EFFECT OF THE ENVIRONMENT ON ZINC AND IRON LEVELS IN COMMON BEANS

Priscila Zaczuk Bassinello[1], Bruno Ramón de Oliveira[2], Lorrana N. Naves Nóbrega[2], Wellington Miguel Rodrigues da Silva[3], Helton Santos Pereira[1], Cléber Morais Guimarães[1], Leonardo Cunha Melo[1] and Maria José Del Peloso[1]

[1]Embrapa Rice and Beans, [2]CEFET-GO, and [3]Uni-Anhangüera-GO
Corresponding author: leonardo@cnpaf.embrapa.br

Biofortification is grounded in solid scientific principles: (a) there is a considerable and useful genetic variability in agriculture basic products; (b) breeding programs could easily manipulate nutritional quality traits, once they are inherited in high proportions and easily selected; (c) desirable characteristics are fairly stable in largely diverse cropping environments and (d) high nutrient content characteristics can be combined with agricultural superior quality characteristics and high yielding traits (Carvalho et 2005). The development of zinc and iron biofortified cultivars is an efficient tool to face iron deficiency anemia and to invigorate the immune system of underserved populations, especially in the Brazilian Northeast Region (CHIARADIA, 1997). Therefore, to characterize Zn and Fe high content promising bean lines concerning genotype x environment (GxE) interaction, those mineral contents have to be evaluated for a certain number of years in various locations and cropping seasons to get a reliable estimate of that interaction. That procedure would allow the identification of genotypes with high stability for those nutrient contents, giving more confidence to breeders when new biofortified cultivars are to be released.

Seventy two common bean genotypes from CIAT High Mineral Nursery (HMN) were evaluated. Trials were carried out in 2007/2008 cropping seasons in different places and under two watering systems (with and without water stress) in the following locations: [1] Porangatu Experimental Station - GO/irrigated, [2] Embrapa Rice and Beans (CNPAF) – Santo Antônio de Goiás-GO/irrigated, [3] CNPAF – Santo Antônio de Goiás-GO/water stress, [4] Ponta Grossa – PR/natural rain fall (without water control). Under no water stress condition, water was supplied when necessary (0.0325 MPa at 15 cm depth). Under hydrous stress, water was supplied 20 days after seedling emergence only. During water deficiency period, plants received approximately half the amount of water supplied to those under no water stress. In all assays the irrigation was controlled with tensiometers. The experimental design used was a completely randomized blocks design arranged in plots with two lines of two meter long, spaced 0.5 m, with 15 seeds per meter and three replicates. Cultural practices were the commonly used for the bean crop. Pods harvested were naturally sun dried and beans washed in distilled water, oven dried at 60°C for 48 h and grinded in a Zirconium ball mill (Restch MM200) to avoid contamination. To determine Zn and Fe contents, (2:1) nitro-perchloric acid digestion was used for organic matter oxidation (AOAC, 1995). The obtained extract was diluted and transferred to the air flame/acetylene atomic absorption spectrophotometer (Varian 50B) for reading. Laboratory tests were performed in triplicate and data submitted to individual and joint analyses of variance and means comparison performed by the Scott~Knott test at 10% probability using the SISVAR version 4.6 program.

Significant differences ($P<0.01$) in Zn and Fe levels were observed in all environments among the genotypes tested, indicating the existence of genetic variability for those traits. Environmental effect was also detected ($P<0.01$) as shown in Fig 1. As for Fe and for Zn CNPAF water stress environment had an effect on their mineral levels, with significant increases in their contents.

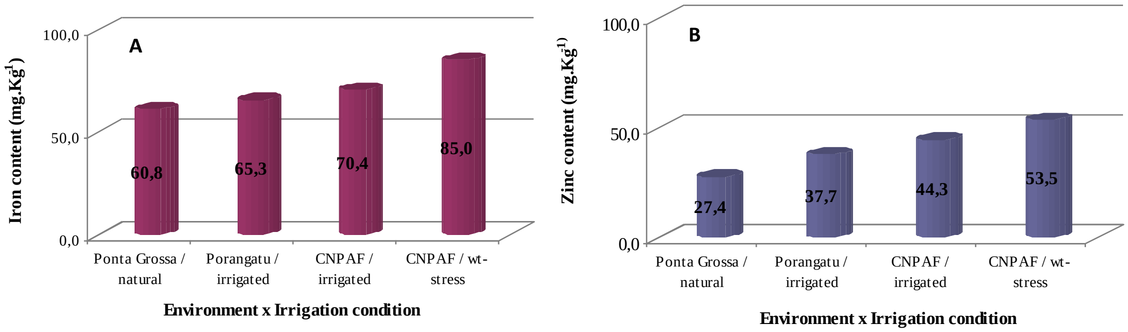

Figure 1. Fe (A) and Zn (B) average contents in common bean genotypes grains under different experimental conditions and environments.

Besides environmental effects, a significant interaction (P<0. 01) among genotypes and environments occurred, indicating a differential response in Zn and Fe contents, when environmental cropping conditions were modified.

Regarding experimental environments and conditions it was possible to observe that 12.5% of the genotypes tested showed Fe levels between 77 and 80.4 mg.kg^{-1}, differing significantly from the highest Fe level genotype tested (HMN-53: 85 mg.kg^{-1}). Regarding Zn, 31% of the genotypes presented levels between 43 and 49 mg.kg^{-1}, approximately.

Other bean genetic sources will be tested to achieve the research goals regarding beans with improved agronomic characteristics, good market quality and high levels of minerals.

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REFERENCES

AOAC (1995), Official Methods of analysis. Arlington: AOAC International, 1995. p: 3.

CARVALHO, J. L. V. de; NUTTI, M. R.; DEL PELOSO, M. J.; FUKUDA, W. M. G.; GUIMARÃES, P. E. de O. Harvestplus – desenvolvendo produtos agrícolas mais nutritivos. In: CONGRESSO BRASILEIRO DE ARROZ IRRIGADO, 4.; REUNIÃO DA CULTURA DO ARROZ IRRIGADO, 26., 2005, Santa Maria, RS. Anais... Santa Maria, RS: Orium, 2005. v. 2. p. 638-640.

CHIARADIA, A. C. N.: GOMES, J. C. Feijão: química, nutrição e tecnologia. Viçosa, MG: Fundação Arthur Bernardes, 1997. 180 p.