ROLE OF ZINC APPLICATION ON RICE GROWTH AND YIELD

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Abstract
Zinc is an important nutrient for the healthy growth and development of plants among the micronutrients. Zinc deficiency is common in high pH soils. The widespread deficiency of nitrogen and phosphorus is followed by Zn deficiency. Grain yield may be enhanced by application of zinc in soil; however concentration of zinc can be improved by foliar spray of Zn fertilizer. Based on various studies, soil and foliar applications of zinc enhance the yield of crops. Flood-irrigated rice is highly sensitive to Zn deficiency and zinc availability can be increased by improving organic content and soil pH.

Key Words: Rice, growth, yield, zinc.

Introduction
Among the micronutrients, zinc (Zn) deficiency is considered as a major threat to the global and regional food security (Rana and Kashif, 2014) as it is the most deficient micronutrient in soils worldwide (Cakmak, 2002; Shivay et al., 2008) and more than 30% of soils have low Zn availability (Alloway, 2008; Gibbson, 2006). In high rice consuming areas, zinc deficiency caused yield reduction and Zn malnutrition in humans (Tiong et al., 2014; Yao et al., 2012). Zn act as an essential component of many enzymes and controls several biochemical processes in the plants required for growth (IRRI, 2000).

Sudha and Stalin, 2015 reported, reduced rice grain yields with low zinc concentrations when there is low supply of zinc. Flood-irrigated rice is more prone to Zn deficiency (Rehman et al., 2012) as submergence condition of rice cultivation influences electrochemical and biochemical reactions and alters pH, PCO₂ as well as the concentration of certain ions.

Increase in paddy yield with Zn has been reported in literature. The grain and straw yield of in different rice genotypes significantly increased to the tune of 14 and 16% respectively with the application of zinc (Sudha and Stalin, 2015). The increasing levels of zinc supply to rice increased the total zinc content per plant at different growth stages and have beneficial effect on tiller production (Impa et al., 2013; Sarwar et al., 2013). Keram et al., 2013 reported that treatments applied with increasing levels of Zn produced more grain and straw yields as compared to treatments applied with NPK alone. Naik and Das (2010) reported that the application of zinc in low land rice soil of West Bengal caused an increase in yield of grain and straw respectively over the control to the tune of 37.8% and 20.9%. In an experiment Abbas et al., (2013) studied that Zn and B application increased the paddy yield. Similar results were observed by Arif and Muhammad (2012).

Due to high cost of fertilizers containing Zn, their use is limited for checking its deficiency (Mustafa et al., 2011). Amongst different methods, the foliar spray of zinc is an efficient one for enhancement of crop productivity. Foliar application of Zn post flowering is effective in increasing zinc in rice grains (Boonchuay et al., 2013 and Yuan et al., 2013). Applying Zn to the soil and treating seeds or plants increase plant yields (Naik and Das, 2007; Shivay et al., 2008; Rehman et al., 2012). Results reported by Mahmoodi and Mogadam, 2015 showed that the increasing Zn concentration in foliar application, increased yield and yield components of rice significantly. Soil applied zinc enhanced rice grain yield as compared to foliar spray (Guo et al., 2016).

The Zn efficiency varied with crop stages with some of the genotypes susceptible at early vegetative and some recovered at peak stage. Phattarakul et al., 2012 found that more increase in grain Zn was there when applied by foliar application at early milk plus dough stages. The application of zinc @ 20 kg Zn ha⁻¹ as basal plus foliar spray was found to have positive and significant influence...
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on grain yield and Zn uptake (Kulhare et al., 2016).

Soil application combined with 0.5% foliar spray (FS) at maximum tillering and panicle initiation (PI) stages reported the highest Zn content in rice grain parts (Ghasal et al., 2017). 15 kg Zn ha⁻¹ along with proper spacing and nitrogen dose recorded highest grain and stover yield in maize (Devi and Ghosh, 2017).

Materials and Methods

A field experiment conducted at farm of Lovely Professional University situated at 31°02′ to 31°08′N and 75°22′ to 75°23′E with an altitude 252 meters m.s.l, which falls under Trans-Gangetic plain region of agro climatic zone of Punjab during kharif, 2017. Eight treatments replicated three times in a randomized block design. Transplanted and direct seeded rice were taken with recommended dose of fertilizers and application of zinc through basal dose and foliar spray methods.

Results and Discussion

The results showed that direct seeded rice observed higher grain yield as compared to transplanted rice. Out of the methods of zinc application (basal and foliar spray @ 0.5%) basal application of zinc proved to be beneficial in getting higher grain yield when applied to direct seeded rice. Both basal application and foliar spray of zinc had the similar effect on transplanted rice as grain yield in both T₅ and T₆ treatments are at par (fig 1 a & b). Direct seeded rice superseded in terms of grain yield production as compared to transplanted rice even in control plots also. Straw yield showed the same trend as grain yield.

Conclusion

Basal application of zinc in direct seeded rice showed a lead in grain yield as compared to foliar spray. Based on the results, direct seeded rice practice may be suggested to the farmers to reduce cost of cultivation on water and time and labour management, but not at the cost of yield reduction.

References


Fig. 1a & b: Effect of Zn application on grain and straw yield of rice.


