Effectiveness of Different Delivery Systems for Remedying Zinc Deficiency

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INTRODUCTION

Worldwide Zn deficiency affects the yield and quality of crops (Alloway 2004) as well as animal and human health (Arthur 2004). Fertilisation to increase the yield, quality and Zn content of crops can be achieved using several delivery methods and product types (Moran 2006), and their application and use are increasing with particular emphasis on enriching seeds with this essential micronutrient (Cakmak 2006).

The work presented here demonstrates that the Zn content of seeds can have a profound effect on the performance of crops grown from them as well as on their nutritional contribution to animal and human diets.

Different methods of Zn application that increase the Zn content of crops and seeds are examined. It is also demonstrated how the partitioning of Zn and other micronutrients during crop development due to grain fill can be used as a bio-fortification procedure to enhance their contribution to animal and human diets.

METHODS

Controlled Environment Greenhouse Trials

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Seeds were planted and grown in 20cm diameter Ward plastic pots containing 3.6 litres of sieved, washed and dried Leighton Buzzard sand with a pH of 7.0. The “complete” feeding regime was based on Hoagland’s solution, using de-ionised water and Analar grade salts. Omitting one nutrient from the “complete” gave specific “nutrient-deprived” replicates.

Yara Hanninghof, Germany

Seeds were planted and grown in Mitscherlich pots containing 6.3kg of arable, loamy-sand topsoil taken from Hanninghof field research plots with a watering and feeding regime to provide full nutritional requirements.

Field Trials

Field trials were fully replication of various designs, or simple split-plot demonstrations, at the locations stated.

RESULTS AND DISCUSSION

It was demonstrated that the soil of a seed’s origin has a distinct effect on Zn content and on the performance in the media in which it was planted and grown. However, increasing loading rates of a Zn-seed treatment also enabled plants to reach maturity in a “Zn-deprived” environment. Therefore, the optimum loading of the Zn-seed treatment was identified and subsequently confirmed in field trials. Related crop varieties, even with similar seed Zn contents, responded differently to Zn-seed treatment loading, but they reached similar growth and yield plateaus at higher rates.

Soil and seed applications of Zn fertilisers were compared in field trials. Seed treatments were more cost-effective as a result of better targeting the micronutrient onto the seed and into the developing root zone after germination.

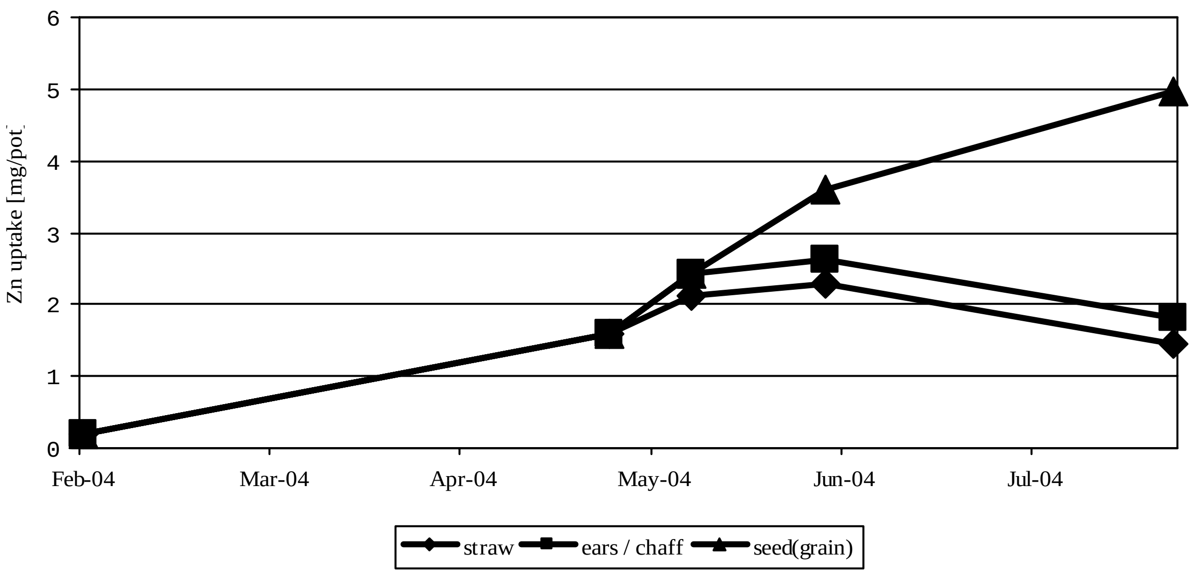

Fig. 1. Partitioning of Zn in wheat plants during growth and development due to seed (grain) fill at Hanninghof Research Station (2004).

The compartmentalisation of Zn and other micronutrients during growth of a wheat crop due to seed (grain) fill (Fig. 1) presents an opportunity to apply Zn-foliar sprays. Foliar Sprays can quickly and efficiently increase seed (grain) content for the benefit of subsequent crop growth or "bio-fortify" the seed (grain) and increase its nutritional value and dietary contribution.

CONCLUSIONS

The Zn content of seeds is fundamental to the yield performance of crops grown from them and their potential contribution to improving animal and human health.

Seed treatments worked well and are very cost effective compared to soil applications of Zn. Fertiliser programmes which include seed treatments combined with foliar sprays of Zn and other micronutrients are proposed as effective and practical method to improve the yield and quality of food crops and to manipulate and enhance their dietary contribution.

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