Plant Archives Vol. 18 No. 2, 2018 pp. 1382-1384 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

ROLE OF ZINC APPLICATION ON RICE GROWTH AND YIELD

Vandna Chhabra* and Rajesh Kumar

Lovely Professional University, Phagwara-144411, Punjab

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, PCO_2 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

***Author for correspondence :** E-mail : vandna.21027@lpu.co.in

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 $31^0$22' to $31^0$81'N and $75^0$23'to 3^0.02'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 T_5 and T_6 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.

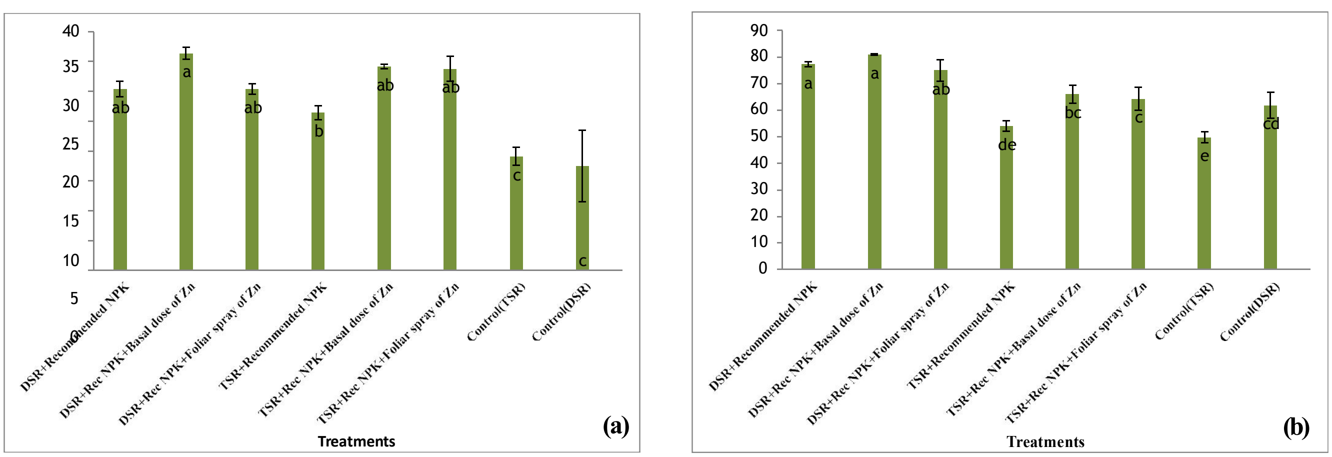

Fig. 1a & b: Effect of Zn application on grain and straw yield of rice.

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

Abbas, M., T.M. Zahida, R. Uddin, I. Sajjid, A. Akhlaq, K. Moheyuddin, J. Salahuddin, A.H. Mari and R.N. Panhwar (2013). Effect of Zinc and Boron Fertilizers Application on Some Physicochemical Attributes of Five Rice Varieties Grown in Agro-Ecosystem of Sindh, Pakistan. *American-Eurasian J. Agric. & Environ. Sci.,* **13(4)**: 433-439.

Alloway, B.J. (2008). Zinc in soils and crop nutrition, Second edition, published by IZA and IFA Brussels, Belgium and Paris, France.

Arif, M. and A.S. Muhammad (2012). Chlorophyll contents and yield attributes in rice. *African J. Biotech,* **11(48)**: 10851-10858.

Boonchuay, P., I. Cakmak, B. Rerkasem, and C. Prom-U-Thai (2013). Effect of different foliar zinc application at different growth stages on seed zinc concentration and its impact on seedling vigor in rice. *Soil Sci. Plant Nutr.,* **59**:180-188.

Cakmak, I. (2002). Plant nutrition research: priorities to meet human needs for food in sustainable ways. *Plant & Soil,* 247:3-24.

Devi, H.S. and G. Ghosh (2017). Effect of planting geometry, nitrogen levels and zinc application on growth and yield of hybrid maize (*Zea mays* L.). *Journal of Pharmacognosy and Phytochemistry,* **6(4)**: 1067-1069.

Ghasal, P.C., Y. Singh, V. Shivay Pooniya,M. Choudhary and R.K. Verma (2017). Response of basmati rice (*Oryza sativa*) varieties to zinc fertilization. *Indian Journal of Agronomy,* **60**: 403-409.

Gibbson, R.S. (2006). Zinc: the missing link in combating micronutrient malnutrition in developing countries. Proceedings of the Nutrition Society, University of East.

Guo, J.X., X.M. Feng, X.Y. Hu, G.L. Tian, N. Ling, J.H. Wang, Q.R. Shen and S.W. Guo (2016). Effects of soil zinc availability, nitrogen fertilizer rate and zinc fertilizer application method on zinc biofortification of rice. *The Journal of Agricultural Science,* **54(4)**: 584-597.

Impa, S.M., M.J. Morete, A.M. Ismail, R. Schulin and S.E. Johnson-Beebout (2013). Zn uptake, translocation, and grain Zn loading in rice (*Oryza sativa* L.) genotypes selected for Zn deficiency tolerance and high grain Zn. *J. Exp. Bot.,* **64**: 2739–2751.

IRRI (2000). Nutritional disorders and nutrient management in rice. *Inter. Rice Res. Ins. Manila,* Philippines.

Keram, K.S., B.L. Sharma and S.D. Sawarkar (2013). Impact of Zn application on yield, quality, nutrients uptake and soil fertility in a medium deep black soil (vertisol) http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.301.9805.

Kulhare, P.S., G.S. Tagore and G.D. Sharma (2016). Effect of zinc fertilization on yield and zinc uptake efficiency of rice genotypes grown in central India. *International Journal of Agriculture Sciences,* **8(2)**: 964-967.

Mahmoodi, B. and M.N. Mogadam (2015). Effect of Zn application on yield and yield components of rice. *Research Journal of Fisheries and Hydrobiology,* **10(11)**: 72-77.

Mustafa, G., A.N. Ehsanullah, S.A. Qaisrani, A. Iqbal, H.Z. Khan, K. Jabran, A.A. Chattha, R. Trethowan, T. Chattha and B.M. Atta (2011). Effect of zinc application on growth and yield of rice (*Oryza sativa* L.). *Int. J. Agro Vet. Med. Sci.,* **5**: 530-535.

Naik, S.K. and D.K. Das (2007). Effect of split application of zinc on yield of rice (*Oryza sativa* L.) in an Inceptisol. *Arch. Agron. Soil Sci.,* **53(3)**: 305- 313.

Naik, S.K. and D.K. Das (2010). Evaluation of various zinc extractants in low land rice soil under the influence of zinc sulphate and chealated zinc. *Communi. Soil. Sci. and Pl. Anal.,* **41**: 122-134.

Phattarakul, N., B. Rerkasem, L.J. Li, L.H. Wu, C.Q. Zou, H. Ram, V.S. Sohu, B.S. Kang, H. Surek, M. Kalayci, A. Yazici, F.S. Zhang and I. Cakmak (2012). Biofortification of rice grain with zinc through zinc fertilization in different countries. *Plant and Soil,* **361**: 131-141.

Rana, W.H. and S.R. Kashif (2014). Effect of different zinc sources and methods of application on rice yield and nutrients concentration in rice grain and straw. *Journal of Environmental and Agricultural Sciences,* 1–9.

Rehman, H.U., T. Aziz and M. Farooq (2012). Zinc nutrition in rice production systems: A review. *Plant Soil,* **361(1-2)**: 203–226. doi: 10.1007/s11104-012-1346-9.

Sudha, S. and P. Stalin (2015). Effect of zinc on yield, quality and grain zinc content of rice genotypes. *International Journal of Farm Sciences,* **5(3)**: 17-27.

Sarwar, N., H. Ali, A. Ahmad, E. Ullah, S. Ahmad, K. Mubeen and J.E. Hill (2013). Water wise rice cultivation on calcareous soil with the addition of essential micronutrients. *J. Anim. Plant Sci.,* **23(10)**: 244.

Shivay, Y.S., D. Kumar, R. Prasad and I.P.S. Ahlawat (2008). Relative yield and zinc uptake by rice from zinc sulphate and zinc oxide coatings onto urea. *Nutr. Cycl. Agroecosys,* **80**: 181– 188.

Tiong, J., G.K. McDonald and Y. Genc (2014). HvZIP7 mediates zinc accumulation in barley (*Hordeum vulgare*) at moderately high zinc supply. *New Phytol.,* **201(1)**:131–143.

Yao, F., J. Huang and K. Cui (2012). Agronomic performance of high-yielding rice variety grown under alternate wetting and drying irrigation. *Field Crops Res.,* **126**:16–22.

Yuan, L., W. Lianghuan, Y. Chunlei and L.V. Qian (2013). Effects of iron and zinc foliar applications on rice plants and their grain accumulation and grain nutritional quality. *J. Sci. Food Agric.,* **93**: 254–261.