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CHOOSING THE GENITORS - AN IMPORTANT MEASURE IN MAKING THE BREEDING WORKS BETTER AT THE SPRING BARLEY

Ioana PORUMB[1], Florin RUSU[1], Ancuța BOANTA[2], Emanuela FILIP[1,2], Nicolae TRITEAN[1], Cristina STANCĂ-MOISE[3], Leon MUNTEAN[2]

[1]Agricultural Research and Development A.R.D.S Turda, Romania,
[2]University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Romania,
[3]University "Lucian Blaga" of Sibiu

Corresponding author: ioanaporumb18@yahoo.com

Abstract

Ensuring progress in improving barley's production and traits of interest is closely linked to the diversity and performance of the original material that can lead to increased genetic variability and new valuable cultivars. Thus, phenotyping of the genotyping collection is a first step in identifying the most valuable available genres and introducing them into hybridization programs, depending on the complementarity of the traits. The traits that have been quantified and used to determine the cognition degree of the cultivars studied are: plants height, ear length, number of grain / ear, grain weight/ear, TKW, protein and starch content. Genotypes have been identified that can be used in future amelioration works either to increase the fall resistance because plants height value are approximately 81 cm or for qualitative improvement, showing high TKW values (52 g), low content protein (less than 10.5%) and high starch content (approximately 60%).

Key words: *climate changes, Barley, morphological traits, cluster, genotype*

INTRODUCTION

One of the oldest plants in culture is barley, most of the archaeological evidence demonstrates this. This plant has played an important role in the development of human civilization, agronomic, physiological, genetic and plant amelioration sciences, being used by farmers since antiquity [2].
Probably in human food, barley was used in the raw form or as roasted bread, porridge or soup as in the case of gladiators who had a diet based on barley, peas or bean porridge to have power in the arena. Only later, barley was used as fodder or in the alcohol industry. At present, about 55-60% of barley production is used as fodder, 30-40% for malt, 2-3% for human food, and about 5% is used as seed for crop re-establishment [4].
Lately, the interest in barley in human food has increased due to the incidence of obesity growth and chronic diseases such as cancer. Research has shown that dietary fiber has many benefits to human health, barley being an excellent source of fiber and beta-glucans.
The genetic background of barley can be classified into: genotypes, improved lines, local populations, wild species and genetic stocks, depending on the breeding stage of the material [3].
Ensuring progress in improving barley's production and traits of interest is closely linked to the diversity and performance of the original material that can lead to increased genetic variability and new valuable cultivars. Thus, phenotyping of the genotyping collection is a first step in identifying the most valuable available genres and introducing them into hybridization programs, depending on the complementarity of the traits.
In this study, only a part of the results of a much wider experience will be presented by which the availability of national plant genetic resources was actually pursued.

MATERIALS AND METHODS

The use in improvement schemes of genres in which the traits of interest or at least a large part of them are expressed at a favorable level as a result of previous improvement processes are important measures in accelerating the rhythm of obtaining new cultivation. In order to assess the variability of the features underlying the two-row spring barley improvement from ARDS Turda, a number of

66 genotypes differentiated from the point of view of the traits of interest were selected from the germplasm collection.

The traits that have been quantified and used to determine the degree of cognition of the cultivars studied are: plants height, ear length, number of grain/ear, grain weight/ear, TKW, protein and starch content. The duration of the experience was carried out during two years, 2016 and 2017, the location of which was the field of spring barley improvement from SCDA Turda. In order to reduce the field needed for this component of the improvement field, the collection is sown in 1m lengths, spaced at 25cm, each genotype having four rows. Every year, in the field of improvement we use the same doses of fertilizer and usually the same type of fertilizer. In order to determine the degree of kinship between the studied genitors, the cluster method was addressed using the "Statistics" program. Determination of chemical indicators was performed by spectrophotometry using the Tango Nir device.

RESULTS AND DISCUSSIONS

Of the morphological traits, the plant's height occupies an important place within the amelioration objectives, being a criterion for selecting new lines from the early stages of improvement.

The remarkable differences between the minimum and maximum values of this traits presented in Table 1 show the existence of real possibilities in identifying valuable genres, complementary to genes of plant height reduction and possessing favorable quantitative qualities. Choosing very contradictory genres in plant height can extend the duration of selection processes and achieve the proposed objectives, given the polygenic nature of this property. By the values of the variation coefficients corresponding to the production components: grain weight/ear, ear length, grain number and TKW, it could be said that between the 66 genotypes analyzed there is quite limited variability in these traits. However, if we refer to the availability reflected between the minimum and maximum values, we can notice the existence of appreciable variability. When including such genres in hybridization programs, we only need to resort to situations that are absolutely necessary. Thus, the useful portion of this variability that may be used is between the minimum and the average.

The values of the variation coefficients corresponding to the plant size, the grain weights and the protein content suggest that these three traits have a significant share in the differentiation of the analyzed genotypes.

Table 1. The variability indicators corresponding to the traits used for the cluster grouping (2016, 2017)

Trait	Average	Minimum	Maximum	Coefficient of variation (%)
Plant height (cm)	94	77	106	7
Length ear (cm)	9	7.7	10.5	6
Grains number/ear	27	23	30	6
Grains weight/ear (g)	1.39	1.16	1.62	7
TKW (g)	49.86	45.2	56.41	5
Protein (%)	11.12	9.39	12.88	7
Starch (%)	56.78	53.96	60.06	3

Source: original.

At the basis of the formation of the first cluster there were 17 genotypes of different origins, forming six groups. The variants 1, 5 and 15 represented by the Turdeana genotypes, Romaniţa (Romania) and Vienna (Germany), are represented by the first group of the cluster, with the average height of 94 cm (Table 2). Among the traits analyzed, the grain weight/ ear is the main component contributing to the differentiation of this group.

The difference between the first and the second group is achieved at the plant's height, grain weight/ ear and starch content. Thus, the second group is composed of four genotypes of three native (Daciana V2, Jubilee V4 and charm V7) and the old variety Thuringia (V21) is characterized by a smaller size of only 91 cm, compared with the first group, a low average grain weight/ear (1.33g) and a 55.48% starch content (Table 2).

The largest differences in the set of genotypes that form this cluster are recorded at the plant's height, so the group three records the highest values of the average height of plants (99 cm). If we compare the first and third groups we could say that the similarity between them is reflected in the average values of the protein and starch content (Table 2). This group (III) is represented by Romanian genotypes such as: Prima (V6), Adina (V8), Bogdana (V9) and Western European genotypes Alexis (V18) and Scarlet (V19).

Table 2. The average performance of the analyzed traits corresponding to genotypes in cluster 1

Cluster 1						
Average 2016-2017	**I/3**	**II/4**	**III/5**	**IV/1**	**V/2**	**VI/2**
Plant height (cm)	94	91	99	86	82	81
Length ear (cm)	10	9	9	10	9	8
Grains number/ear	28	27	28	26	24	24
Grains weight/ear (g)	1.46	1.33	1.35	1.20	1.36	1.18
TKW (g)	50.45	48.91	48.55	47.05	53.77	49.27
Protein (%)	10.95	11.17	10.96	11.60	9.72	10.00
Starch (%)	56.98	55.48	56.08	54.96	57.04	58.39

Source: original.

The Capriana spring barley (V3), SCDA Turda, forms the group number four, differentiated by the other groups of this cluster by the lowest values of grain weight/ear (1.20 g), TKW (47 g) and of the starch content (54.96%), but with the highest average protein content of 11.60%. (Table 2).
The last two groups (V and VI) of the cluster one are the foreign genotypes: Sidney (V10), Victoriana (V16), Steward (V11) and Marthe (V17) (Figure 1). They can be used in future qualitative improvement and increase of fall resistance because they record the lowest waist values (82 and 81 cm), high TKW values, the lowest protein content and the highest starch content. Similarity of genotypes within these two groups is evident, with only 0.5 linkage units being differentiated.
For the formation of the second cluster, it was chosen to group the lines that have a genealogy of an old variety (Trumpf) which in the 70s and 80s occupy significant areas in Romania and the Alexis genotype that also has this genealogy. The mean values of the 10 genotypes that form six cluster groups are shown in Table 3.

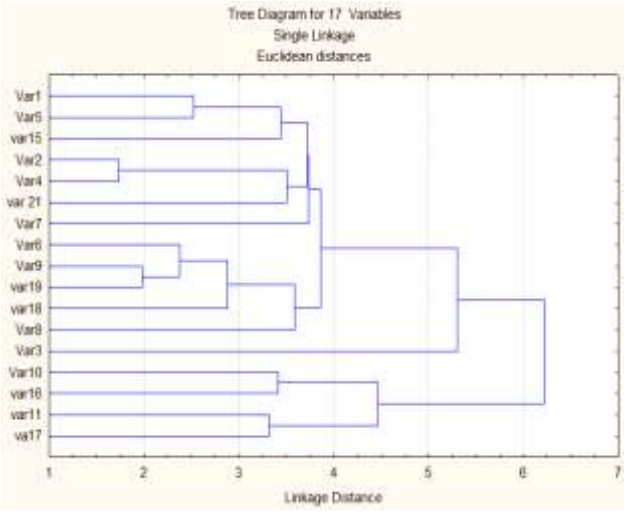

Fig. 1. Cluster presentation of variation some genotypes with regard on some morpho-productive and quality traits
Source: original, obtained through the statistical program.

The four lines forming the first group of the cluster record average plant height of 100 cm, protein and starch content is relatively high (12.10% and 57.38%).
Along with the four lines joins the Alexis genotype (V18) with some similarity to the above lines in terms of plant height, ear length, protein content, why the V18 would appear slightly separate from V103, V104, V106 and 107 s due to the grain weight/ ear (Figure 2).The variants of this group varied by one or two linkage units (Figure 2).
The other lines make up five separate groups with a high degree of similarity in the number of grain/ear, except the To 2270/10 (V108) line with the highest average of 30 grain/ear (Table 3).
A particular behavior that can be observed for variant 168, which differs from the rest of the groups by the highest mean plant height of 106 cm. In terms of protein content, group V is made up of variant 105 with the lowest values (10.56%) consisting of the Gritt and Trumpf barley genotypes (Table 3).
Although these lines have a common hereditary basis, the variability of the

analyzed features did not show a pronounced constraint (Figure 2).

Table 3. The average performance of the analyzed traits corresponding to genotypes in cluster 2

Cluster 2						
Average 2016-2017	**I/5**	**II/1**	**III/1**	**IV/1**	**V/1**	**VI/1**
Plant height (cm)	100	98	95	106	94	89
Length ear (cm)	10	9	9	10	10	10
Grains number/ear	27	30	26	29	26	29
Grains weight/ear (g)	1.30	1.40	1.46	1.50	1.47	1.43
TKW (g)	48.37	48.78	52.99	49.93	56.41	45.20
Protein (%)	12.10	12.53	11.88	11.77	10.56	11.08
Starch (%)	57.38	55.33	53.97	55.23	59.89	55.98

Source:original.

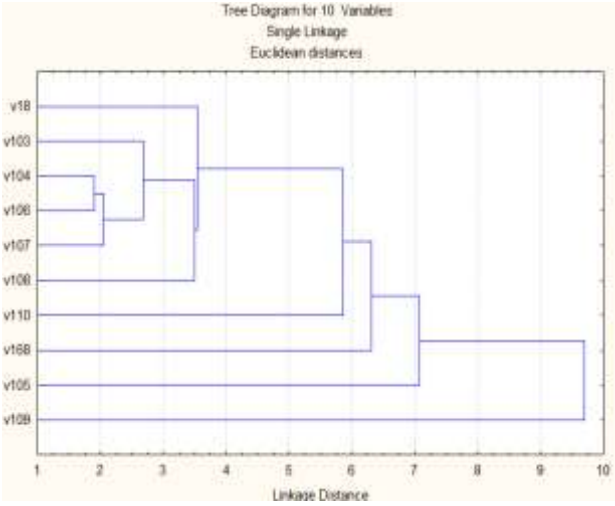

Fig. 2. Cluster presentation of variation some genotypes with regard on some morpho-productive and quality traits
Source: original, obtained through the statistical program.

In the third cluster are presented Limagrain creations, Saaten-Union Western European breeding and SCDA Turda brand lines obtained between 1980 and 1990. Variants V77, V84, V85, V74, V75 AND V76, V82 and V73, represented by the lines created at SCDA Turda, are differentiated by 1, 2 or 2.5 linkage units, except lines To 3272/79 (V77) and To 2167/94 (V84) along with the Elisa genotype (V23), which form a separate group of cluster three, being quite similar in the analyzed traits (Figure 3) [1].
The differences in these lines are plotted by the mean values presented in Table 4, with higher or lower oscillations for most traits, except for protein content ranging from 11.18% to 11.88%.
The differentiation between the first (I) and the second (II) group is at the level of the plant's height, the length of the ear and the protein content, also in the other three traits analyzed, the two groups are obviously similar [1].

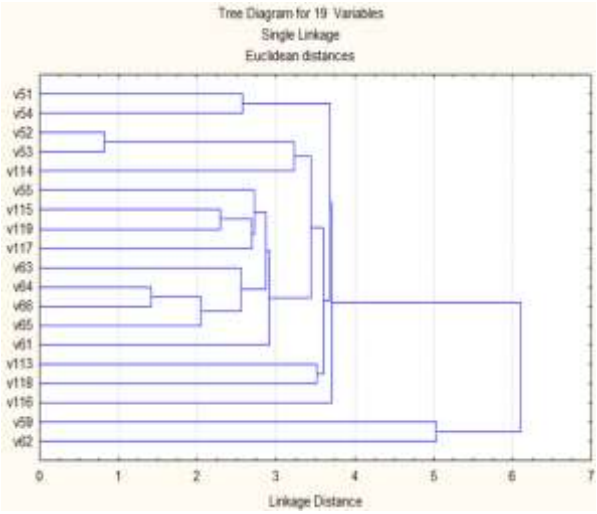

Fig. 3. Cluster presentation of variation some genotypes with regard on some morpho-productive and quality traits
Source: original, obtained through the statistical program.

The group (IX) of the V83 and V24 variant is characterized by a low protein content of 10.86% and a superior starch content of 58.47%. The two variants, the Turda line and the Chronicle genotype, components of group IX, have similarities for most traits, except for the protein content (Table 4).
The Belgravia, Odissey, Overture, and Concerto genotypes represented by variants 25, 26, 27 and 28 form the group X of the present cluster, differentiated by the groups represented by the plant's size of 86 cm, with significant TKW values of 52, 52 g, and especially with the lowest protein content and the highest starch content (Figure 3).
Variants 25, 26, 27, and 28 could be used in future amelioration works as valuable drivers for line improvement.
Two other variants (31 and 67), which are part of this cluster and appear as two separate groups, are the Salome and Armada cultivars (Figure 3).

TKW is the main feature that makes the difference between the two variants and the rest of the genotypes in this cluster. The Salome genotype is ranked second as a low value of this trait and the Armada genotype records the highest values (Table 4).

The Armada genotype can be ranked as a valuable resource for improving grain size and production capacity.

The group XIII include two genotypes, Tatum and Sulilly, represented by variants 29 and 30, similar in terms of protein and starch content to those of group X but totally different from the rest of the cluster genotypes in plant size (78 cm), the number of grain (the smallest 25) and the grain weight/ear (Table 4).

Table 4. The average performance of the analyzed traits corresponding to genotypes in cluster 3

Cluster 3							
Average 2016-2017	I/1	II/3	III/1	IV/1	V/1	VI/1	VII/1
Plant height	104	98	98	99	100	101	98
Length ear (cm)	8	10	10	9	10	9	9
Grains number/ear	28	28	27	30	27	29	28
Grains weight/ear (g)	1.39	1.43	1.43	1.47	1.41	1.48	1.33
TKW (g)	49.26	49.27	50.38	50.23	49.54	49.52	45.79
Protein (%)	10.68	11.52	11.18	11.50	11.63	11.46	11.88
Starch (%)	56.56	55.85	56.14	56.03	57.02	55.51	54.88
Cluster 3 (from groupVIII-XIII)							
Average 2016-2017	VIII/1	IX/2	X/4	XI/1	XII/1	XIII/2	
Plant height	100	90	86	93	90	78	
Length ear (cm)	10	10	9	10	9	9	
Grains number/ear	30	28	26	29	27	25	
Grains weight/ear (g)	1.48	1.42	1.45	1.41	1.47	1.30	
TKW (g)	48.35	50.26	52.52	47.95	55.42	52.36	
Protein (%)	11.34	10.86	9.75	10.87	11.24	10.04	
Starch (%)	58.87	58.47	59.07	55.96	56.85	58.72	

Source:original.

The first two groups of five variants (51, 52, 53, 54 and 114) are similar in terms of chemical composition and differentiated to TKW, grain weight/ ear and plant height (Table 5).

The group placed in second place in terms of starch content (57.29) is the third, made up of variants 115, 117 and 119 (Figure 4) represented by the lines created by Turda and the Dutch cultivar Mazurka (V55) a separate version of this group having the highest TKW values. Although the variants (Tocada V63, Şteffi V64, Ditta V66 and Germina V65), which form the fourth class of this cluster, are very similar in terms of morphoproductive and quality traits, it can be noticed that between Tocada (V63) and Germina (V65) recorded some differences (Figure 4). Thus, variant 63 records the highest values for TKW and grain/spice weight, while variant 65 records the lowest values of grain weight/ear and the highest protein content of 11.73% (Table 5). The difference between the five and the previous group is based on the starch content which is 59.64% for the Xanadu genotype that forms the group.

In Group 6, variants 113 and 118 are represented by Turda lines which differ from the other lines created at Turda by higher plant height values at the level of this cluster, the lowest TKW and content high protein ratio of 12.19% (Table 5).

Tabelul 5. The average performance of the analyzed traits corresponding to genotypes in cluster 4

Cluster 4								
Average 2016-2017	**I/2**	**II/3**	**III/4**	**IV/4**	**V/1**	**VI/2**	**VII/1**	**VIII/2**
Plant height (cm)	91	98	97	93	96	101	97	86
Length ear (cm)	10	9	10	10	9	10	9	9
Grains number/ear	29	28	29	27	26	28	24	26
Grains weight/ear (g)	1.38	1.46	1.44	1.39	1.41	1.33	1.17	1.37
TKW (g)	47.05	52.17	49.81	49.87	51.01	46.97	47.73	48.82
Protein (%)	11.62	11.32	11.47	11.15	11.29	12.19	12.42	10.23
Starch (%)	55.88	54.87	57.29	56.47	59.64	55.73	56.50	57.80

Source: original.

The lowest grain/ear numbers, grain/ear weight and highest protein content are trait to variant 11, a Turda line forming group VII.

Therefore, use these options in future amelioration work can be starting points for

the qualitative improvement of collection barely lines.

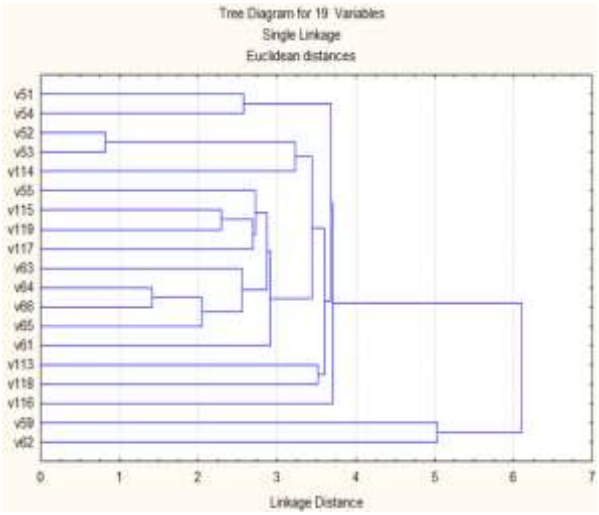

Fig. 4. Cluster presentation of variation some genotypes with regard on some morpho-productive and quality traits
Source: original, obtained through the statistical program.

Beatrix and Pasadena are components of group VIII, respectively variants 59 and 62, differentiated by the other components by one, two or even three linkage units (Figure 4), having the lowest protein content and the shortest dimension of 86 cm (Table 5). These traits recommend the use of these cultivars to improve the resistance to fall associated with the qualitative improvement of new cultivation.

CONCLUSIONS

Grouping genotypes in the form of clusters based on the similarities and differences between genotypes, allowed to formulate recommendations based on morphoproductive and qualitative traits, in order to make future improvement works more efficient.
Cultures Sidney, Victoriana, Steward and Marthe can be used to increase the resistance to fall because the values of the plant height is about 81cm. The same cultivation is recommended to be used for qualitative improvement, showing high values of TKW (52g), the lowest protein content (less than 10.5%) and the highest content of starch (about 60%). Besides these, Belgravia, Odissey, Overture and Concerto can also be included as valuable genitors of the above-mentioned traits.
For the improvement of one of the most important components of the production, namely the weight of the grain/ear, the Romanian genotypes Turdeana and Romaniţa as well as the German variety of Vienna are recommended.
The size of the grain in particular and the production capacity in general can be improved by using the Armada cultivar in future hybridization works.

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