EVALUATION OF SYRIAN WINTER WHEATS AS A SOURCE OF NEW GENETIC VARIABILITY

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ABSTRACT

Germplasm from synthetic wheats is an invaluable source of new genetic variability for breeding varieties with desirable characters. The selection of drought-tolerant genotypes becomes increasingly important with the respect to the pronounced climate change bringing higher temperatures, lower precipitation and its uneven distribution during the growing season.

The aim of this work was to identify and evaluate differences in winter wheat genotypes originated from the International Center for Agricultural Research in the Dry Areas, Syria (ICARDA) and 2 wheat varieties commonly cultivated in the Czech Republic. The breeding material was grown at the Field Research Station in Žabčice in 2012/2013 season. The height of plants, level of lodging, grain yield, seed size (TSW) and qualitative parameters of grain were evaluated. The Syrian genotypes showed a wide variation in all evaluated parameters. Most of them were comparable or even better than the modern Czech varieties. One of the most promising lines was 42/1 characterized by the highest grain yield, high TSW and also high content of crude protein in grain. Further work will be aimed at the evaluation of morphological and physiological parameters associated with drought tolerance.

Key words: winter wheat, genetic resources, tolerance to drought

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INTRODUCTION

Water is an important environmental factor and a major limitation for plant growth, development and yield. Due to the climate change we need to find new genetic resources for breeding more tolerant genotypes (Marcińska, 2013). Commercial breeding programmes are based on crosses among closely related elite lines, which lead to a reduced genetic variation. One method how to incorporate wild genes into modern wheat is through new breeding lines derived from synthetic wheats (Valkoun 2001). Synthetic wheat is artificially created wheat which was re-synthesized from the wild ancestors, e.g. *Ae. tauschii*, *T. urartu*, *T. baeoticum* and *Ae. speltoides*, and can be be an invaluable source of novel genetic diversity.

MATERIAL AND METHODS

A breeding material of nine winter wheat originated from ICARDA, Syria: 27 (142670), 30 (142688), 31 (142705), 42 (142760), 45 (142779), 46 (142780), 47 (142799), 51 (142805), 53 (142397) and 2 winter wheat varieties commonly planted in the Czech Republic (Meritto and Etela) was evaluated in this work. Syrian synthetic hexaploids were produced from crosses of a local durum wheat landrace (Haurani) with two *Ae. tauschii* accessions. Backcross progenies with agronomically desirable traits were identified in crosses of hexaploid synthetics with locally adapted bread wheat varieties. The process of improvement is described in Valkoun (2001). These lines were obtained from the collection of wheat genetic resources maintained at the Crop Research Institute in Prague.

The Syrian breeding material was planted at the Field Research Station of Mendel University in Žabčice in the 2011/2012 growing season. The superior individuals, which survived severe frost and drought during the spring of the 2012 year, were selected and their seed was re-planted using double-row plot design without replication. The field evaluation included measurement of plant height and assessment of morphological traits and susceptibility to lodging. After harvest the yield and qualitative parameters were evaluated; the protein content and sedimentation test values were estimated using NIRS Granolyser (Pfeuffer).

RESULT AND DISCUSSION

Plant height, thousand grain weight, grain yield, crude protein content and sedimentation test values were evaluated in progenies of 38 individually selected plants from 9 Syrian breeding materials and in two modern Czech varieties. The height of plants ranged from 61 to 135 cm (Graph 1). The variety Etela has 87 cm and Meritto 92 cm. The largest differences in plant height were found in progenies of No. 27. Strains 27/1, 27/2 and 27/4 reached over 130 cm and strains 27/6, 27/7, 27/8 were the shortest, between 60 and 65 cm. The observed differences are probably associated with the presence of various dwarfing alleles. Strains 27/1 and 27/2 showed low lodging resistance.

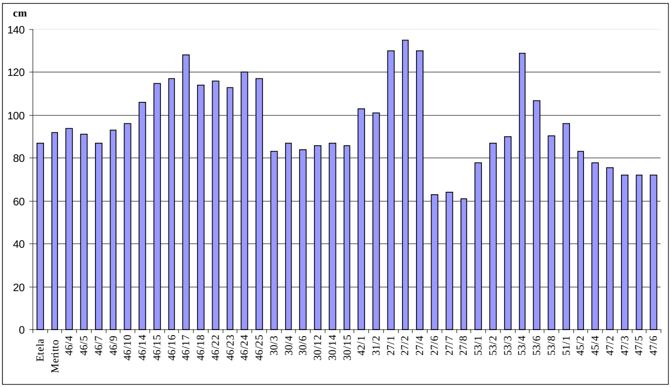
The weight of thousand grains can be also associated with tolerance to biotic and abiotic stress factors. Most of the Syrian strains had grain size comparable to varieties Meritto (39.5 g) and Etela (45.5 g) (Graph 2). The largest grain was produced by the strain 27/4 (54.2 g) and the strains 30/3 and 30/4 had the thousand seed weight under 30 g.

Due to double-row design the yield was expressed in grams of seed per plant (Graph 3). The big differences among evaluated progenies were found for this trait, the best yielding was No. 42/1 (10.38 g) and the lowest yielding strains were No. 30/14 (2.24 g) and No. 53/6 (2.23 g). Some Syrian strains exceeded the yield of Czech varieties Etela and Meritto.

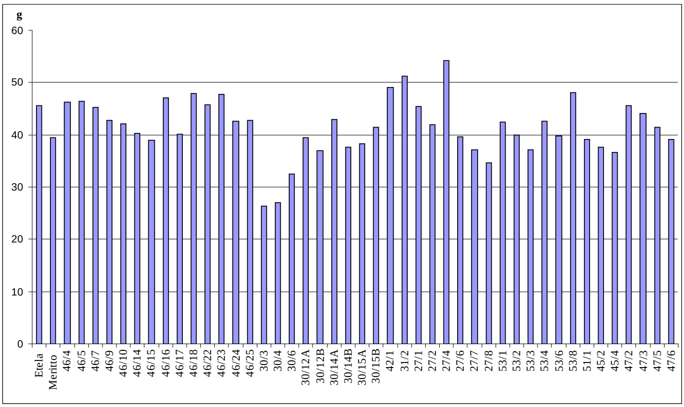
The content of crude protein co-determines the suitability of end-use. For bread-making purposes the desirable content of crude protein is above 11.5% (Zimolka et al, 2005). All evaluated genotypes overcame this minimum value (Graph 4). The highest protein content was found in progenies of No. 53 (over 14%) with the maximum value in 53/3 line (18.4 %).

The sedimentation test assesses the level of protein quality. Most of Syrian genotypes had higher sedimentation values than Czech varieties (Graph 5). The highest values were estimated for progenies derived from No. 53, the strain No. 53/3 reached the value of 69.9 ml.

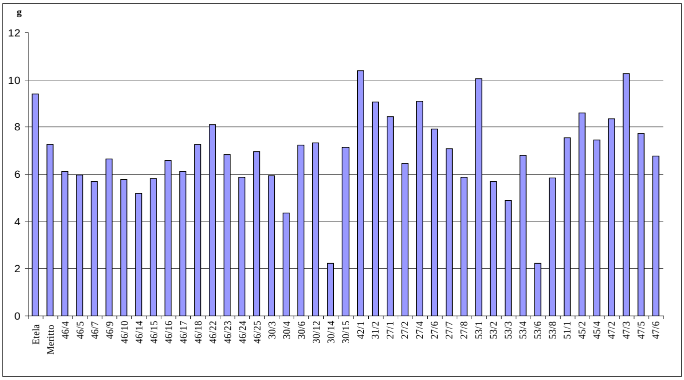
Due to their unique origin the Syrian genotypes may carry specific traits for higher tolerance to drought stress, therefore further work will be aimed at evaluation of their drought tolerance under laboratory and field conditions. Preliminary results by Stehno et al. (2011) showed that the water use efficiency of those Syrian genotypes evaluated as ^{13}C isotope discrimination was lower than that of common European varieties. It suggested that they can have a good drought-tolerance potential and can be utilized as a source of stress-tolerance traits in breeding (Dotlačil et al, 2011).



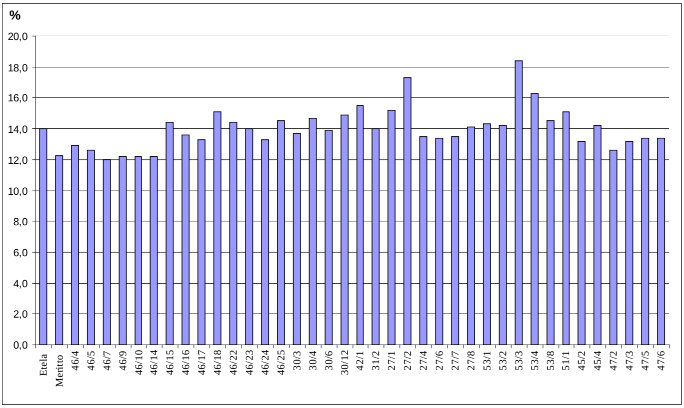
Graph 1 The comparison of plant height of Syrian wheat genotypes and Czech varieties



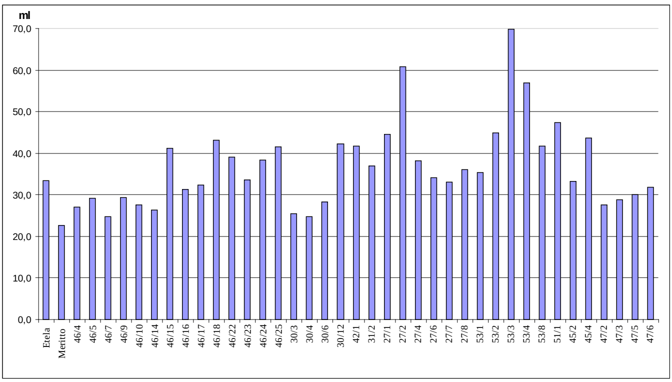
Graph 2 The comparison of thousand grain weight of Syrian wheat genotypes and Czech varieties



Graph 3 Grain yield per plant of Syrian wheat genotypes and Czech varieties



Graph 4. Crude protein content in Syrian wheat genotypes and Czech varieties



Graph 5. Sedimentation test values in Syrian wheat genotypes and Czech varieties

CONCLUSIONS

The evaluation of winter wheat breeding material of Syrian origin showed broad variation in all observed characters. The performance of some Syrian genotypes was comparable or even better than that of the Czech modern varieties. One of the most promising genotypes was No. 42/1 characterized by the highest grain yield, high TSW and also high content of crude protein.

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