



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

Madyan Vanessa Prado-Murcia; Daniel Mauricio Villegas; Mike Bastidas; José Luis Urrea-Benítez; Jacobo Arango.
International Center for Tropical Agriculture, Tropical Forages Program, Colombia.

Contact: m.prado@cgiar.org

CIAT / J.L. Urrea

Introduction

- ▶ Hidden hunger, or micronutrient deficiencies, occurs when the quality of food fails to meet human nutritional needs. One-third of the world's population suffers from micronutrient deficiencies (FAO et al., 2022). The consequences include physical and mental underdevelopment, weakened immune systems, especially in children, pregnant women, and the elderly (ENSIN, 2015).
- ▶ Pastures of the *Urochloa* genus, were identified by Subbarao et al., (2009), with the potential to reduce nitrification through root exudation of compounds. This process is known as Biological Nitrification Inhibition (BNI), that promotes nutrient recycling, primarily nitrogen (N), which is stored in the soil in stable forms and becomes accessible to plants.
- ▶ A study from Karwat et al. (2017) in Colombian Eastern Plains showed that the *Urochloa*-maize rotation improves maize productivity parameters. Following studies conducted in Palmira (Colombia) have discovered that that in addition, biofortified maize crop increase their potential for zinc micronutrient absorption, thereby improving the grain's nutritional quality.

Results

Pastures with high BNI potential showed a 22.4% increase in grain Zn absorption, averaging 31.8 mg kg⁻¹, compared to control treatments without BNI at 24.7 mg kg⁻¹, showing significant differences (Figure 2).

Treatment with the highest Zn concentration in grain was Uh72 with 33.53 mg kg⁻¹ (Table 1). The bare soil and continuous maize control treatments without BNI had Zn concentrations of 24.28 mg kg⁻¹ and 25.24 mg kg⁻¹, respectively, which were 27.6% and 24.7% lower than Uh72.

Biofortified maize reached a maximum accumulation of 43.85 mg kg⁻¹, promoted by the BNI effect of the pastures, representing a 36% increase compared to the value reported in the factsheet (32 mg kg⁻¹) and a 75% increase compared to the baseline Zn content in conventional maize (25 mg kg⁻¹) (Andersson, et al., 2017).

Table 1. List of *Urochloa* genotypes with average Zn levels over five sowing cycles

Treatments	Zn in grain (mg kg ⁻¹)	Nitrification rates (mg N-NO ₃ ⁻ /kg)*
Uh 675	31.83 (9.1)ab	5.15 (1.7)a
Uh 91	31.53 (7.2)ab	5.37 (1.3)ab
CIAT 16888	30.81 (6.8)ab	5.65 (1.6)ab
Cv. Marandu	32.78 (7.5)ab	5.98 (1.2)abc
Cv. Mulato II	31.30 (6.7)ab	6.00 (1.6)abc
Uh 1149	30.51 (8.7)b	6.15 (1.8)bc
CIAT 679	31.71 (8.4)ab	6.24 (1.5)bcd
**Uh 72	33.53 (8.4)a	6.62 (1.9)cde
CIAT 26146	31.63 (7.9)ab	7.13 (1.0)de
Fallow	24.28 (5.3)c	7.58 (2.3)e
Continuous maize	25.24 (6.1)c	-

Values in brackets represent the standard deviation of the mean, n = 15. Different letters indicate statistical differences according to the TukeyHSD test (α = 0.05).

*Nitrification rates in *Urochloa* plots in the last year (2018) before planting biofortified maize.

**Uh Uh72, the treatment exhibiting the highest concentration of zinc.

References

Andersson M, et al. (2017). Progress update: Crop development of biofortified staple food crops under HarvestPlus. African Journal of Food, Agriculture, Nutrition and Development, 17(02):11905-11935. <https://doi.org/10.18697/ajfand.78.harvestplus05>

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Objective

To evaluate the residual effect of *Urochloa* genotypes with contrasting BNI capacity on the maize yield and Zn uptake in the grain of biofortified white maize (SGBIOH2).

Methodology

Study conducted at the Palmira Campus of the Alliance Bioversity & CIAT, Colombia. Altitude: 1001 m.a.s.l.; Avg. Temperature: 23.4°C; Precipitation: 1,051 mm/year. Soil order: Mollisol, pH: 7.5, texture: silt loam.

First Phase (2016), Final phase (2019-2023), experimental design in RCBD, 3 repetitions.

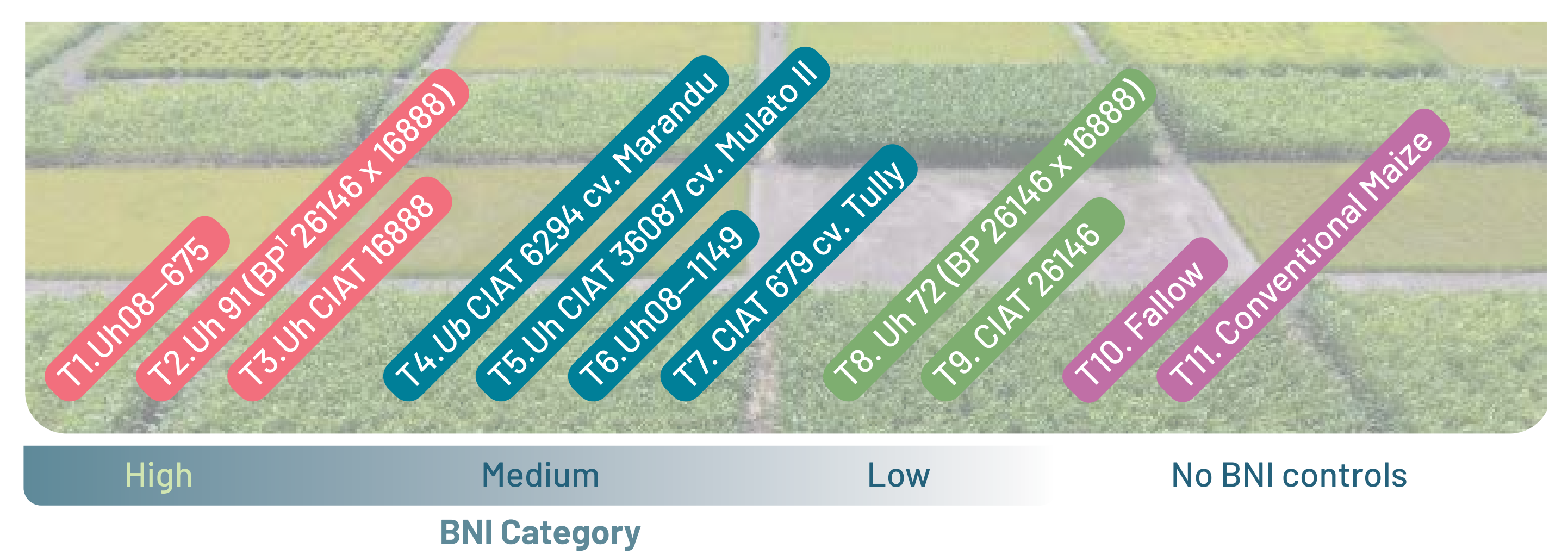


Figure 1. Experimental design. T=Treatment. Uh=*Urochloa humidicola*; Ub=*Urochloa brizantha*. T11. Conventional Maize (Maize planting history spanning over 10 years)

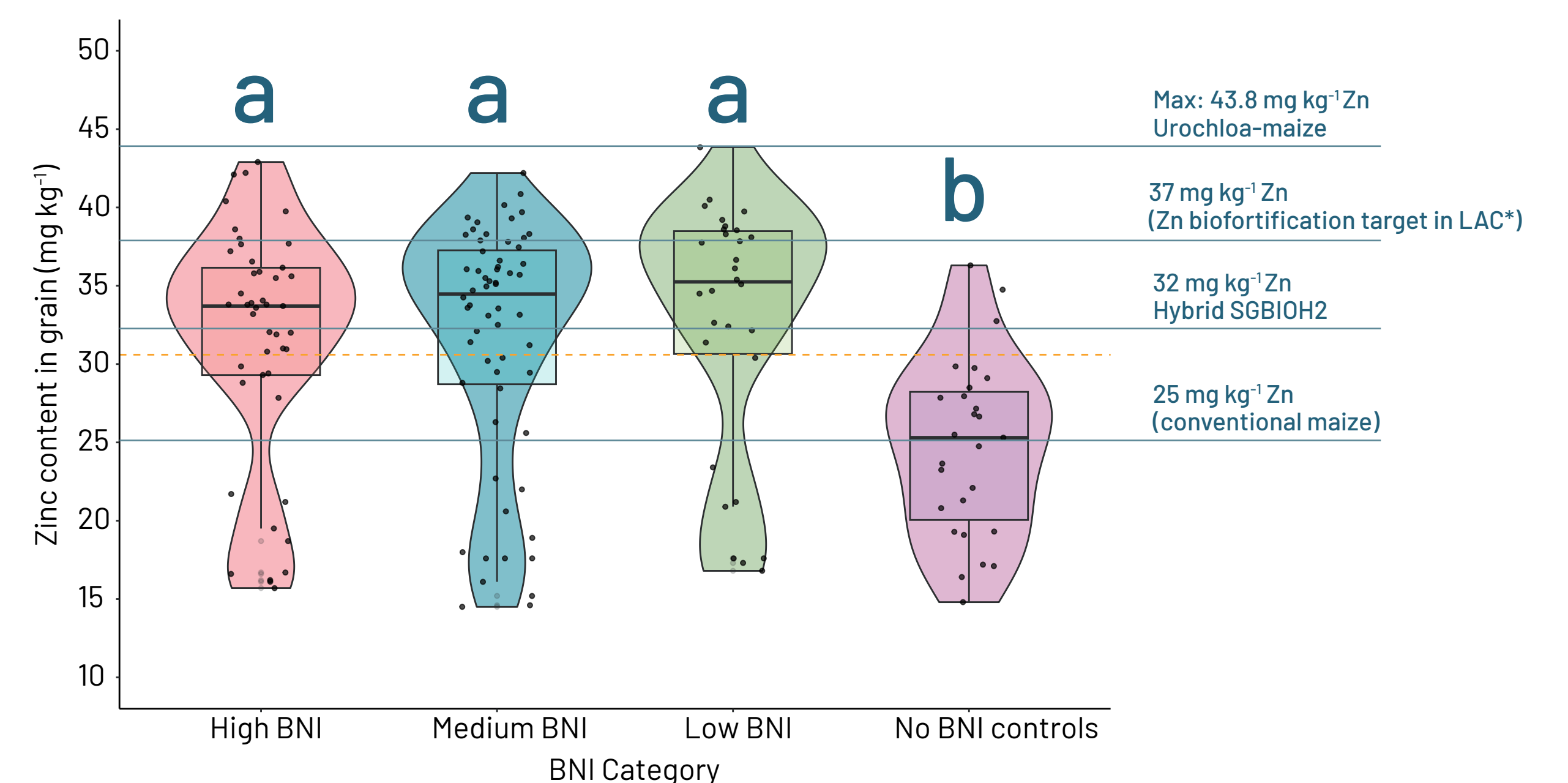


Figure 2. Zn content in plants by BNI categories. n =160. Different letters indicate statistical differences according to the TukeyHSD test (α = 0.05). * LAC=Latin America and the Caribbean.

Conclusions

The accumulation of Zn in the grain was higher in soils where *Urochloa* pastures were previously planted, planted, regardless of the BNI level (i.e. high, medium, or low) compared to control treatments without BNI. This highlights the potential for improving nutritional parameters, especially Zn, in the grass-maize rotation. Adequate N supply, as a result of BNI, may favor the accumulation of Zn in maize grain.

