Requirements of Zinc for Some Major Crops and Cropping Patterns in Bangladesh

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INTRODUCTION

Zinc deficiency is a major nutritional disorder of crops in Bangladesh (Jahiruddin 2006) and is mainly due to continuous mining of soil nutrients for increased cropping intensity (180% at present). Zinc deficiency is common in maize (*Zea mays*) and rice (*Oryza sativa*). Crop responses to added Zn may vary with varieties. A reduction of Zn application to a crop is possible when crops are grown in sequence. Plants emerged from seeds with low Zn concentrations could be highly sensitive to biotic and abiotic stresses (Obata et al. 1999). Zinc-enriched seeds may perform better with respect to seed germination, seedling health, crop growth and yield (Cakmak et al. 1996). Rice is the principal crop in Bangladesh, and the dominant cropping pattern is rice based. The goal of the present study was to examine the requirement of Zn application for individual crops (maize, rice and wheat) and different cropping patterns (maize-rice, wheat-rice and rice-rice).

METHODS

An experiment with a maize-rice pattern was conducted on a calcareous soil for three years. Zinc (ZnO) was applied to maize (cv. Pacific 984, a hybrid variety) (0, 2, 4 kg ha^{-1}) and to rice (0, 1, 2 kg ha^{-1}). A separate experiment was carried out to study the response of eight maize varieties (5 hybrids, 3 composites) to added Zn (0, 3 kg Zn ha^{-1}) over two years.

A field trial was performed on a non-calcareous soil for two years to screen out wheat genotypes for efficient Zn uptake into the seed. Three Zn-applications (seed priming, soil application, foliar spray) and 10 wheat genotypes (2 varieties, 8 advanced lines) were tested.

A field experiment was conducted on a non-calcareous soil for three consecutive years with wheat (cv. Kanchan), boro rice (winter rice) as first crop and transplanted aman rice (summer rice) (cv. BRRI dhan 32) as second crop. Zinc was applied to the first and second crop at three rates (0, 50, 100% of recommendation).

RESULTS AND DISCUSSION

Maize responded to Zn application significantly. Grain yield increased from 7.4 t ha^{-1} in the control to 10.61 t ha^{-1} at the highest Zn level (averages of three years) (Fig. 1). The yield at 4 kg Zn ha^{-1} was significantly higher than the yield at 2 kg Zn ha^{-1} in the first year, while identical yields were obtained in the subsequent years indicating a residual effect of Zn application. There was a significant influence of Zn on the transplant aman rice, particularly when maize (the first crop) received no Zn or a low rate of Zn (2 kg ha^{-1}) (Fig. 2). The response of hybrid maize was higher than that of composite maize. A 15-20% higher grain yield was obtained with Zn application (Fig. 3).

Significantly higher wheat yields and Zn concentrations were recorded with seed priming followed by soil application. Foliar spraying was found to be less effective for Zn absorption by plants. The concentrations of grain-Zn varied from 25.46 to 41.71 µg g^{-1}. Grain yields and grain-Zn concentrations varied also with wheat genotypes. As observed in the wheat-rice and rice-rice patterns, a 50% reduction of the recommended rate of Zn application did not affect the yield of the second crop. For all experiments, evaluation was made mainly in terms of yield and Zn content.

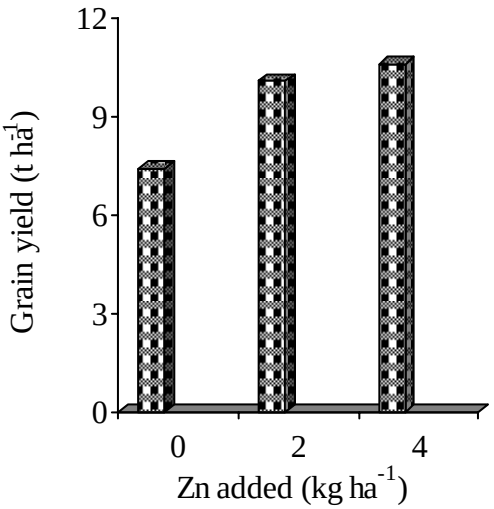

Fig. 1. Effect of added Zn on maize

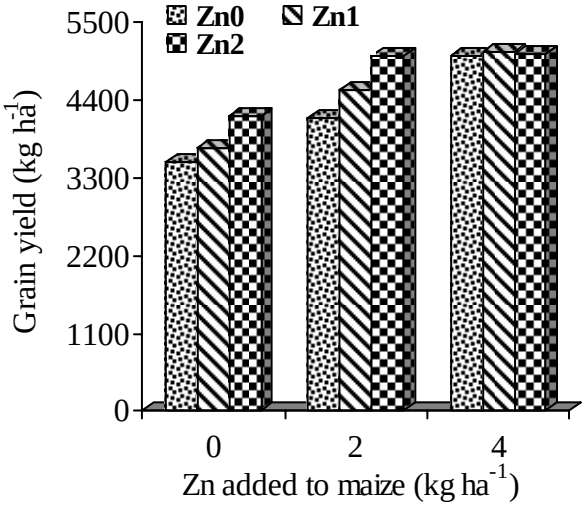

Fig. 2. Residual and direct effects of Zn on rice

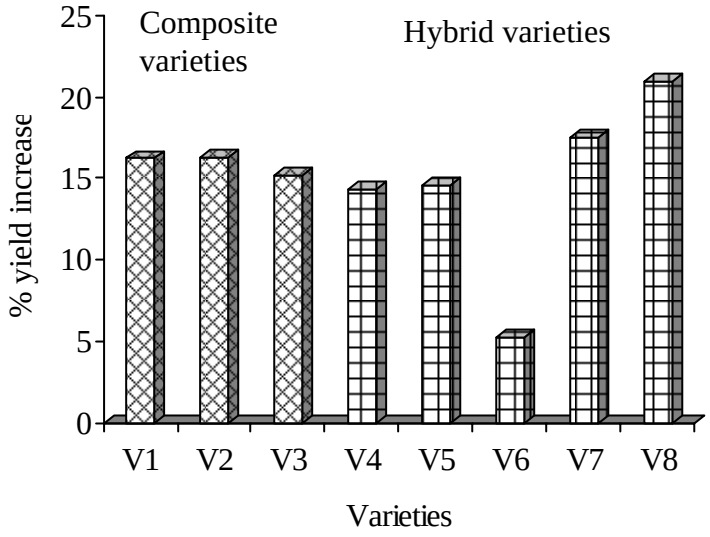

Fig. 3. Effect of added Zn on different varieties of maize

CONCLUSIONS

Zinc should be applied to both maize and rice at the rate of 2 kg ha^{-1} or alternatively at 4 kg Zn ha^{-1} to maize only.

ACKNOWLEDGEMENTS

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