Alleviation of Zinc Deficiency in Soils of Gujarat for Enhancing Yield and Zinc Concentration of Nutritionally Important Crops

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INTRODUCTION

There has been rise in Zn deficiency in soils of Gujarat due to changes in cropping patterns and adoption of intensive cropping. Low yields as a result of micronutrients deficiencies have been widely noticed in rice, wheat and other crops which subsequently reflects in inadequate Zn consumption by human beings due to dietary deficiency (Singh, 2009). Therefore, Zn supplementation in staple crops is essential for maintaining optimum Zn concentrations in soil, plant, seed/grain in order to enhance Zn concentration in blood plasma of human and animal.

METHODS

Zinc deficiency to the extent of 34 percent was noticed in soils of Gujarat based on analysis of 4,227 surface soil samples collected during past two decades under delineation programme. Zinc deficiency in soils was assessed using critical level of 0.5 mg kg^{-1} soil for DTPA-Zn (Lindsay and Norvell, 1978). Several experiments on important field crops viz. *bajra*, groundnut, wheat, maize and rice at different locations were conducted using appropriate statistical design to find out the response of Zn supplementation through $ZnSO_4.7H_2O$ by different modes of application *viz.* soil, foliar, farmyard manure (FYM) enrichment. The standard packages of practices were followed in the experiments to grow the crops and grain yields were recorded.

Secondly, the non replicated trials (Frontline Demonstrations) on farmers' fields were conducted at different locations on some important crops (wheat, rice, *bajra*, mustard and groundnut) keeping different treatments including recommended Zn treatment (5 kg Zn ha^{-1}). The concentration of Zn in grain/seed samples were analyzed on an atomic absorption spectrophotometer (AAS) using diacid digestion mixture (HNO_3:$HClO_4$ 4:1); and mean Zn concentrations (mg kg^{-1}) were determined.

RESULTS AND DISCUSSION

Soil application of Zn (5 kg ha^{-1}), spray of multi-micronutrients mixture (customized inorganic fertilizer) and use of Zn-enriched FYM on soils marginal to deficient in Zn were found beneficial to correct Zn deficiency and increased crops yield significantly. The response by the crops to application of Zn varied from nine percent in maize to 29 percent in wheat (Table 1).

Table 1. Effect of Zn application on yield of different crops.

Sr. No.	Crop	Location	Period	Yield (kg ha^{-1})		Zn application details (method)	CD at 5%
				Control	Zn-Treated		
1	*Bajra*	Anand	2001-04	1919	2255	2.5 kg ha^{-1} through Zn-enriched FYM (soil)	185
2	Groundnut	Anand	1999-02	1111	1421	5 kg ha^{-1} (soil)	100
3	Wheat	Anand	1999-02	3677	4253	5 kg ha^{-1} (soil)	545
4	Maize	Godhra	2000-02	1636	2327	Multi-micronutrients mixture-4%Zn (1% foliar)	187
5	Rice	Navagam	1998-04	6171	6338	2.5 kg ha^{-1} (soil)	141

Zinc supplementation not only increased yield of crops but also enhanced mean Zn concentrationd of food grains as noticed in the Frontline Demonstration experiments conducted at different locations on wheat, rice, *bajra,* mustard and groundnut (Fig. 1). The adoption of the technologies by farmers confirmed the impact of Zn application in increasing Zn concentration of edible portions of crops over normal farmer's practice (control). Use of the multi-micronutrients mixture was found effective to enhance yield and concentrations in vegetables also (Patel *et al.*, 2009).

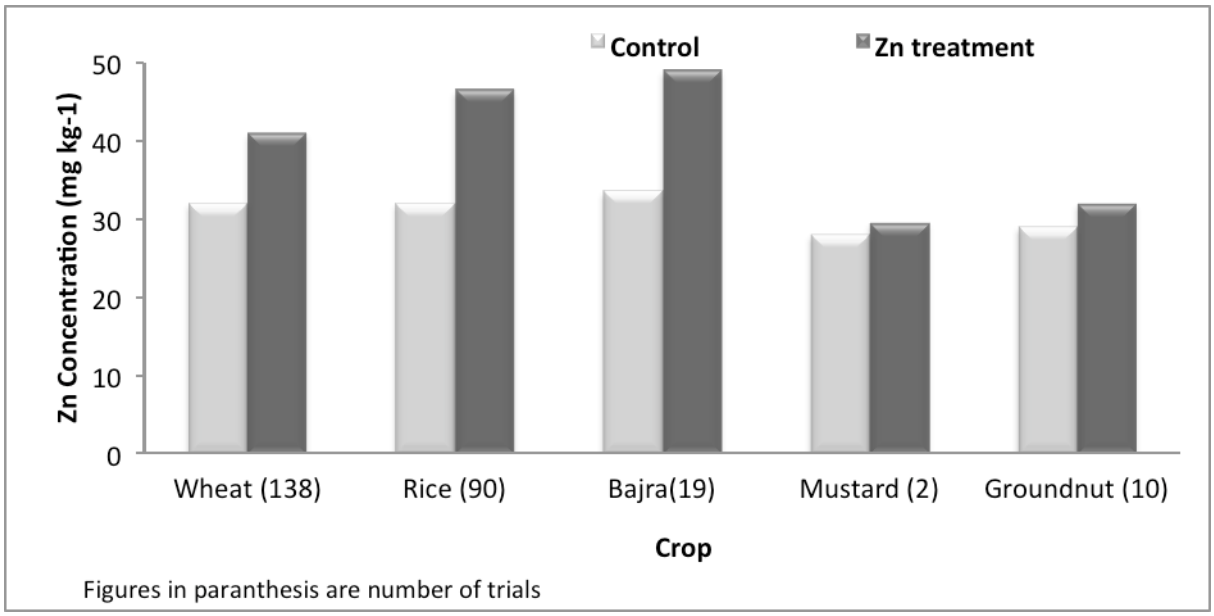

Fig. 1. Effect of Zn application on its concentration in edible parts of different crops.

CONCLUSIONS

The fertilization strategy for biofortification appears to be useful in improving yield and Zn concentrations in edible portions of nutritionally important crops. Therefore, inclusion of Zn in balanced fertilization for different crops/cropping systems has to be accomplished to improve human health while alleviating Zn deficiency in soils and crops.

ACKNOWLEDGEMENTS

The authors are grateful to the Indian Council of Agricultural Research, New Delhi and Anand Agricultural University, Anand for providing financial assistance and infrastructural facilities for conducting various experiments under AICRP on Micronutrients scheme at Anand centre.

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