

# Study of the Significance of Zinc Nutrition on Crop Productivity and Quality of Produce at Farmers' Fields in India

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## INTRODUCTION

Fertilizer consumption in India is highly skewed with wide inter-state, inter-district and inter-crop variations with respect to macro-nutrients and micronutrients coupled with the limited use of organic sources. This has led to a stagnation or a decline in crop yields even in the agriculturally progressive states such as Punjab and Haryana. Regarding total fertilizer consumption, 55% is confined to five states only, namely Uttar Pradesh, Andhra Pradesh, Maharashtra, Punjab and Karnataka. The per-hectare consumption varies from 212.7 kg ha<sup>-1</sup> in Punjab to less than 5 kg ha<sup>-1</sup> in Arunachal Pradesh, Nagaland and Sikkim, compared to the national average of 106.7 kg ha<sup>-1</sup> (Anonymous 2006).

Indian soils suffer from substantial deficiencies of nutrient elements, especially micronutrients. On an all-India basis, Zn deficiency is the most common and widespread (48%). Zinc is being recognized in India as the fourth important yield-limiting nutrient, next to N, P and K.

The factors responsible for accentuating Zn deficiency include the use of high-yielding varieties and intensive farming, increased use of DAP instead of single super phosphate (which contributes some Zn with Zn-impurities), regular use of urea (with a more acid forming effect) instead of ammonium sulphate, P-induced Zn deficiency and the use of qualitatively poor irrigation water without adequate drainage (Quijano-Guerta et al. 2002, Prasad 2006). Different crops showed appreciable responses to Zn nutrition, up to 500 kg ha<sup>-1</sup> in soils that are Zn-deficient or adequate in Zn status (Singh 1999). The present study was undertaken to evaluate the response of different crops to Zn fertilization in farm fields in different states of the country.

## METHODS

Soil samples were taken from farm fields and analyzed for their Zn status. Almost 50% of the soils sampled, especially from Rajasthan, were Zn-sufficient, and hence received no recommendation for Zn-fertilization. However, we decided to undertake Zn-based balanced-fertilization two plot-unreplicated demonstration trials, irrespective of the available Zn status of the soil sampled because of our understanding of widespread responses of different crops to Zn-fertilization. Thus, for this purpose, we used a uniform dose of 25 kg ha<sup>-1</sup> of ZnSO<sub>4</sub>·7H<sub>2</sub>O for different crops in all states. Zinc sulphate was applied as basal by spreading it before leveling the field for sowing. The field demonstrations were conducted mainly under the auspices of the DSCL's pioneered, long-term, integrated rural-development project called "Shriram Krishi Vikas Programme (SKVP)".

## RESULTS AND DISCUSSION

We found invariably satisfactory responses to Zn application in all crops and states. On average, the yield advantage with Zn application was per hectare 437.5 kg (10.7%) in wheat, 350 kg (5.6%) in paddy, 417.5 kg (18.3%) in cotton, 375 kg (19.1%) in pearl millet, 150 kg (6.6%) in mustard, 50.0 qtl (9.4%) in sugarcane, 25.5 qtl (9%) in potatoes, 150 kg (9.5%) in soybean and 4.5 qtl (18.8%) in onions. Table-1 embodies detailed data of the effects of Zn

application on some crops grown in Rajasthan. These results were generally in line with results of Singh (1999). In grain crops, such as wheat, paddy and mustard, yield increase was attributed mainly to more and bolder grains per ear head or pod with better colour and luster. In wheat, the number of grains per ear head increased on average by 8, and grains were bolder and more lustrous than in controls. Similar observations were recorded for mustard and paddy. In potato, onion and garlic, the proportion of smaller tubers and bulbs decreased, and skin colour and smoothness improved as well as sensitivity to bruising, especially in potatoes.

A characteristic effect on yield and quality of poppy (opium) was observed. The average yield increased by 20%, and there was a marked effect on quality. In poppy, milk formation occurred about 15 days earlier with better milk content. Zinc-treated 115-days old crops could receive 3-4 insertions (cuts) compared to one cut in controls. Treated crops matured earlier. The produce from Zn-plots had an attractive pinkish colour and obtained a better opium price on the market.

We also observed effects of Zn nutrition on the physical quality of produce, fewer incidences of pests and earlier crop maturities. As a result of better sized grains and tubers and better produce quality, the produce from Zn-treated fields generally got better acceptance and market prices.

The fact that in this study some soils, despite being classified as Zn-sufficient, exhibited good crop responses to Zn applications, especially in Rajasthan, could be explained from two points of view. Under dry-land conditions, as generally prevailing in Rajasthan, soil moisture decreases in the surface layer, reducing Zn absorption and possibly causing Zn deficiency. However, it is more likely that the soil test ratings are faulty. That would imply that the soil test reports and recommendations are not correct, thereby necessitating a thorough revision of the soil test ratings for Zn.

**Table 1: Effect of ZnSO<sub>4</sub> on the yield of different crops in Rajasthan (2003-04, 2006-07).**

Crop /Year	2003-04				2004-05			
	Demos	Average Yield (q/ha)			Demos	Average Yield (q/ha)		
		Control	Project	% increase		Control	Project	% increase
Wheat	19	44.5	50.8	14.2	17	40.5	50.3	24.2
Mustard	7	14.5	16.3	12.4	12	15.5	17.8	14.8
Bajra	9	25	32	28	12	26	31	19.2
Crop /Year	2005-06				2006-07			
	Demos	Average Yield (q/ha)			Demos	Average Yield (q/ha)		
		Control	Project	% increase		Control	Project	% increase
Wheat	10	39.3	48	22.1				
Mustard	5	14.5	17	17.2				
Onion	9	195	240	23.1				
Groundnut	11	26.3	31.5	19.8	8	24	32.5	35.4
Pearl millet					9	23	28.8	25.2

## CONCLUSIONS

There were characteristic responses of different crops to Zn application, in crop productivity and in physical produce quality. However, this was observed irrespective of initial soil test values of available Zn, especially in Rajasthan. This suggests that the soil-test ratings for Zn in Indian soils, particularly in Rajasthan, need a thorough revision that is based on multi-location and crop-response correlation-studies. A systematic standardization of location-specific soil-test ratings and crop and location-specific fertilizer-recommendations for different crops are needed because Zn nutrition may become a yield-limiting factor in Indian agriculture.

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