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Effect of zinc fertilization on yield, economics, iron and zinc content in grain and soil available Fe and Zn under alternate wetting and drying condition

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Abstract
A field experiment was conducted during *summer* season of 2015 at Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh). Three high zinc rice varieties and MTU-1010 were fertilized with zinc through different method of application. Variety R-56 and MTU-1010 recorded maximum growth and yield attributes as compared to other varieties. Application of 25 kg $ZnSO_4$ ha^{-1} and foliar spray of 0.2% Zn through $ZnSO_4$ at panicle initiation and flowering stage recorded maximum growth and yield attributes as compared to other zinc fertilization

Keywords: Economic, Fe, High zinc rice, Yield, Zn.

Introduction

Rice is the most important cereal crop in Asia. India is the second largest producer and consumer of rice in the world. Area under rice crop in India is about 43.95 million hectare with production of 103.61 million tonnes and productivity of 2492 kg per hectare during 2015-16 (Anonymous, 2015) [1]. Chhattisgarh is known as "Rice bowl of India" where the total rice grown area is 3.71 million hectares with production of 7.71 million tonnes and productivity of 2050 kg per hectares (Anonymous, 2016) [2]. Zinc deficiency is a well documented problem in food crops, causing decreased crop yields and nutritional quality. In developing countries zinc, iron and vitamin A deficiencies were reported in human population. Increasing the grain Zn concentration in rice may be a sustainable way to alleviate human Zn deficiency in monotonous diet area of India as well as Chhattisgarh. The poor tribals' who cannot afford for different known sources of zinc, the high zinc rice varieties may benefit their health without any additional cost (Black *et al.*, 2008) [3]. Despite the importance of high Zn content rice genotypes as constraints, little efforts have been devoted to developing high Zn content rice genotypes through breeding or by fortification as applied Zn fertilizers through basal or foliar application.

Zinc is an essential micronutrient for the normal growth, development and health of plants and human beings. Currently, large areas of agricultural land are now known to be zinc deficient, causing severe reductions in crop productivity and nutritional quality of the food crops. Still in many countries, zinc deficiency is unrecognized or underestimated and untreated. There is, therefore, an urgent need to understand and address zinc deficiency in these countries in order to contribute to both crop production and human health. Zinc is also particularly important for better tolerance of crop plants under various stress factors such as drought, heat and salinity. Applying zinc fertilizers to soil and or into plant leaves offers a simple and highly effective solution to zinc deficiency problems in crop plants and to increasing zinc concentrations of foods. This strategy greatly prevents unnecessary loss of food production and helps to improve in public health. For example, enrichment of rice and wheat grain with zinc may save the lives of up to 48,000 children in India annually (Stein *et al*, 2007) [8]. Considering the importance of micronutrient based malnutrition as major public health, the future demand of high grain Zn rice varieties, may provide the alternative to combat malnutrition. Based on the above facts, three high zinc rice varieties and one most popular variety MTU-1010 were fertilized with zinc through different methods of application under study.

Materials and Methods

The treatment comprised of four varieties *viz.* MTU-1010, RHZ-2, RHZ-7 and R-56 in main plots and three zinc fertilization *Viz.* Control (no Zn), soil application of 25 kg $ZnSO_4$ ha $^{-1}$ and foliar sprays of 0.2% Zn through $ZnSO_4$ at panicle initiation and flowering stage in sub plots in split plot design replicated thrice. Single rice seedling was transplanted at 20 x 10 cm spacing and fertilized with 120: 60: 40 kg N, P_2O_5, K_2O ha^{-1} respectively through urea, single super phosphate and muriate of potash. Total concentration of zinc and iron was analyzed by atomic absorption spectroscopy.

Results and Discussion

There was significant variation in grain yield, net returns, benefit cost (B: C) ratio, Fe and Zn content in grain due to different varieties and zinc fertilization (Table 1). Results revealed that the maximum grain yield (53.84 q ha^{-1}) was recorded with variety R-56 and it was statistically at par with variety MTU-1010 (50.02 q ha^{-1}). Whereas, the minimum grain yield was recorded with variety RHZ-7 with respect to zinc fertilization soil application of 25 kg $ZnSO_4$ ha^{-1} produced maximum grain yield (50.05 q ha^{-1}) which was statistically at par with foliar spray of 0.2% $ZnSO_4$ at panicle initiation and flowering stage. The minimum grain yield was recorded control. The reason behind these results might be due to maximum growth and yield attributing characters with variety R-56 which ultimately increased grain yield. Minimum rice yield was recorded under control which might be due to the non availability of zinc, while the higher rice yield due to zinc application as Zn plays an important role in biosynthesis of the IAA and initiation of primodia for reproductive parts. These results are similar to the findings of Ghani *et al.* (1990) [5].

The maximum net returns (Rs. 47543 Rs ha^{-1}) and B: C ratio (1.85) were received with variety R-56 followed by variety MTU-1010. The above economic parameters were minimum with variety RHZ-7 with respect to zinc fertilization, the maximum net returns (Rs. 40959 Rs ha^{-1}) and B: C ratio (1.51) were recorded with soil application of 25 kg $ZnSO_4$ ha^{-1} followed by foliar spray of 0.2% $ZnSO_4$ at PI & FL. The minimum value of net returns and B: C ratio were noted under control (no zinc). Application of micronutrients was found to be economical having more benefit cost ratio as compared to control. Similar observations were noted by Ghatak *et al.* (2005) [6].

Iron and zinc content in grain (ppm) were significantly affected due to different rice varieties and zinc fertilization (Table 1). Significantly higher Fe content in grain was recorded with variety RHZ-7 (17.95 ppm) over other varieties and it was followed by variety R-56 (12.55 ppm). Minimum Fe content in grain was observed with variety RHZ-2. The variation of grain Fe content was directly correlated with genetic character of different rice varieties with respect to zinc fertilization the maximum Fe content in grain was recorded with foliar spray of 0.2% $ZnSO_4$ at PI & FL (13.15 ppm) followed by soil application of 25 kg $ZnSO_4$ ha^{-1}. Minimum Fe content in grain was observed under no zinc fertilization. The maximum zinc content in grain was recorded with variety RHZ-7 (23.87 ppm). However, it was statistically at par with variety RHZ-2 (22.90 ppm) and variety R-56 (22.29 ppm). Minimum zinc content in grain was recorded with variety MTU-1010 (19.07 ppm). In case of zinc fertilization, signizinc content in grain was recorded with foliar spray of 0.2% $ZnSO_4$ at PI & FL (26.25 ppm) as compared to other zinc fertilization. Minimum zinc content in grain was recorded under control.

The reported data are mostly based on brown rice. As polished rice is the main consumed portion by human, rare information was found on Zn concentration in polished rice after foliar Zn fertilizations. Moreover, time of foliar application and the different forms of foliar Zn fertilizers may differentially influence grain Zn concentration. In recent past, several studies have been conducted to adjust time of foliar Zn application in cereal crops. It is now well established that foliar Zn application after flowering stage (e.g., at early milk plus dough stages) more distinctly increase the grain Zn concentration. On the other hand, different Zn fertilizers such as inorganic and organic Zn salts play a fundamental role in the way in nutrient transport from leave to the grain. Unfortunately, studies evaluating the effectiveness of foliar application of different Zn forms on rice grain Zn accumulation are still rare. Similar results have been reported by Chaab *et al.* (2011) [4].

Table 1: Effect of rice varieties and zinc fertilization on yield, economics, nutrient content and soil fertility

Treatment	Grain yield (q ha^{-1})	Net return (Rs ha^{-1})	B:C ratio	Fe content in grain (ppm)	Zn content in grain (ppm)	Zn (ppm)	Fe (ppm)
Varieties							
MTU-1010	50.02	42348	1.65	9.60	19.07	2.62	12.38
RHZ-2	47.50	38921	1.52	9.37	22.90	2.57	12.33
RHZ-7	40.01	28735	1.12	17.95	23.87	2.53	13.00
R-56	53.84	47543	1.85	12.55	22.29	2.72	12.83
SEm±	1.42	-	-	0.04	0.72	0.07	0.27
CD (P=0.05)	4.50	-	-	0.14	2.50	NS	NS
Zn fertilization							
Control (no Zn)	45.30	36099	1.42	11.23	18.93	2.46	12.50
25 kg $ZnSO_4$ ha^{-1} (Soil application)	50.05	40959	1.51	12.72	20.92	2.72	12.87
Foliar spray of 0.2% $ZnSO_4$ at PI&FL	48.18	39184	1.49	13.15	26.25	2.64	12.54
SEm±	1.42	-	-	0.03	0.56	0.06	0.23
CD (P = 0.05)	4.50	-	-	0.09	1.70	0.20	NS
Initial						1.72	9.33

PI & FL- Panicle initiation and flowering stage

Data of table 1 showed that only soil available zinc was influenced significantly due to zinc fertilization**.** Zinc content increased in soil after harvesting crop from their initial level (1.72 ppm). The maximum zinc content in soil was recorded with soil application of 25 kg $ZnSO_4$ ha^{-1} followed by foliar spray of 0.2% $ZnSO_4$ at PI & FL. The minimum soil available zinc was recorded with no zinc fertilization treatment. These results are in consonance with the findings of Patnaik and Raj (1999) [7].

This study can be concluded that among high zinc rice varieties, variety R-56 and soil application of 25 kg $ZnSO_4$ ha^{-1} recorded maximum grain yield, net returns, B: C ratio.

Variety RHZ-7 and foliar spray of 0.2 % $ZnSO_4$ at panicle initiation and flowering stage recorded maximum Zn and Fe content in grain. Whereas, the zinc content in soil increased from initial and was maximum with soil application of 25 kg $ZnSO_4$ ha^{-1}.

References

1. Anonymous. GOI. Second estimate, 2015-16, Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture, GOI, 2015-16.
2. Anonymous. Krishi Darshika, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.), 2016.
3. Black RE. maternal and child under nutritin: global and regional exposures and health consequences. *lancet,* 2008; 371:243-260.
4. Chaab A, Avaghebigh RS, Motesharezadeh B. Differences in the zinc efficiency among and within maize cultivars in a calcareous soil. Asian Journal of Agricultural Sciences. 2011; 3(1):26-31.
5. Ghani A, Shah M, Khan DR. Response of rice to elevated rates of Zn in mountainous areas of Swat. Sarhad journal of Agri. 1990; 6(4):411-415.
6. Ghatak R, Jana PK, Sounda G, Ghosh RK, Bandyopadhyay P. Response of transplanted rice to zinc fertilization at farmer's field on red and laterite soils of West Bengal. Journal of Interacademicia. 2005; 9(2):231-234.
7. Patnaik MC, Raj GB. Direct, residual and cumulative effects of zinc in rice rice cropping system. *Oryza.* 1999; 36(4):331-334.
8. Stein. Publication of Health Nutrition. 2007; 10:492-501.