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Evaluation of the yield and the yield stability of perspective lines of barley

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Summary

The study was carried out in the Experimental field of the Department of Genetics and Plant Breeding – Agricultural University, Plovdiv during the period 2009-2011. New breeding lines were investigated using block design with 4 replications and 20 m2 plot size. The aim of the investigation was to estimate barley lines by yield, stability and some important traits, using Obzor as a standard. Applying biometrical and cluster analysis and index of yield stability, it has been established that some breeding lines: numbers 21411003, 21401409 and 21001008, respectively, had better traits in comparison with the standard cultivar "Obzor" as well as stable yields regardless of differences in the climatic conditions over the years. These lines can be certified as new cultivars according to the government's requirements for cultivar testing.

Key words: barley, cluster analysis, yield stability.

Introduction

Incessant changes in weather conditions directed selection activities towards the creation of types of barley that have good adaptive capacity and stability in the manifestation of their biological features.

Based on the surveys conducted by Allard and Bradshaw (1964), Tsenov N, T. Gubatov, V. Peeva (2006), Dimova D., M. Dimitrova, G. Rachovska (2006), Valchinkov St. (1990), the types which show good genotype productivity under various weather conditions are characterised by good adaptability as well.

The creation of types having permanent economic indicators regardless the environmental conditions is important for production.

The purpose of this survey is to evaluate the yield, yield stability and some important quantitative traits of 10 perspective lines of barley and the Obzor cultivar

in order to propose them for the State cultivar testing or include them in future breeding programmes.

Materials and methods

The investigations were conducted within the period 2009-2011 in the experimental field of the Genetics and Plant Breeding Department at the Agricultural University – Plovdiv with 10 perspective lines of barley and the standard cultivar Obzor. We used a block scheme of 4 replicates and a 20 m^2 experimental lot.

During the vegetation period, we registered the type composition and density of the weeds as well as the level of invasion for different genotypes. We took samples consisting of 40 plants per variant and analysed the following traits: height of the plant, general germination, length of the central ear, weight of the grains from the central ear, weight of the grains from the entire plant and absolute weight.

The genotypes studied have been evaluated in terms of yield and stability of its manifestation by applying the parameter of Kang (1993) – Yield stability index (Ysi).

Using the average data about the yield and traits analysed, we performed clustering of the studied variants. We used the SPSS computer programme and grouping of the variants was made by determining the Euclidean distance between two objects (Ward, 1963; Duran and Odell, 1974). The clusters were graphically illustrated by means of a dendrogram. The relative importance of the traits, when grouping genotypes into a cluster, was determined by analysing the main components, (Philippean, 1990).

Results and discussion

The yields for different variants and years were processed using a dispersion analysis. The results of the analysis, which are presented in Table 1, show that there are certain differences between the genotypes studied and between the environmental conditions over the years. The evidence proving the difference in a relation between a genotype and the environment was a reason to evaluate the variants, not only in terms of yield, but also in terms of yield stability.

In Table 2, we have shown the results from the stability analysis conducted. The lines and the standard cultivar Obzor have been presented in a descending order based on their yield. We have assessed evidence of the difference between the lines and the standard. The line 21401409 (765 kg/da) had the highest average yield for that period.

The difference between the line and the standard is statistically significant. The line 21001008 also had a yield that was higher than the standard level. The line 20411003 had an average yield of the Obzor cultivar. The other lines had low yields.

We noticed that the line 20411003, whose yield was lower than for the aforementioned lines, had the highest stability index (Ysi $=14^{+}$). This line was least influenced by climatic variations over the years of the survey.

Tab. 1. Results from the dispersion analysis (2009-2011)
Rezultati disperzione analize

Reasons for variation	Fg	SQ	S^2	$F_{exp.}$	F_{table}
General	43	68347			
Genotypes	10	13745	1374,5	$3,40^{+}$	2,35
Conditions of the environment	3	27433	9144,3	$22,65^{+}$	3,10
Interaction	30	27169	905,6	$2,24^{+}$	2,04
Heterogeneity	10	9875	987,5	$2,44^{ns}$	3,40
Errors	20	8075	403,75		

The lines 21401409 (Ysi $=13^{+}$) and 21001008 (Ysi $=10^{+}$) and the Obzor cultivar have a high level of stability (Ysi $=12^{+}$).

Tab. 2. Evaluation of the genotypes in terms of yield and stability
Evaluacija genotipova u vezi sa prinosom i stabilnošću

Variants	Average yield kg/da	Range of yield	Correc-tion of the range	Range coefficient	Variance of stability	Coefficient of stability	Stability index (Ysi)
21401409	765^{+}	10	1	11	1042,8	-1	13^{+}
21001008	723^{ns}	12	1	13	47,83	0	10^{+}
Obzor	715	17	3	20	1743,99	-8	12^{+}
20411003	686^{ns}	15	1	16	10145,36	-2	14^{+}
20801506	681^{-}	9	-3	6	2132,25	0	6^{+}
20301005	650^{-}	7	-1	6	6833,44	-4	2
20210104	644^{-}	5	-2	3	3243,58	-1	2
20510103	610^{-}	6	-2	4	1286,26	-4	0
20905108	600^{-}	5	-1	4	3416,55	-1	3
21102508	586^{-}	7	-2	5	1735,88	-6	-1
86101108	580^{-}	2	-2	0	2356,43	0	0

$LSD_{P\ 0,05} = 28,49$

In order to establish genetic closeness or remoteness of the genotypes regarding the average manifestation of the traits studied, we used a cluster analysis.

We can see from the dendrogram (Figure 1) that the variants 21041409, 21001008, Obzor and 20411003, which had the highest yields and a high stability index, were united into one cluster group. For the sake of the practical selection activities, these lines can be regarded as equal enough. The other lines are divided into two opposite cluster groups.

The analysis results concerning main components show that three of them can be used to explain 97.8% of general variation (Table 3). As regards the first component, which can explain 69.4% of general variation, yield, weight of the grains from the entire plant, weight of the grains from the central ear and absolute

weight are features that have the greatest influence on the aforementioned clustering.

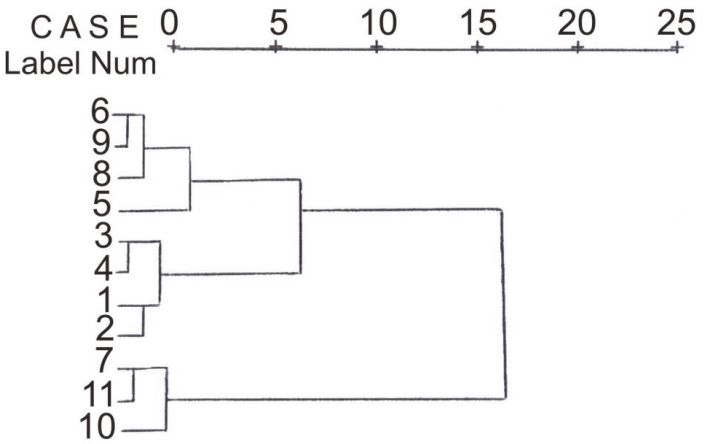

Fig. 1. Clustering of the tested genotypes
Grupisanje ispitivanih genotipova

Regarding the second main component, the highest correlation coefficients are those of the following traits: length of the central ear, weight of the grains from the entire plant, absolute weight and number of productive tillers. This component can explain 17.48% of general variation.

Tab. 3. Results from the analysis of the main components
Rezultati analize glavnih komponenti

Traits	Main components		
	1	2	3
Yield	0,965	0,315	0,310
Number of tillers	0,912	0,323	0,425
Weight of the grains of the central ear	0,912	0,248	0,189
Weight of the grains of the plant	0,948	0,436	0,301
Length of the central ear	0,679	0,502	0,275
Height of the plant	-0,634	0,243	0,279
Absolute weight	0,860	-0,393	0,312
Explained % of the general variation	69,4%	17,48%	10,90%

As regards the third main component, which explains 10.9% of variation, the traits related to productive germination, absolute weight, yield and length of the central ear play an important role.

Conclusion

1. Out of the 11 genotypes of barley examined, the most perspective ones in terms of yield and stability are 20411003, 21401409 and 21001008 lines. These lines can be submitted for State cultivar testing.

2. What is important for practical selection is the evaluation of genetic remoteness between the variants assessed on the grounds of their phenotype manifestation in various environments.

3. The traits that are the most important and that explain the highest percentage of general variation can be regarded as the most reliable ones in the selection process when conducting selection activities.

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Evaluacija prinosa i stabilnosti prinosa perspektivnih linija ječma

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Sažetak

Ispitivanja su sprovedena na eksperimentalnom polju Odsjeka za genetiku i oplemenjivanje bilja – Poljoprivrednog univerziteta, Plovdiv tokom 2009-2011. godine. Ispitivane su nove oplemenjivačke linije upotrebom blok dizajna za 4 replikacije na parceli od 20 m2. Cilj istraživanja bio je da se ocijene linije ječma u odnosu na prinos, stabilnost i neke važne karakteristike primjenom Obzor kao standarda. Primjenjujući biometričku i klaster analizu i indeks stabilnosti prinosa ustanovljeno je da neke oplemenjivačke linije broj 21411003, 21401409 i 21001008 imaju bolje karakteristike u odnosu na standardni kultivar „Obzor“ kao i stabilne prinose bez obzira na razlike u klimatskim uslovima tokom perioda. Ove linije mogu biti potvrđene kao novi kultivari prema državnim zahtjevima za testiranje kultivara.

Ključne riječi: ječam, klaster analiza, stabilnost prinosa.

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