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RESEARCH PAPER

Effect of sulphur and zinc levels on yield and nutrient uptake by hybrid rice in partially reclaimed sodic soil

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Abstract : A field experiment was conducted to study the individual and interactive effect of S and Zn on yield and uptake of nutrients by hybrid rice. Application of 60 kg S ha^{-1} recorded significantly higher grain and straw yield and sulphur uptake. Similarly significant response of rice to Zn addition was recorded up to 15 kg^{-1}. Increase in S and Zn levels increased significantly their uptake by rice crop. The interaction of S and Zn was non significant and the highest grain and straw yield were recorded with the combined application of 60 kg S and 15 kg Zn ha^{-1}. Nitrogen, sulphur and zinc uptake in crop increased significantly with S and Zn additions in all treatments.

Key Words : Hybrid rice, Sulphur, Zinc, Yield, Nutrients uptake

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INTRODUCTION

Among the nutritional disorder zinc deficiency has been recognized as an important and wide spread deficiency in rice. The deficiency of sulphur is also coming up as a serious problem in plant nutrition, mostly in light textured and sodic soils. Sulphur losses from soil through leaching and erosion are important reasons forever growing incidence of 'S' deficiency in the soil. Wide spread sulphur deficiency has been observed in crop and soils in 30 districts of the eastern Uttar Pradesh irrespective of soil texture and cropping pattern Zinc deficiency has been recognized as an important and wide spread nutritional disorder of rice. That reported wide spread deficiency of Zn in various districts of Uttar Pradesh and observed DTPA zinc in the range of 0.08 to 9.76 ppm. The annual increase in demand in India is estimated to be 2.6 million tones of rice. Hybrid rice is the practically feasible and adoptable technology for enhancement of rice production and productivity. Hybrids have recorded 15-20 per cent higher yield than the high yielding varieties on the farmers' fields. The relationship between sulphur and zinc has been studied by several workers in different crops, but the interaction between different level of sulphur and zinc in hybrid rice specially is partially reclaimed sodic soil is of great importance and very little investigation has been done. Hence, a field experiment was conducted to investigate the response of hybrid rice to sulphur and zinc application.

MATERIAL AND METHODS

The field experiment was conducted during *Kharif* 2010 and 2011 in Randomized Block Design using hybrid rice a test crop. The average of two years data is given in the Table A. The soil was sodic (pH 8.2) in reaction. It had 0.29 $mgkg^{-1}$ organic carbon, available S 14.09 kg ha^{-1} and Zn 0.45 ppm and also available N 145.72kg ha^{-1}. The treatments consisted of four levels of S (0, 20, 40, 60 kg ha^{-1}) and zinc (0, 5, 10, 15 kg ha^{-1}). Sulphur and zinc were applied basal dressing through elemental sulphur and zinc oxide, respectively. Nitrogen, phosphorus and potassium were applied @ 150, 60, 40 kg ha^{-1} through urea, DAP and muriate of potash, respectively. Initially half dose of N was given at the time of planting and remaining half in two equal splits at tillering and panicle initiation stages of growth. At maturity

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Table A : Chemical properties of soil before the sowing the hybrid rice

Soil characters	pH	EC (dSm^{-1})	Organic carbon ($mgkg^{-1}$)	Exchangeable sodium (m.e./100g soil)	Available nitrogen (kg ha^{-1})	Available P_2O_5 (kg ha^{-1})	Available K_2O (kg ha^{-1})	Available S (kg ha^{-1})	Available Zn (ppm)
Value	8.2	0.37	2.90	16.50	145.72	17.50	215.20	14.09	0.45

grain and straw yields were recorded. Nitrogen was determined in the hybrid rice grain and straw samples by Kjeldahl's method (Jackson, 1973). Phosphorus was estimated by tri-acid mixture as described by Jackson (1973). Sulphur content was determined by turbidimetric method following Chesnin and Yien (1953). The zinc content in grain and straw of hybrid rice was estimated by the use of DTPA extractant an atomic absorption spectrophotometer following Lindsay and Norvell (1978).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Grain and straw yield :

Data on grain and straw yield are presented in Table 1. Maximum grain and straw yield was recorded in treatment S_3 (60 kg S ha^{-1}). The rice yield was 70.00 qha^{-1}, which was at par with S_2 (40 kg ha^{-1}) with respect to grain and straw yield. Maximum grain yield was obtained with the application of Zn_3 (15 kg ha^{-1}). The rice yield was 68.50 q ha^{-1} and straw yield was 73.65 q ha^{-1}, which was at par with Zn_2 (40 kg ha^{-1}). Higher magnitude of grain yield response than straw indicates greater contribution of S in grain production. Slaton *et al.* (2005) and Pooniya and Shivay (2011) reported that 40 kg S $ha^{-1}$and 15 kg Zn ha^{-1} was optimum dose for most of the crop under field conditions.

Table 1 : Effect of S and Zn levels on grain and strew yield (q ha^{-1}) of hybrid rice

Treatments	Grain yield(qha^{-1})		Straw yield(qha^{-1})	
	2010	2011	2010	2011
S_0	52.40	53.00	61.37	60.88
S_1	60.00	58.00	64.96	64.35
S_2	66.25	64.25	70.57	70.00
S_3	70.00	67.00	72.47	72.48
S.E.±	1.93	1.31	1.01	1.05
C.D. (P=0.05)	6.0	4.07	3.12	3.25
Zn_0	54.50	52.50	61.40	59.27
Zn_1	60.25	58.00	65.75	65.08
Zn_2	66.50	63.80	70.75	70.01
Zn_3	68.50	66.75	73.65	72.35
S.E.±	1.93	1.31	1.01	1.05
C.D. (P=0.05)	6.0	4.07	3.12	3.25

S and Zn uptake of nutrients by hybrid rice crop:

The uptake of Zn by grain increased significantly with increasing levels of Zn from 1.19 to 1.40 kg ha^{-1} in both the year (Table 2). Increasing levels of sulphur to 60 kg ha^{-1} significantly increased the zinc uptake by hybrid rice crop showing synergetic effect of higher level. Application of S significantly increased the S uptake by hybrid rice crop from 14.74 to 18.76 kg ha^{-1}, respectively. This increase in S uptake may be attributed to increase of S content in plant and dry matter yield. The uptake of S was also influenced significantly by Zn application. Uptake of S increased up to 15 kg Zn ha^{-1} and then increased at higher level due to synergetic effect of Zn on S.

Increasing levels of S and Zn progressively enhanced the total N uptake by rice from 164.00 to 190.84 kg ha^{-1} in both the year. This increase in N uptake may be attributed to

Table 2 : Effect of S and Zn on uptake of nutrients by rice crop

Treatments	N uptake		S uptake		Zn uptake	
	2010	2011	2010	2011	2010	2011
S_0	164.00	164.92	15.13	14.92	1.22	1.19
S_1	173.41	174.09	15.52	15.23	1.25	1.24
S_2	185.00	185.28	17.67	16.78	1.31	1.30
S_3	190.16	190.84	18.76	17.70	1.37	1.34
S.E.±	2.49	2.46	0.34	0.24	0.01	0.01
C.D. (P=0.05)	7.47	7.40	1.03	0.74	0.04	0.04
Zn_0	166.25	166.70	15.42	14.74	1.27	1.22
Zn_1	174.58	175.16	16.63	15.85	1.28	1.24
Zn_2	186.00	182.59	17.31	16.75	1.35	1.31
Zn_3	189.75	190.68	17.73	17.29	1.40	1.36
S.E.±	2.49	2.46	0.34	0.24	0.01	0.01
C.D. (P=0.05)	7.47	7.40	1.03	0.74	0.04	0.04

increase in N content of plant yield of hybrid rice due to rising S and Zn levels. Such synergistic relationship between N and S was reported by Singh and Singh (2008) and Rahman *et al.* (2008) in rice crop.

Conclusion:

It may be concluded that application of 40 kg S ha^{-1} might be necessary for obtaining satisfactory yield of rice in partially reclaimed sodic soil and application of 10 kg Zn ha^{-1} might give an added benefit.

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