Identification of drought tolerant barley genotypes (Hordeum vulgare *L.)* using drought tolerance indices

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Extended Abstract

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Introduction: Drought stress affects 40-60% of agricultural lands all over the world (Bray, 2002). With a precipitation of 240 mm/year, Iran is located in arid and semi-arid region of the Earth. Due to the shortage of rainfall in Iran, a considerable part of crop breeding programs is devoted to research concerning drought tolerance. These efforts have resulted in the introduction of stable and drought tolerant varieties. Although barley is more tolerant to drought stress compared to other cereals, it is susceptible to moisture shortage during tillering and grain formation stages, which will result in yield losses. Yield provides the most direct index for evaluating response of crops to environmental stresses. Although grain yield is affected by environmental factors, it is an index to evaluate response of cereals to environmental stress. The objective of drought tolerance research is to provide relatively tolerant varieties that exhibit less yield losses compared to other genotypes under water-deficit growing conditions. To select plants based on their yield performance, various indices have been proposed. All these indices consider yield under two conditions of stress and non-stress

Material and Methods: This study was carried out in two separate experiments (normal and cut irrigation after 50% flowering) with 20 barley genotypes, which were compared in a randomized completed block design with three replications at Mashhad agricultural research station during two succeeding years. Each genotype was planted on two parallel ridges (six rows) with a length of six meters. Besides, all the cultural practices treatments were applied to the experimental

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plots according to the conventional farming methods used in other experimental farms. Soil fertilization was based on the soil nutrient analysis. Barely seed density was maintained at 350 seeds per meter square. No effective rainfall was recorded between irrigation cut off and physiological ripening of the genotypes during two years of the experiment. Under normal condition, 3-4 rounds of irrigation were applied according to crop water demand, while under water deficit condition, irrigation was cut after ear had emerged on 50 % of the plants. Stress tolerance indices were calculated based on two-year means, which included mean productivity (MP), geometrical mean productivity (GMP), stress tolerance index (STI), stress susceptibility index (SSI), tolerance index (TI), yield stability index (YSI), and relative drought index (RDI). Data were analyzed and Duncan mean's comparison was applied by SAS statistical software (SAS 9.1.3.). Biplot analysis was adopted by GEA-R software.

Result and Discussion: The combined analysis of data conducted by Bartlett analysis showed uniformity among the collected data during two years of the experiment. The use of GGEBiplot analysis to evaluate the investigated indices made it easy to compare the genotypes. The correlation between yield under stress and non-stress conditions was not significant. Genotype×environment interaction was significant over two years of the experiment, which showed high intensity of drought stress. Blum (1999) and Panthuwan *et al.,* (2002) believed that potential yield could only affect yield under normal or moderate stress conditions but under high-level stress, genotype×environment interaction would have a significant impact on crop yield. Biplot correlation could show the relation between grain yield and the calculated indices where GMP, MP and STI were the most suitable drought tolerance criteria under the both experimental conditions. Lines 6, 20 and 15 were identified as superior genotypes based on GIBplot polygon. Keeping in view both yield and stability, adopting GGEBiplot method produced the same results as were obtained from the other methods. The biplot results showed that Line 6 was the ideal genotype. The results indicated that GIBplot and GGEBiplot were suitable methods to identify superior genotypes according to biplot of different drought tolerance indices considering both yield and stability.

Conclusion: Based on the findings of this study, STI, MP and GMP were the best indices for identifying superior genotypes under the two experimental environments. Lines 6, 20 and 15 were identified as superior genotypes. Line 6 was also considered as an ideal genotype.

Keywords: Barley, genotype-environment interaction, GGEBiplot, GIBiplot, stress indices

References

Blum, A. 1999. Improving wheat grain filling under stress by stem reserves mobilization. *Euphytica,* 100:77-83.

Bray, E.A. 2002. Classification of genes differentially expressed during water-deficit stress in *Arabidopsis thaliana*: an analysis micro-array and differential expression data. *Annual Botany*, 89:803-811.

Panthuwan, G., Fokai, S., Cooper, M., Rajatasereekul, S., and O'Toole, J.C. 2002. Yield response of rice genotypes to different types of drought under rainfed lowlands. Part 1: grain yield and yield components. *Field Crop Research,* 41:45-54.