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ARTICLE

Predicting water stress tolerance of malting barley varieties with seedlings PEG-reactions

Anna Skribanek[1]*, András Tomcsányi[2]*

[1]Faculty of Natiral Science and Technic, Instituion of Biology,University of West Hungary, Szombathely, Hungary, [2]Research Station of Cereal Research Nonprofit Co., Táplánszentkereszt, Hungary

ABSTRACT We analyzed the correlation between 32 malting barley variety seedlings PEG-reactions and the water stress tolerance. We characterized the water stress tolerance with the yield differences of the year 2007 (extreme arid) and 2006 (normal fall). Under PEG solution effect the proline and sucrose content was higher, and the roots and leaves growth was lower. The correlation between them was r=0.32-0,49. After the contraction of the four best correlated PEG-reactions attribute with water stress the correlation of the contracted PEG-reaction index improved up to r=0,65.
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KEY WORDS

malting barley
PEG
water stress

Because of the climate changing it is very important to recognize the water stress tolerance of the cultivated plants. It is especially important with the humid malting barleys. The adaptation of these plants to arid conditions seems to be more difficult than those of the drought-resistance plants. For the first step we worked out a method to predict the drought-resistance of the malting barley varieties. According to some literature data there is a correlation between the seedling growth, osmotic substances and the water stress tolerance (Karamanos 1995; Verslues et al. 1998; Kerepesi and Galiba 2000). We examined 32 test varieties with PEG 20% solution, originated from breeding program of Cereal Research Non-Profit Company. We measured the correlation of changing the proline and sucrose content, the root and leaf growth of the seedlings under field water stress. We characterized the field water stress tolerance of the varieties with the differences in yield in the extremely arid 2007 year and in the normal rainfall 2006.

Materials and Methods

The influence of field aridity

The influence of field aridity was predicted with the small plot experimental results of the extremely arid 2007 year and the normal rainfall 2006. The main characteristics of the two years' weather in Táplánszentkereszt are shown in Table 1. In year 2007 during the 3,5 months vegetation period the rainfall was 50 mm less than in 2006, even more in adverse dispersion. In 2007 the average temperature was 2,5°C higher what even more increased the important drought-stress. In 2006 the weather was as the average before. The data of Táplánszenkereszt are similar to nationwide trend.

*Corresponding authors. E-mail: sanna@ttmk.nyme.hu, toma@gabonakutato.hu

Field water stress tolerance of varieties

We examinated water stress tolerance of 32 malting (spring) barley cultivated varieties. Their drough resistance were defined by their yield differences between the two year in average of five small plot trials (Táplánszentkereszt, Sopronhorpács, Kompolt, Putnok and Szeged)

PEG-examinations

The 32 varieties were pre-seeded on filter paper, than the 30-30 plants were put into water culture on seeding grid. After a week the water culture was changed into PEG-4000 20% so-

Table 1. Weather statistics in years 2006 and 2007 in Táplánszentkereszt.

	Rainfall (mm)			Temperature (°C)		
Month	2006	2007	Years average	2006	2007	Years average
March	23.5	65.3	33.2	4.0	7.6	5.7
April	54.5	4.7	40.1	11.9	13.5	10.3
May	60.7	47.4	62.8	15.3	17.5	15.8
June	88.7	47	79.2	19.6	21.9	18.9
Avg.	227.4	164.4	215.3	12.7	15.1	12.7
Year-Avg.	12.1	-50.9		0.0	2.5	

Table 2. Correlations in the two experimental years.

	Yield 2006 (t/ha)	Yield 2007 (t/ha)	Drought-influence difference (t/ha)
Yield 2006 (t/ha)	1.00		
Yield 2007 (t/ha)	0.33	1.00	
Drought influence difference (t/ha)	-0.82	0.27	1.00

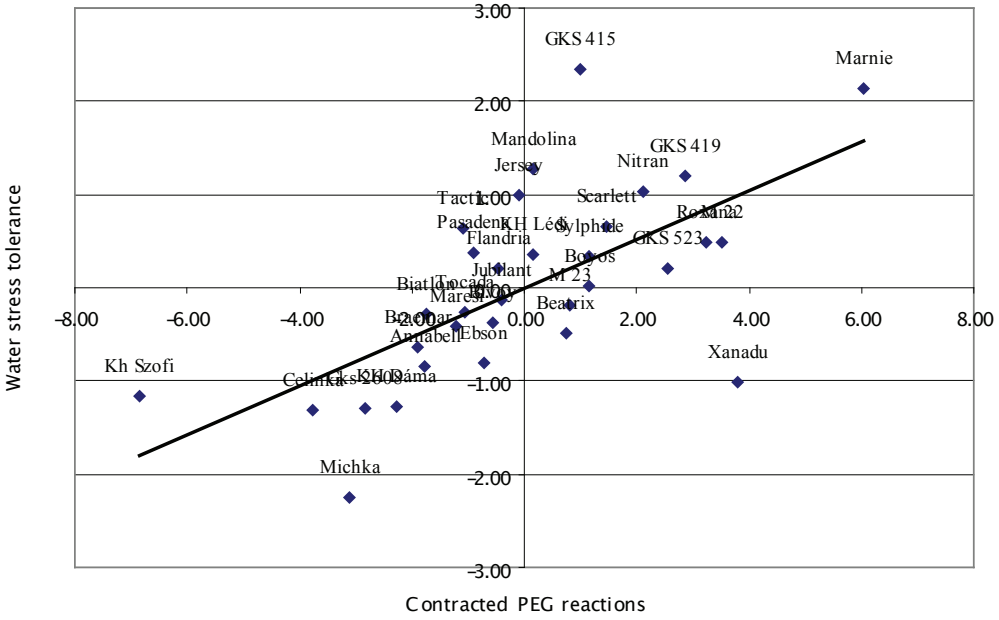

Figure 1. Correlation between the contracted PEG-reactions and the field water stress tolerance (yield difference in 2006-2007).

lution, while we only changed the water under control plants. In each experimental year we made 3 repetitions in random blocks. Two days after the PEG treatment we measured the root-length, the wet and dry mass of the leaves, proline and sucrose content of the leaves. The proline content was by the method of Bates (1973), and the sucrose content was determined by phenol-sulphuric acid (colorimetric) method (Dubois 1956).

Correlation examinations

The correlations between the characteristics were evaluated by Bravais f correlation coefficient and by principal component analyses (Sváb 1979). We standardized the measured data to contract the characteristics.

Table 3. Correlation of signal properties.

	Proline content (PEG 20%)	Sucrose tolerance index (PEG20%/ control)	Root length (PEG20%)	Leaves mass (control)
Proline content (PEG 20%)	1.00			
Sucrose tolerance index (PEG20%/kontroll),	-0.08	1.00		
Root length (PEG20%)	-0.16	0.31	1.00	
Leaves mass (control)	0.28	0.12	0.64	1.00

Results

We investigated the water stress tolerance of the varieties from the yield and the yield-differences between the years 2006 and 2007. The five experimental places' average product was 0,6t less in 2007, and the differences between the varieties was very high, between the max and min yield difference was 2,35t/ha. The correlation between the two years' yield was very little (Table 2). The water stress tolerance is in strong negative correlation with the products of the year 2006. It means that in year 2006 the drought sensitive types performed well.

The laboratory examinations based on PEG reaction showed little/middle correlation with the product results. The root-length and the leaves mass declined, while the sucrose and proline content increased on the PEG treatment affect. None of the characteristics showed a high correlation to use for selectation.

We chose those characteristics which exhibited best correlation with the methods of measuring the correlations between the characteristics and the principal component analyses. These characteristics are as follows: proline content (PEG 20%), sucrose tolerance index (PEG20%/control), root-length (PEG20%), leaves mass (control). Among the chosen characteristics only the root-length and the leaves mass was middle/well correlated (Table 3).

After contracting the characteristics the correlation between the water stress tolerance and the contracted experimental results (contracted PEG reactions) were middle tight (r=0,65; Fig. 1). This so called contracted index is able to select the varieties.

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