to draw a valid conclusion (Gomez and Gomez, 1984).

Results and Discussion

The hybrid PHB 71 showed the highest gross return (₹78007 and ₹79570) over HUR 105 and HUBR 2-1, but in respect of net return (₹46886 and ₹48180) and B: C (2.58 and 2.63) ratio HUR 105 showed superiority over the two during first and second year of investigation, respectively. In spite of high cost of hybrid seed, this cultivar has more potential to produces higher grain and straw yield and recorded higher monetary advantages over normal variety. These results were in accordance with Yadav (2007); Singh (2012); Singh *et al.* (2013); Hardev *et al*. (2014) and Shukla *et al*. (2014).

Amongst the zinc management data revealed that the higher cost of cultivation with Zn (EDTA) 1.0 kg ha^{-1} at basal and Zn (EDTA) 0.5 kg ha^{-1} at basal + 0.5 kg ha^{-1} at maximum tillering stage because more cost of Zn-EDTA. Application of Zn (EDTA) 0.25 kg ha^{-1} at basal + Zn (EDTA) 0.05% spray at maximum tillering stage (Z_6) showed significantly higher monetary advantage over rest of zinc management treatments including control and recorded the maximum gross return (₹87211 and ₹88531), net return (₹57572 and ₹58892) and B:C ratio (2.94 and 2.99), but it was at par with Zn (EDTA) 0.5 kg ha^{-1} at basal + 0.5 kg ha^{-1} (Z_4) during both the years of study, respectively. This might be due to higher grain and straw yield were produced under Zn (EDTA) 0.25 kg ha^{-1} at basal + Zn (EDTA) 0.05%.Whereas lower gross return, net return and B:C ratio were recorded due to application of Zn (EDTA) 0.5 kg ha^{-1} (Z_1) at basal during both the years of study. The results were close conformity with the findings of Chaphale and Bodole (1999); Mandal *et al.* (2009); Singh and Shivay (2013).

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