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Urochloa and biofortified maize rotation improve zinc uptake: A promising strategy to fostering human health

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Abstract

Biofortification of crops is a promising strategy for addressing micronutrient deficiencies in populations with limited access to diverse diets. Zinc is a critical trace element for human health, and therefore, more equitable food systems. Zinc deficiency in soil can affect plant growth and yield. The capacity of Urochloa grasses to biologically inhibit nitrification (BNI) and fix nitrogen in the soil, has been shown to improve soil health and crop productivity. In this study, we evaluated the effect of Urochloa grasses subsequently cultivated with maize on the zinc concentration in the grain. We conducted a two-year experiment in 20×20 m plots with nine Urochloa genotypes and a bare soil control, followed by four consecutive cycles of biofortified maize (SGBIOH2). Our results showed an average increase of 9.32 $^{mg}/_{kg}$ of zinc in maize grain compared to the content observed in the control. The genotypes U. humidicola Uh 72 and Urochloa brizantha cv. Marandu showed the highest zinc concentrations during the planting cycles, at 37.29 $^{mg}/_{kg}$ and 36.18 $^{mg}/_{kg}$, respectively, compared to the average of 25.83 $^{mg}/_{kg}$ in the control treatment. Maize rotation as a subsequent crop of Urochloa grasses had a highly positive effect on zinc concentrations in the grain, enhancing its biofortifying properties. In the soil analysis, high levels of phosphorus were reported, which is inversely related to soil zinc content. Phosphorus is an essential element to produce ATP, the molecule that gives energy to the nitrifying bacteria that carry out nitrification. This may decrease the solubility and mobility of zinc, which in turn affects the nutritional quality of the plants. Brachialactone, an organic compound present in the roots of Urochloa grass, plays an important role in this interaction as it has been scientifically demonstrated that has the potential to inhibit soil microbial activity responsible for nitrification processes. By inhibiting nitrification thanks to the BNI potential of pastures and the root system of a biofortified crop, it is possible to extract and mobilise more zinc from the soil through the roots and plant tissues. Therefore, rotation with Urochloa grasses can be an effective approach to improve the nutritional quality of maize.

Keywords: Crop productivity, hidden hunger, human health, soil health

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