# Effect of Soil Micronutrient Fertilization on Sorghum Grain Fe and Zn Contents

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## INTRODUCTION

Malnutrition due to micronutrient deficiencies, such as Fe and Zn, causes blindness and anemia (even death) in more than half of the world population, especially in women and pre-school children of South and Southeast Asia and Sub-Saharan Africa. These are regions where sorghum is cultivated and consumed as staple food. Though genetic enhancement of micronutrient contents of sorghum is cost-effective and involves non-recurring investment to combat malnutrition due to micronutrient deficiency (Reddy et al. 2005), it is a long-term approach. Growing high-yielding sorghum cultivars with micronutrient fertilization provides an attractive and immediate approach to improve grain-micronutrient contents considering that soil Zn-fertilization has improved grain-Zn content in wheat (Johnson et al. 2005). However, there is no evidence that micronutrient fertilization improves grain-micronutrient contents in sorghum. A study was conducted at the International Crops Research Institute for the Semi-arid Tropics (ICRISAT), Patancheru, India to assess the effect of soil-micronutrient fertilization on grain-Fe and Zn contents in sorghum. The study was part of 'HarvestPlus', a challenge program of Consultative Group on International Agricultural Research (CGIAR).

## METHODS

Twelve sorghum lines, including hybrid seed parents, restorer lines and popular varieties, with high and low grain-Fe and Zn contents were selected. Sorghum was grown on vertisols (medium black soil) and alfisols (red sandy loam soils) at five micronutrient levels in the post-rainy season of 2006. Iron and Zn fertilization was combined with recommended levels of B and S to rule out possible B or S deficiencies (as found in experimental field soils of ICRISAT). The five fertilization levels were: $T_1$: recommended NPK + zero micronutrients; $T_2$: recommended NPK + recommended Fe (10 kg ha$^{-1}$); $T_3$: recommended NPK + recommended Fe, S and B (10, 30 and 0.5 kg ha$^{-1}$, respectively); $T_4$: recommended NPK + Zn + recommended S and B (10, 30 and 0.5 kg ha$^{-1}$, respectively); and $T_5$: recommended NPK + Zn (10 kg ha$^{-1}$). The experiment was conducted in a strip-plot design with three replicates. Each line was sown in four rows of 2-m length with a row-to-row spacing of 75 cm. The seedlings were thinned 10 days after sowing to maintain 15 cm between plants within a row. Hand-threshed selfed-seed samples from all entries, fertilizer levels and replicates were analyzed for grain-Fe and Zn contents in the soil chemistry laboratory at ICRISAT. The data were statistically analyzed using Genstat Package.

## RESULTS AND DISCUSSION

Analysis of variance (Table 1) indicated significant mean squares due to genotype and first-order interaction of genotype with soil type and second-order interaction of genotype with soil type and different micronutrient-fertilization levels for grain-Fe and Zn contents. Soil type did not significantly affect the grain-Zn content of the tested sorghum lines, but affected grain-Fe content. Interestingly, non-significant variance due to micronutrient-fertilization levels suggested poor evidence of the effect of soil-micronutrient fertilization on grain-Fe and Zn contents in any particular soil type. However, significant mean squares due to interaction of micronutrient-fertilization levels with soil type indicated that grain-Zn (but not Fe) content of genotypes varied with a given combination of micronutrient level and soil type.

**Table 1. Mean sum of squares due to different micronutrients-fertilization levels for grain-Fe and Zn contents in sorghum, ICRISAT-Patancheru, 2006 post-rainy season.**

| Source of variation | Degrees of freedom | Fe (ppm) | Zn (ppm) |
|---|---|---|---|
| Soil type | 1 | 1685.62** | 379.63 |
| Residual | 4 | 12.06 | 76.7 |
| Micronutrient fertilization levels (MFL) | 4 | 53.69 | 90.36 |
| MFL × soil type | 4 | 169.34 | 210.96** |
| Residual | 16 | 155.95 | 43.57 |
| Genotype | 11 | 466.1** | 584.05** |
| MFL × genotype | 44 | 26.7 | 20.1* |
| Genotype × soil type | 11 | 167.8** | 33.76** |
| MFL × genotype × soil type | 44 | 63.6** | 24.07** |
| Residual | 220 | 36.23 | 13.33 |

Analysis of variance indicated overall trends in variation of lines for grain-micronutrient contents influenced by micronutrient fertilization, but did not reveal patterns of variation when pair-wise fertilization-level effects were examined. The mean performance of lines at different fertilization levels (Table 2) indicated that grain-Fe and Zn contents were significantly higher without micronutrient fertilization than with Fe and Zn fertilization in combination with B and S. However, there were no differences in grain-Fe and Zn contents of lines grown at any micronutrient level.

## CONCLUSION

It appears that micronutrient fertilization tends to decrease grain-micronutrient contents. However, the results are based on single-year and single-location data and a small plot size. Multi-location and multi-year trials on large plots are needed to confirm these results.

**Table 2. Sorghum grain-Fe and Zn contents as influenced by soil-micronutrient fertilization, in ICRISAT-Patancheru, post-rainy season of 2006.**

| Micronutrient | Fe (ppm) | | Zn (ppm) | |
|---|---|---|---|---|
| fertilization level | Vertisols | Alfisols | Vertisols | Alfisols |
| Control | 38.55 | 38.11 | 26.29 | 29.57 |
| Fe | 35.45 | 39.52 | 25.27 | 28.93 |
| S + B + Fe | 34.57 | 38.57 | 26.34 | 25.84 |
| S + B+ Zn | 32.87 | 39.41 | 28.71 | 26.37 |
| Zn | 33.00 | 40.48 | 22.09 | 28.27 |
| LSD (5%) | 1.88 | | 1.88 | |


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## REFERENCES


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