Grain Protein and Zn Concentration in Wheat

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INTRODUCTION

The Harvest Plus strategy of biofortification in wheat focuses on increasing Zn concentrations in grain through plant breeding. A relationship between grain protein and Zn concentration in the grain has been reported (Diestelfeld et al. 2007). There is the hypothesis that breeding wheat with higher grain-protein levels may allow a higher Zn accumulation in the grain. In addition, higher protein concentrations in the grain could be achieved with crop management. The objective of this work was to test if higher grain-protein concentrations through nitrogen management are related with higher Zn concentrations in the wheat grain.

METHODS

A field experiment was conducted during the wheat crop cycle at the CIMMYT research station in the Yaqui Valley near Ciudad Obregon, Sonora, Mexico in 2004-2005. The experiment consisted of a factorial combination of eight basal N applications at planting (0, 35, 70, 105, 140, 175, 210 and 245 kg N ha^{-1}), five top dress applications (0, 50, 100, 150 and 200 kg N ha^{-1}) in bread wheat (var. Kronstad F2004) and durum wheat (var. Jupare C 2001). The N source for all applications was urea. Phosphorus was applied at 100 kg ha^{-1} of 11-52-00 on all plots during land preparation and before bed formation. The top dress application was applied before the second post-plant irrigation in the furrows, about 80 days after planting. The experiment was started after an unfertilized sorghum crop with the objective of reducing residual soil-N levels. Wheat was planted on the optimum planting date, in 80 cm beds with two rows on top of the bed at 20 cm distance with a seed rate of 100 and 120 kg of seed ha^{-1} for bread and durum wheat, respectively. The plot size was four beds of 5 m length. Broadleaf and grassy weeds were controlled chemically. Plots were kept weed-free by hand-weeding after chemical applications. No fungicides were applied since both varieties are resistant to prevalent leaf rusts. The crop received a total of five irrigations. The plots were harvested mechanically using a small plot combine. The harvested area comprised the central 3 m of the inner two beds.

Protein concentrations were determined using dry combustion. Micronutrient concentrations were measured in nitric/percholoric acid digests of whole grains by Inductively Coupled Plasma - Atomic Emission Spectrometry (ICP-AES).

RESULTS AND DISCUSSION

The experiment was successful in generating protein concentrations ranging from less than 10 to 16% for Kronstad F2004 and from less than 10 to 14.4% for Jupare C2001. Zinc concentrations varied from 24 to 38 ppm in grains from both cultivars. The correlation between Zn and protein concentrations was very weak when all data were used. However, when low protein values were eliminated (e.i. all data with less than 13% and 12% protein for Kronstad F2004 and Jupare C2001, respectively), the correlation improved significantly for both cultivars. This is preliminary information from one experiment only, but the results suggest that protein and Zn concentrations may only be related with each other at higher protein levels.

The results show that the increment in Zn concentration is approximately 11 ppm when protein concentrations increased from 14 to 16% in cultivar Kronstad F2006. Such an increment in Zn concentration could have a measurable impact on human health. The grains collected from the second year of this experiment are currently being analysed for protein and micronutrient concentrations.

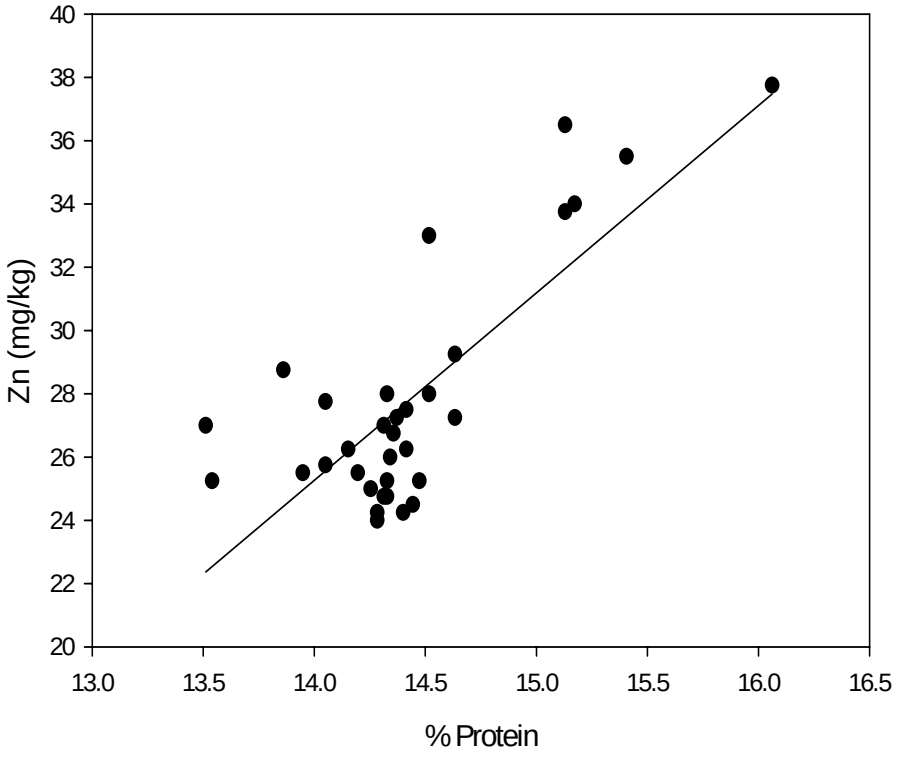

Fig. 1. Relationship between Zn and protein concentrations in grain from cultivar Kronstad F2004.

CONCLUSIONS

The preliminary results of this study suggest that protein and Zn concentrations in the wheat grain might only be related to each other at higher protein levels. Data from the second year of the same experiment will be available soon and may help to establish the consistency of these results.

ACKNOWLEDGEMENTS

This research was funded by the Harvest Plus program.

REFERENCES

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