Characterization of Zinc Contents of Brazilian Wheat Genotypes

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INTRODUCTION

Biofortification could be an alternative strategy to complement other current interventions such as fortified foods and vitamins and mineral supplements in developing countries to combat malnutrition. Research and development of biofortified foods in Brazil highlight a unique aspect that makes Brazil different from other countries, as Brazil is the only country where eight different crops are studied at the same time, namely, pumpkin, rice, sweet potatoes, common beans, cowpeas, cassava, maize, and wheat (Nutti,2011). Among the eight crops studied in the biofortification network in Brazil, wheat has its importance increased as its consumption has an average of eight million tons per year, a significant amount to be considered in the Brazilian diet. Although the biofortification projects started in Brazil since 2003, the official work with wheat has started in 2007, being the first field trials implemented in 2008/2009. Initially, a collection of 180 wheat genotypes defined not only by its importance in agriculture, but also by a collection of historic cultivars, representative of the variability and adaptation of Brazilian wheat genotypes in different country regions, was selected. Considering that some genotypes provided by the Embrapa Active Wheat Germplasm Bank, presented very small amount of seeds, new multiplication was necessary, which was carry out in the 2008/2009 summer in a greenhouse at Embrapa Wheat and harvested in April and May 2009. The complete collection was established at Embrapa Wheat and harvested in November and December 2009. This collection consisting of 180 wheat genotypes was also planted in experimental fields at Embrapa Soybean and at Embrapa Cerrados. Evaluation of wheat genotypes for their Fe and Zn content was performed according to methodology recommended by the HarvestPlus Sampling Protocols for Micronutrient Analysis in Embrapa Food Technology laboratories. The aim of this study was to determine the variability of Zn content in Brazilian wheat in order to select the most promising genotypes for future breeding and production of new materials.

METHODS

The aim of this study was to estimate the genetic diversity in a collection of 180 accessions of wheat cultivars, in different environments in Brazil: at Embrapa Trigo, in Passo Fundo, RS; at Embrapa Soybean, in Londrina, PR; and at Embrapa Cerrados, in Planaltina, DF. The collection was composed by old varieties (in general, cultivars out of recommendation, but adapted to the Brazilian environments) and cultivars still in recommendation in the Brazilian wheat regions. From 2009 to 2010, wheat was planted and harvested in the experimental fields of Embrapa Wheat, Embrapa Soybean and Embrapa Cerrados. Samples were sent to Embrapa Food Technology laboratory for zinc analysis using the methodology recommended by HarvestPlus Sampling Protocols for Micronutrient Analysis (Stangoulis and Sison, 2007). The samples were harvested and threshed by hand in order to avoid soil contamination, and then the wheat samples were sent to the Embrapa Food Technology laboratory, where they were ground in a Retsch MM200 Ball Mill with zirconium balls. Approximately 0.8 g was weighed in 25 mm diameter glass tubes. Wet digestion occurred in a digester block, using a nitropercloric mixture 2:1(method975.03, item 03/02/2005, AOAC, 2005) and the digested volume was completed to 25 ml. The quantification of the iron and zinc levels was performed by optical spectrometry emission with inductively coupled plasma (ICP-OES), according to method 990.08, item 9.2.39, AOAC methodology 2005.

RESULTS AND DISCUSSION

Table 1 shows a wide genetic variability in grain Zn concentrations of wheat for the year 2009. In general, the old varieties showed the highest values. The highest levels of zinc were found in the old cultivars Fronteira, Trigo de Chapéu, IAS 59, Jesuíta, Cotiporã and in IPR 111 and BRS Guamirim. BRS Guamirim and IPR11 are the only varieties with good yield potential still indicated for cultivation in the South of Brazil. The old genotypes were out of recommendation for cultivation, due to their susceptibility to diseases, higher plant size and less yield potential.

Table 1. Variability of grain Zinc Levels for the 2009 Harvest

Origin	Zinc ($mg.kg^{-1}$)
Brasília	20,99-46,70
Londrina	22,26-55,10
Passo Fundo	22,80-49,37

For the year 2010, the same trend was observed with less variability in the older materials. Using these results, a new collection with the 50 best materials was selected for high Zn concentrations in each location. Based on these results, the influence of the harvest year and soil assessed. Also, the blocks of crosses aiming to incorporate high Zn characteristics in new populations of plants with better architecture and better adapted to Brazilian conditions were started.

Table 2. Variability of Zinc Levels for 2010 Harvest

Origin	Zinc (mg.kg-1)
Passo Fundo	18,95-41,54
Passo Fundo	19,35-40,02
Londrina	21,61-38,53
All (2010)	18,95-41,54

CONCLUSIONS

This work enabled to start understanding the variability presented in three locations during two seasons of a representative collection of Brazilian wheat genotypes. Results indicated a potential to continue seeking modern materials with higher contents of zinc, and new alternatives to improve these materials.

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