Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 18, Issue 1, 2018
PRINT ISSN 2284-7995, E-ISSN 2285-3952

THE QUALITATIVE ASSESSMENT OF THE SPRING BARLEY GERMPLASM COLLECTION FROM ARDS TURDA

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Abstract

The success of the amelioration experiments is closely connected to the coefficient of variation found at the genetic material level. The working collections of the amelioration programs don’t intend to conserve the whole existent diversity at the level of a species, just to a useful portion of it, adapted to the specific ecological zones to each amelioration program. In this idea, the assessment of diversity and genetic stability of the genotypes with different provenances is an important step into the breeding experiments. To obtain some information regarding the coefficient of variation and stability of some qualitative parameters of spring barley namely protein content, starch and TKW, they were analyzed 185 genotypes from the breed assortment of spring barley from ARDS Turda in two years of cultivation.

Key words**:** *spring barley, protein, starch, TKW, coefficient of variability*

INTRODUCTION

The main directions towards the amelioration of the spring barley with two rows from ARDS Turda, are the growth of the productivity and quality of the new cultivars.
The qualitative amelioration implies two objectives, that form the main areas of use of the barley, namely animal feeding and the alcohol industry, often beer.
The qualitative amelioration for the beer industry is very complex including reaching many chemical requirements for the grains (protein content, starch, protein factors and amino acids) and of qualitative criteria of the malt (Bishop index, protein content, Kolbach index and so on). The new cultivars’s improvement that have as target animal feeding, implies the qualitative and quantitative growth of protein content.
The negative correlation between bean production and protein content both to wheat and barley [5], it’s preferable in the case of beer barley and less beneficial to the feed forms of barley or in the case of the wheat destined to the bakery industry.
Between the numerous requirements towards the quality of the barley destined beer, the appreciation of the protein and starch content, lead the direct factors in the cultivars’s amelioration for beer industry.
An indirect factor in the quality appreciation of beer barley is the size and uniformity of the grains. The size of the grains is directly associated with their weight reflected in the mass of a thousand grains.
Therefore, the qualitative assessment of the spring barley germplasm at least through those three indicators above, stands for an essential stage in choosing the genitors for the success of cross breeding experiments and the amelioration of beer barley.

MATERIALS AND METHODS

For this study within the spring barley collection from ARDS Turda there was chosen a number of 185 genotypes represented by older cultivars and lines obtained in the first 15 years from the creation of the amelioration program in Turda.

Besides this older germ-plasm it was analyzed also an important number of new spring barley genotypes.

Each genotype was sowed on five rows each 1m long, 30cm between the rows. The sowing experiment was made normal in perfect era for this type of cultivation in Transilvania, namely spring time, at the beginning of March. The crop rotation of the amelioration field is since 3 years ago corn- peas-barley. The fertilization system is balanced and constant from a year to another using only nitrogen based fertilizer with doses between 100-120 kg s.b/ha. The fertilization is done once in the spring time shortly after the plants risen.

For the chemical analysis there were extracted three samples from the seeds quantity corespondent to each genotype of every year. The determination of protein and starch content was made with the spectrometer Tango NIR. To determine the TKW they were made 10 determinations for each genotype and for each year based on the weight of the bgrains/ear.

RESULTS AND DISCUSSIONS

An important component of the production with direct implications towards the quality of the grains destined beer, is the TKW. To this attribution there is closely connected the size of the embryo and also the quantity of backup substances accumulated inside the bean, mandatory to provide a good germination and in the same time a superior germinative energy. To produce quality malt, the germinative energy is an primary factor as importance.

The reduced values of the variability coefficient from the two years of about 6% respectively 5% (Table 1) reflects a reduced grade of variation of the genotypes regarding this important quantitative trait of the production. The differences pronounced between the minimum and maximum values of the two years put in light the existence of an important difference between the 185 analyzed genotypes.

In many works from the speciality literature [2] there is mentioned that despite the weight of the grains/ear, number of grains/ear, numbers of tillers and production in general, TKW is the least affected by the environmental conditions having the highest stability. Even though all these studies indicate the high stability of this attribute, they don’t exclude the importance of the environment in the phenotypic expression. The results from the our study indicates a quite important impact of the environment in TKW expression, if we compare the environments of the two years. Also the averages show that between the 185 genotypes prevail the forms with bigger grains (talking about genotypes subject to breeding processes). Even if the differences between the average values of the two years are quite important, the variation coefficients’s values are quite close suggesting yet the idea of TKW stability.

Other two quantitative traits polygenic controlled with major implications in beer industry, the proteic and starch content are presented in table 1. The reduced differences between the averages and the values of variation coefficient of the two years reflect the stability and considerable involvement of the genotype in the control of protein content. The variation coefficients among with the differences between minimum and maximum show that through those 185 genotypes exists important differences of protein content. Thereupon, we can affirm that between these genotypes there can be identified formes that could be used to ameliorate the protein content in a way or another.

The views regarding protein content stability are diversified but lately they come together to the idea that the genotype is the most implied in the control above protein content. These affirmations come off also from our study. Bude and Mihăilescu [1], underlines the genotype involvement in protein content conditioning for barley.

The variability parameters at the other important qualitative character about barley grains destined to the beer industry namely starch content are presented in table 1. As well as in the case of proteins and in the case of starch it can be remarked the same reduced difference between the averages of the two years. The small values of the variability coefficients, reflects a weak differentiation between the genotypes. However the large lapse between the minimum and maximum values show the fact that between the studied genotypes exists an important variation that could be used in improving the starch content.

Table 1. Variability parameters for TKW, protein and starch on 185 genotypes from the spring barley collection (ARDS Turda 2016, 2017)

	Traits	**2016**					**2017**				
		Count	$\bar{x}$	**Min.**	**Max.**	**CV %**	**Count**	$\bar{x}$	**Min.**	**Max.**	**CV%**
1	**TKW (g)**	185	44.20	35.80	51.20	5.88	185	55.01	48.33	63.13	4.71
2	**Protein (%)**	185	11.77	9.41	14.89	7.30	185	11.14	9.17	14.05	7.70
3	**Starch (%)**	185	57.05	52.72	63.81	3.60	185	56.53	53.43	59.42	2.18

x- mean, Min. - minimum, Max. – maximum, CV % - coefficient of variation

Source: Own results.

To identify the most valuable genotypes facing the stability of the 3 quantitative traits has grain made the correlation of annual values of the two experimental years, as a quantification measurement of repeatability. The small variation amplitudes of annual values offers an important information regarding the stability. We can affirm that the correlation coefficient value (r) suggests indirectly the heritability of the attribute itself, the superior values close to 1 indicate a high heritability.

Figure 1 presents the behavior of the genotypes in terms of annual correlation values of TKW. The quantitative nature of this trait determines a different relationship of the genotypes at additive level in the interaction with the environment, this being reflected in the fluctuation of the values from a year to another. Between the 185 genotypes they can be identified types that have a high stability grade, registering reduced variations of the TKW but with values over the average of the two years, these ones being marked with red. These genotypes will be used in different hybrid combinations as valuable genitors to improvement the TKW stability to the new cultivars.

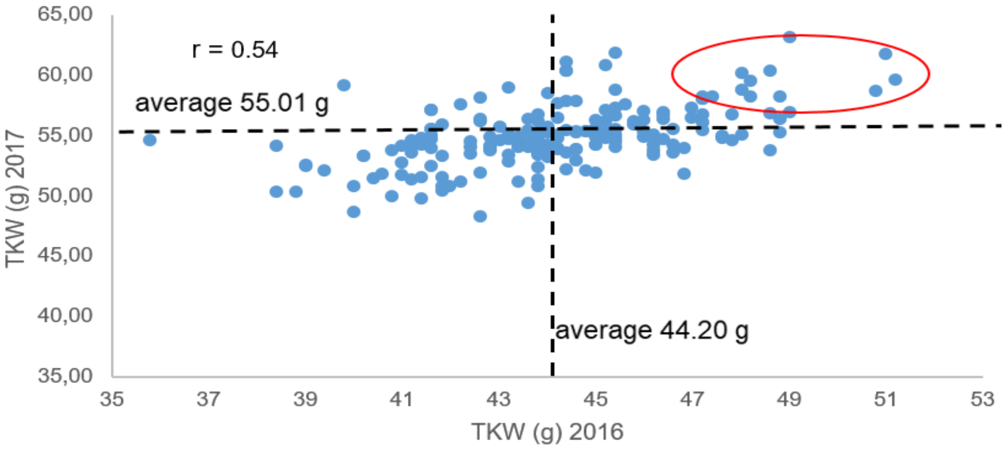

Fig. 1. Corelation (r) between the anual values (2016 and 2017) for the TKW in barley genotypes 185 as a measure of repetability trait

Source: Original.

The reaction of the genotypes regarding the accumulation of proteins in the grain in the two years is presented in Figure 2. As in the case of TKW also in the situation of proteins it can be remarked a different behavior of the genotypes regarding the genetic factor implication in phenotypic expression. Thereby, in the group of genotypes analyzed they can be identified variants with a pronounced stability (the ones in the red zone) and with values under the average of the two years corespondent to the requirements of the beer factories. Besides all these varieties with a superior stability it is remarked types less stable that could be ameliorated throughout a system of simple or complex hybrids to reduce the stability of protein content.

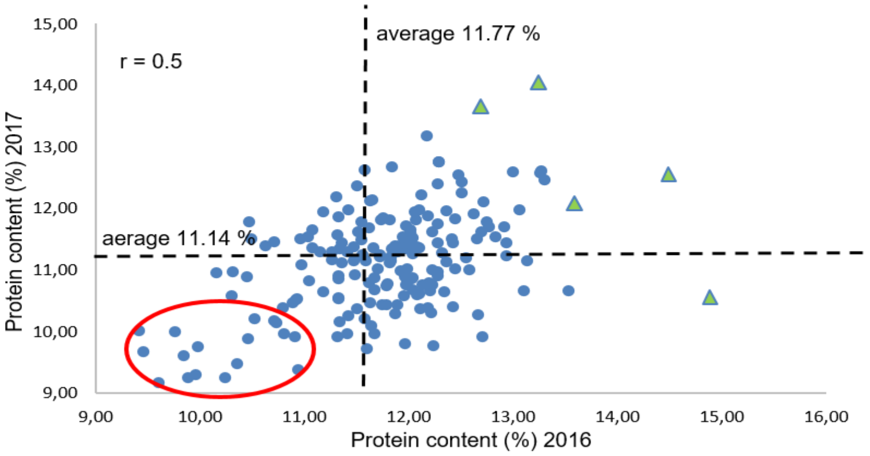

Fig. 2. Corelation (r) between the anual values (2016 and 2017) for the protein content in barley genotypes 185 as a measure of repetability trait
Source: Original.

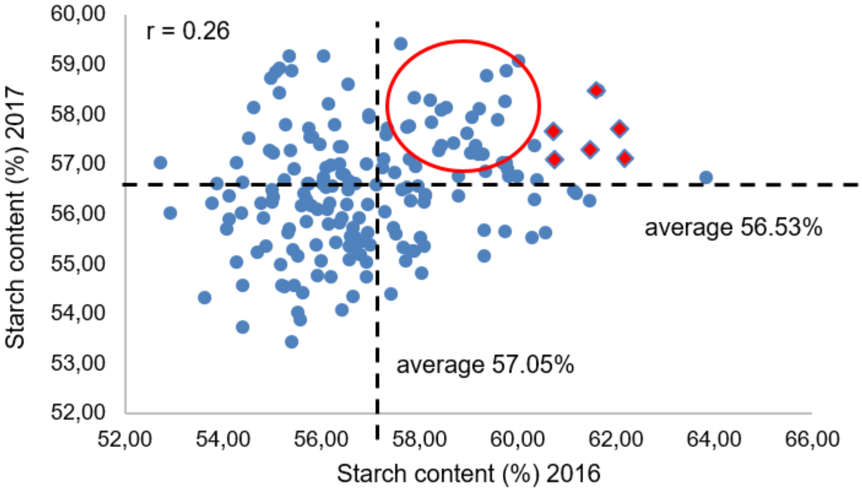

Fig. 3. Corelation (r) between the anual values (2016 and 2017) for the starch content in barley genotypes 185 as a measure of repetability trait
Source: Original.

The genotypes that present a good fixation at genetical level of the starch content (those put in the inside of Figure 3, and didn’t register oscillating values from a year to another, makes potential valuable genitors to qualitatively breeding the beer barley. In another study done in Turda on a higher number of genotypes they were obtained similar values of the correlation coefficient “r” of 0,27 [4]. Above it was assumed that the repeatability grade of the values reflects indirectly the heritability largely. Based on this reason we can say that the results of our study are in concordance with the results of other experiments done at Fundulea on different breeds of barley and winter barley and spring barley that mention similar contributions of the genotype of 20-30% in the accumulation of starch [3].

CONCLUSIONS

The appreciation of the potential of the genotypes from the assortment of varieties, makes a first step in the qualitative amelioration of spring barley. The variation coefficient values and variation amplitude correspondent to the content of protein in the studied material. The correlation coefficients of the annual values in 2016 and 2017 of 0.54 in the case of TKW and 0.5 for protein, suggest that there is considerable stability of these properties in the analyzed germplasm. From the data of this study it appears that in the phenotypic control of the starch content, an important role alongside the genotype is also the environment, all of which are reflected in the lower values of the correlation coefficient of the annual determinations of 0.26.

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