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Research Paper

Analysis of grain elements and identification of best genotypes for Fe and P in Afghan wheat landraces

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This study was carried out with the aim of developing the methodology to determine elemental composition in wheat and identify the best germplasm for further research. Orphan and genetically diverse Afghan wheat landraces were chosen and EDXRF was used to measure the content of some of the elements to establish elemental composition in grains of 266 landraces using 10 reference lines. Four elements, K, Mg, P, and Fe, were measured by standardizing sample preparation. The results of hierarchical cluster analysis using elemental composition data sets indicated that the Fe content has an opposite pattern to the other elements, especially that of K. By systematic analysis the best wheat germplasms for P content and Fe content were identified. In order to compare the sensitivity of EDXRF, the ICP method was also used and the similar results obtained confirmed the EDXRF methodology. The sampling method for measurement using EDXRF was optimized resulting in high-throughput profiling of elemental composition in wheat grains at low cost. Using this method, we have characterized the Afghan wheat landraces and isolated the best genotypes that have high-elemental content and have the potential to be used in crop improvement.

Key Words: wheat landraces, elements, high-throughput method, best genotypes.

Introduction

Elements are required not only for plant growth, but also as minerals for human nutrition and health; at least 50 are vital for the wellbeing of humans (Tolonen 1990).

Hence it is important to analyze the bioavailability of elements in plants, especially in food crops that are considered important staples. Cereals are one of these crops and in particular wheat accounts for 20% of the world population's calorie intake. Mg, Fe, and Zn are mainly present in the aleurone layer of bread wheat grains, and whole wheat products are an important source of the daily requirements for these minerals and trace elements in humans (Piergiovanni *et al*. 1997). Potassium ions (K^+) are the major cationic osmoticum in plants, detailed reviews of K^+ homeostasis can be found elsewhere (Pettigrew 2008). Phytate, which is abundant in cereal grains, reduces the bioavailability of micronutrients, particularly Zn and Fe, to humans and monogastric animals (Fan *et al*. 2008). The chemical composition of wheat grain was well reviewed by Šramková *et al*. (2009). However, this crop contains suboptimal quantities

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