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Effect of Zinc on growth and yield of rice var. Pusa Basmati-1 in Saran district of Bihar

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ABSTRACT
A field experiment was carried out to find out the effect of zinc on growth and yield of Rice var. Pusa Basmati-1 in Saran district of Bihar and found that the highest effect was observed when 10 kg $ZnSO_4$/ha was used.

Key words: Rice, *Oriza sativa* L., Zinc, Yield, Growth

INTRODUCTION

Rice (Oryza sativa L.) being the principal and the stable food for more than half of the world population and is one of the most important food grains of world's inhabitants which provides 21% and 15% per capita of dietary energy and protein, respectively [1]. The hope for better nourishment of the population depends upon the development of better rice varieties and improved methods for rice production and processing.

Among the rice germplasms, scented rice is dominating group due to its quality like size and shape of grain, appearance, hulling and milling, cooking quality and other qualities, which include scent and linear expansion of kernel on cooking. It has higher export value in the international rice market. Basmati rice is widely grown in an area of 10.2 lakh hectares including Haryana, Punjab, parts of Uttar Pradesh and Uttarakhand that produces 6 – 6.5 lakh tones of milled rice annually, about 60% of it is now exported. Besides this, it is also grown in Delhi, Rajasthan, Jammu and Kashmir hills and moderate low temperature areas of Tamilnadu, Andhra Pradesh, Bihar, West Bengal and Assam. Now on production point of view, some new Basmati rice are evolved under high yielding group viz., Pusa Basmati – 1, Haryana Basmati, Kasturi etc. These are early maturing high yielder and long slender.
Zinc is one of the most important micronutrient essential for plant growthespecially for rice grown under submerged condition. Zinc is a majorcomponent and activator of several enzymes involved in metabolic activities. Zinc deficiency continues to be one of the keyfactors in determining rice production in several parts of the country [2].Zinc deficiency in rice has been reported in lowland rice of India [3].

Zincdeficiency in plant is noticed when the supply of zinc to the rice plant is inadequate. Among the many factors which influence zinc supply to the plants, pH, concentration of zinc, iron, manganese and phosphorus in soil solution are very important. Brar and Sekon (1976)[4]stated that decrease in availability of zinc in submerged soils are due to the formation of insoluble franklinite ($ZnFe_2O_4$) compound (submerged soil), insoluble ZnS (intense reduced condition), insoluble $ZnCO_3$ (partial pressure of CO_2 coupled with decomposition of OM) and insoluble $Zn(OH)_2$ (alkaline pH).

Zinc deficiency is usually corrected by application of zinc sulfate. Zinc deficiency and response of rice to zinc under flooded condition have been studied by many workers [5]. The literature survey revealed that no such works have been done by anyone especially in Saran division of Bihar. Keeping in view of the importance of zinc nutrition and its use efficiency in growth and yield of rice, the field experiments were conducted at the Agricultural Farm in Newaji Tola in Chapra of Saran division of Bihar.

MATERIALS AND METHODS

Experimental site

The field experiments were conducted at the Agricultural Farm in Newaji Tola in Saran district of Bihar, which is located approximately 3 km of Chapra town, at an elevation of 98 m above mean sea level at 25.97° N longitude and 81.15° E latitude during Kharif season of year 2012 and 2013 consecutively. All the facilities necessary for cultivation, including labour, irrigation were readily available.The soil physio-chemical properties of the experimental site were studied from soil samples collected at 20 cm – 30 cm depth randomly from the experimental plots. The results of some selected soil physio-chemical properties are presented in Table 1.

Table-1: Selected Physio-chemical of the soil on the experimental site

Characteristics	Average range
Soil type	Sandy loamy
EC(ds/m)	0.08 –0.12
pH	7.6 – 7.8
Organic carbon (%)	0.71 – 0.73
Available Nitrogen (kg/ha)	208.00 – 210.00
Available Phosphorus (kg/ha)	17.34 – 17.50
Available Potassium (kg/ha)	148.03 – 150.16
Zinc (kg/ha)	4.58 – 5.70

Four high zinc groups and four low zinc types rice genotypes were sown in the field at the rate 20kg/ha and transplanting of seedling (3-4 seedlings/ hill) were done 25 days after sowing, with a spacing ofrow to row 20 cm & plant to plant 15 cm. Seeds were sown in field in a randomized complete block design (RCBD) with four treatments (0kg/ha ZnSO4, 05kg/ha ZnSO4, 10kg/ha ZnSO4 and 20kg/ha ZnSO4) and four replications. Required agronomic management practices were followed as per recommended package. The experiments were conducted under irrigated shallow low / medium land situation, medium in fertility with good drainage facility the results of the experiment were statistically evaluated in the form of Analysis of Variance (ANOVA).

RESULTS AND DISCUSSION

The result of the present investigation, regarding the influence of different level of Zinc and its interaction on growth and yield of rice crop have been presented in tables, wherever required. The result has been interpreted in the light of impact of different treatment during the experimentation. The results have been divided into the following two sub-headings:

1. Vegetative Growth Parameters:

These parameters included plant growth, plant Height (cm), plant dry weight (g), number of tillers / m^2, number of effective tillers / m^2, crop growth rate (g / m^2 /day), and relative growth rate (g / g / day).

The experimental results observed for different parameters are presented in Table-2.

Table – 2: Effect of different levels of Zinc and different stage on crop of Rice (Oryza sativa L.) var. Pusa Basmati-1 at different intervals (2012-2013)

Factors	Plant Height (cm)				Plant dry weight (g)				Number of tillers / m^2			
	60 DAT		80 DAT		60 DAT		80 DAT		60 DAT		80 DAT	
Zinc (N)	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
N_0 (0 kg ha^{-1})	58.54	60.64	86.76	89.80	19.07	19.74	47.46	49.30	464	480	466	482
N_1 (5 kg ha^{-1})	77.20	79.88	94.56	97.95	22.97	23.85	58.63	60.47	637	659	638	661
N_2 (10 kg ha^{-1})	78.51	81.39	97.94	101.53	25.61	26.67	63.56	65.86	737	763	646	669
N_3 (20 kg ha^{-1})	78.25	81.13	95.69	99.15	23.71	24.70	60.93	63.14	640	663	640	663

Factors	Number of effective tillers / m^2				Crop growth rate (g / m^2 /day)		Relative growth rate (g / g / day)	
	60 DAT		80 DAT		61 - 80 DAT		61 - 80 DAT	
Zinc (N)	2012	2013	2012	2013	2012	2013	2012	2013
N_0 (0 kg ha^{-1})	213	220	217	225	49.71	51.68	0.0431	0.0431
N_1 (5 kg ha^{-1})	287	297	292	302	63.09	65.40	0.0476	0.0476
N_2 (10 kg ha^{-1})	300	311	306	317	66.01	68.09	0.0483	0.0481
N_3 (20 kg ha^{-1})	298	308	304	314	64.95	66.65	0.0481	0.0480

It is observed that in the second year of experimentation (2013) the vegetative growth against all the parameters registered slightly higher as compared to the first year (2012) at the all stages of growth, which might have been due to better agro-climatic conditions in the second year as well as nutrient uptake by the experimental field during the first year.The increase in the zinc content in grain and straw might be due to the presence of increased amount of Zn in soil solution by the application of zinc that facilitated greater absorption. Increase in Zn content in grain and straw due to zinc fertilization was reported earlier [6-7]. The zinc contentwas higher in grain than in straw. Similar results were reported by others [5(a)].

2. Yield and yield attributes:

These parameters included length of panicle (cm), number of grains per panicle, number of filled grains per panicle, number of unfilled grains per panicle, test weight (g), grain yield (q ha^{-1}), straw yield (q ha^{-1}) and harvest index.

The length of panicle is recorded at the end of the vegetative growth of the crop during two years of experimentation, are shown in the table-3. In the second year (2013) the panicle were longer as compared to the first year (2012) probably due to intake of nutrients by the experimental field in first year as well as better climatic conditions in the second year. In the second year (2013) the number of grains per panicle was little more than the first year (2012) which might be attributable to better soil health and agro-climatic conditions in the second year. Higher number of filled grains per panicle was recorded in the second year as compared to the first year, perhaps due to better climatic condition and initial soil fertility in the second year. In the second year (2013) the test weight of grains was higher as compared to first year 2012) due to comparatively better vegetative growth of plants during this period. In the second year (2013) the grain yield was higher as compared to first year (2012) due to comparatively better initial soil health coupled with better agro-climatic conditions in the second year. In the second year (2013) the straw yield was higher as compared to first year (2012) due to better growth and grain yield during the second year. Harvest index was marginally higher in 2013 as compared to 2012, due to higher biological and economic yield during the second year. It is also observed that in the second year of experimentation (2013) the vegetative growth against all the parameters registered slightly higher as compared to the first year (2012) in relation to growth, yield and yield attributes, which might have been due to better agro-climatic conditions in the second year as well as nutrient uptake by the experimental field during the first year[9,10].

Table-3: Effect of different levels of Zinc on yield and yield attributes

Factors	Length of panicle (cm)		Grains per panicle		Filled grains per panicle		Unfilled grains per panicle	
	Test weight (g)		Test weight (g)		Test weight (g)		Test weight (g)	
Zinc (N)	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
N_0 (0 kg ha^{-1})	16.00	16.57	80.37	83.23	74.48	77.13	5.93	6.14
N_1 (5 kg ha^{-1})	21.20	21.95	92.71	96.01	82.54	85.48	10.21	10.57
N_2 (10 kg ha^{-1})	22.59	23.39	96.37	99.80	84.67	87.68	11.75	12.16
N_3 (20 kg ha^{-1})	22.24	23.03	95.04	98.42	83.71	86.69	11.37	11.78

Factors	Test weight (g)		Grain yield (q/ha)		Straw yield (q/ha)		Harvest index.	
	Test weight (g)		Test weight (g)		Test weight (g)		Test weight (g)	
Zinc (N)	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
N_0 (0 kg ha^{-1})	21.48	22.25	23.48	24.32	44.73	46.37	34.52	34.50
N_1 (5 kg ha^{-1})	23.15	23.98	30.14	31.21	61.93	64.25	32.83	32.78
N_2 (10 kg ha^{-1})	24.12	24.97	31.34	32.45	67.23	69.25	31.82	31.94
N_3 (20 kg ha^{-1})	23.05	24.29	30.94	32.04	65.68	67.44	32.06	32.25

CONCLUSION

On the basis of the results obtained in the present experiment, it may be concluded that application of Zinc @ 10 kg ha^{-1} (Zn)was found optimum level for growth, yield attributes and yield of the crop, over all other treatment combinations in relation to growth, yield and post harvest under existing agro climatic conditions of Bihar and hence can be recommended.

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