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Variability and Stability of Bread and Durum Wheat for Phytic Acid Content

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Abstract : Phytic acid is a major pool in the flux of phosphorus through agroecosystems and represents a sum equivalent to > 50% of all phosphorus fertilizer used annually. Nutrition rich in phytic acid can substantially decrease micronutrients apsorption as calcium, zink, iron, manganese, copper due to phytate salts excretion by human and non-ruminant animals as poultry, swine and fish, having in common very scarce phytase activity, and consequently the ability to digest and utilize phytic acid, thus phytic acid derived phosphorus in animal waste contributes to water pollution. The tested accessions consisted of 15 genotypes of bread wheat (Triticum aestivum L. ssp. vulgare) and of 15 genotypes of durum wheat (Triticum durum Desf.). The trials were sown at the three test sites in Serbia: Rimski Šančevi (RS) (45º19´51´´N; 19º50´59´´E), Zemun Polje (ZP) (44º52´N; 20º19´E) and Padinska Skela (PS) (44º57´N 20º26´E) during two vegetation seasons 2010-2011 and 2011-2012. The experimental design was randomized complete block design with four replications. The elementary plot consisted of 3 internal rows of 0.6 m2 area (3 × 0.2 m × 1 m). Grains were grinded with Laboratory Mill 120 Perten (“Perten”, Sweden) (particles size < 500 µm) and flour was used for the analysis. Phytic acid grain content was determined spectrophotometrically with the Shimadzu UV-1601 spectrophotometer (Shimadzu Corporation, Japan). Objectives of this study were to determine: i) variability and stability of the phytic acid content among selected genotypes of bread and durum wheat, ii) predominant source of variation regarding genotype (G), environment (E) and genotype × environment interaction (GEI) from the multi-environment trial, iii) influence of climatic variables on the GEI for the phytic acid content. Based on the analysis of variance it had been determined that the variation of phytic acid content was predominantly influenced by environment in durum wheat, while the GEI prevailed for the variation of the phytic acid content in bread wheat. Phytic acid content expressed on the dry mass basis was in the range 14.21-17.86 mg g-1 with the average of 16.05 mg g-1 for bread wheat and 14.63-16.78 mg g-1 with the average of 15.91 mg g-1 for durum wheat. Average-environment coordination view of the genotype by environment (GGE) biplot was used for the selection of the most desirable genotypes for breeding for low phytic acid content in the sense of good stability and lower level of phytic acid content. The most desirable genotypes of bread and durum wheat for breeding for phytic acid were Apache and 37EDUYT /07 No. 7849. Models of climatic factors in the highest percentage (> 91%) were useful in interpreting GEI for phytic acid content, and included relative humidity in June, sunshine hours in April, mean temperature in April and winter moisture reserves for genotypes of bread wheat, as well as precipitation in June and April, maximum temperature in April and mean temperature in June for genotypes of durum wheat.

Keywords : genotype × environment interaction, phytic acid, stability, variability
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