INFLUENCE OF ZINC UNDER DIFFERENT MOISTURE REGIMES ON YIELD AND NUTRIENT UPTAKE OF RICE IN INCEPTISOL

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ABSTRACT

Field experiment was conducted in rice consisting of three moisture regimes (25, 50 and 75 mm irrigation) and four levels of zinc sulphate (0, 15, 30 and 45 kg ha\(^{-1}\)) replicated thrice under factorial randomized block design. The grain, straw yield and the uptake of N, P and K by rice increased significantly with increasing levels of zinc up to 30 kg ZnSO\(_4\) ha\(^{-1}\). The relative uptake of zinc was higher at the first level of 15 kg ZnSO\(_4\) ha\(^{-1}\) rather than respective higher doses. A slight increase in the grain and straw yield of rice was observed with higher moisture regimes. The productivity and uptake of various nutrients by rice were highest at 30 kg ZnSO\(_4\) ha\(^{-1}\) and 75 mm of irrigation.

Key words : Zinc, Moisture regimes, Productivity.

Micro-nutrient deficiencies are becoming serious because of escalated nutrient demand from more intensive and exploitative agriculture. This is particularly of greater concern in case of zinc due to its nutritional importance as it is required for several biochemical processes in the rice plant, such as cytochrome and nucleotide synthesis, auxin metabolism, chlorophyll production, enzyme activation, and membrane integrity (Anonymous, 2000). Zinc deficiency is prevalent worldwide and is a barrier for achieving yield goals in crops. In the last few years, the induction of zinc deficiency has increased due to the replacement of traditional rice varieties by modern varieties that are less tolerant to zinc deficiency, removal of large amount of zinc by modern high yield potential varieties, continuous cropping without rotation and excessive phosphate fertilizer use. Thus, zinc is becoming the most important nutritional factor, limiting the grain yield of rice especially in light textured soils. Recovery of applied nutrients is mainly governed by available soil moisture. Thus, scheduling of water supply at the most critical growth stages would boost the crop production efficiency on one hand and water economy on other hand. Therefore, it has become necessary to search for an approach where in efficiency of fertilizer nutrient could be increased by optimum application of nutrients particularly zinc at proper water regimes. Considering the above facts, the present investigation was undertaken.

A field experiment was conducted on rice at research farm during kharif season, 2007. The treatment combinations consisting of three moisture regimes (25, 50 and 75 mm irrigation) and four levels of zinc sulphate (0, 15, 30 and 45 kg ha\(^{-1}\)) were replicated thrice under factorial randomized block design. The dose of N, P and K as per recommendation, viz. 50, 30 and 25 kg ha\(^{-1}\) were applied through urea, diammonium phosphate and murate of potash, respectively. The initial soil properties of experimental field were pH 6.8, EC 0.13 dS m\(^{-1}\), organic carbon 0.48 percent, available nitrogen 268, phosphorus 18.5, potassium 116 kg ha\(^{-1}\), respectively and zinc 0.4 mg kg\(^{-1}\). The rice cultivar IET 1410 was transplanted in the month of July 2007 and harvested in October 2007. The dry matter yield was recorded as per treatments. The grain and straw samples were analyzed for N, P, and
K content and their total uptake was worked out (Jackson, 1978). The zinc content of grain and straw samples was analyzed by atomic absorption spectrophotometer (Lindsay and Norvell, 1978) and its uptake was calculated.

The application of varying levels of zinc had a significant effect on grain and straw yield of rice (Table 1). The grain and straw yield increased significantly with increasing levels of zinc up to 30 kg ZnSO₄ ha⁻¹. However, the degree of response was higher at lower rate of 15 kg ZnSO₄ ha⁻¹. Application of ZnSO₄ at the rate of 30 kg ha⁻¹ increased the average grain and straw yield from 2069 to 2924 and 3250 to 4364 kg ha⁻¹, respectively. The control plot produced the lowest grain and straw yield than the treated one. The balanced application of ZnSO₄ up to 30 kg ha⁻¹ in the soil might have favoured the use efficiency of zinc by rice crop. These results are coinciding with the observation of Paramasivam et al. (1992) and Zhu et al. (2008).

The uptake of N, P and K by rice increased significantly with increasing levels of zinc up to 30 kg ZnSO₄ ha⁻¹ and thereafter the uptake of P declined. A progressive decrease in P content of grain and straw and an increase in N, K and Zn content in grain and straw was observed with an increase in the level of zinc. Negative responses of zinc at higher level might be attributed to reciprocal inactivation of P in the roots thereby inhibiting the translocation of these nutrients to upper plant parts (Khan and Zende, 1977). A positive correlation was found between the concentration of zinc in the rice grain and the concentrations of zinc in the soil. The increasing levels of ZnSO₄ resulted in increase in zinc uptake continuously by grain and straw of rice but level of significance was observed up to 30 kg ZnSO₄ ha⁻¹. The positive correlation between the zinc and dry matter yield of the rice has also been reported by Rahman et al (2007). However, the values of 30 and 45 kg ZnSO₄ were at par. The relative uptake of zinc was higher at the first level of 15 kg ZnSO₄ ha⁻¹ rather than respective higher doses. These observations are in line with that reported by Khurana et al. (2002) and Bansal and Patel (2008).

Grain and straw yields of rice also varied slightly with different moisture regimes. However, no marked effect was observed on grain and straw yield as the minimum moisture level was sufficient to meet the requirement of the crop.

**CONCLUSION**

Rice is the dominant cereal crop in many developing countries and is the staple food for more
than half of the world’s population. Zinc is the critical element for the rice as it has direct role in the physiology of the plant besides it improves the milling quality and shape of the rice grain as well. Hence, to customize the zinc requirement of rice with moisture regime and soil type is the need of the hour. In the present study, the percent utilization of zinc by the grain and straw of rice was highest at 75 mm of irrigation level and 30 kg ZnSO₄ ha⁻¹.

REFERENCES