THE VARIABILITY AND HERITABILITY OF SOME MORPHO-PRODUCTIVE TRAITS OF SPRING BARLEY (TURDA 2016)

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Abstract: *For efficient breeding in order to obtain new spring barley genotypes, we proposed an inventory of the biological material used for breeding programs for the identification of genotypes, which could be used as genitors in future hybridization works. Periodic inventory of the germplasm collection regarding the existing variability, appears to be necessary due to new entries (new genotypes and lines), in order to assess them in terms of some morphological traits and stability of yield components. The variability of the germplasm collection for spring barley from Turda, was achieved using the main parameters of variability (mean, standard deviation, coefficient of variation, the minimum and maximum) to the following traits: flag leaf length and width, plant height, grain weight / plant and T.K.W. The collection of germplasm study involves a large volume of work, such analysis on a large number of genotypes (540) have not been made before at A.R.D.S. Turda. There were analysed 10 morphological and production traits. In this paper will be presented only some of the traits mentioned above regarding some of the most representative genotypes from the collection. The decrease of plant height is a priority of the breeding program of spring barley in Turda. Following this direction, there have been also calculated some derivatives genetic parameters (heritability coefficient, dominance) in a set of six hybrid combinations. Following measurements it was able to observe that in the germplasm collection there is an important source of morphology characters variation, but also for the quantitative production traits (T.K.W., grain weight / plant) which can be used in future crosses for the obtain of new genotypes that provide a transgressive segregation. Regarded as a simple parameter, coefficient of heritability, has not great importance in assessing some traits, but along with the pressure of selection and variability, can provide information on the probability of gene transmission which is desired to be obtained in the new genotypes. The heritability coefficient in narrow sense for plant height (0.57), indicating a major involvement in controlling plant height, which would suggest that the selection work for this trait could start from early generations. In this study, we can say that through a judicious choice of the parents and through an appropriate selection pressure, there can be obtained new spring barley genotypes, to bring more in terms of quantity. However we must work towards improving the collection with new entries to bring additional variability.*

Keywords: *genotype, heritability coefficient, spring barley, TKW*

INTRODUCTION

Obtaining new genotypes of spring barley, superior in terms of quality and production is largely conditioned by the biological breeding material variability, the collection of germplasm and choosing of the parents. The existence of a significant variability in the collection, the emergence of transgressive segregation is possible by hybridization works, which in final leads to obtaining useful genotypes. Therefore, it requires a periodic assessment of the variability existing in the levels of collection, in order to identify genotypes valuable in terms of morphological traits, as well as agricultural components of production. Besides the production, the decrease of plant height is a priority of the breeding program of spring barley in Turda, in order to limit the quantitative and qualitative losses caused by plants fall phenomenon. To obtain the most effective results in the breeding works for plant height, there have been calculated some genetic derivatives parameters (heritability coefficient, dominance) in a set of six hybrid combinations.

MATERIAL AND METHODS

The collection of spring barley germplasm from Turda, comprises of approximately 550 genotypes, represented by foreign and domestic genotypes, as well lines from advanced selection cycle. Sowing of this important component from the breeding field was done manually, for every genotype were sowed five rows with a length of 1 meter. From 20 to 20 variants there was sown the check genotype, represented by Romaniţa. In 2016, the field collection was sown in March 22 and the rising occurred in April 5, which indicates a normal germination. For each genotype, the calculations regarding the flag leaf length and width were made during the first 10-15 days after heading.

Leaf length was determined from the base of the ligula to the top, while the width was measured in the basal portion of the leaf, being analyzed a number of 185 genotypes. Plant height was determined after phenophase heading with a graduated ruler from ground level to the top awns, because all genotypes in the collection are forms with awns. In this study will be presented only some of the agronomic production traits namely: grain weight / plant and T.K.W.

For the estimation of genetic parameters derived, the 6 hybrid crosses were represented by the parental populations (P1 and P2), populations of hybrid (F1 and F2), and the two backcross (BC1 and BC2). Heritability coefficient in a broad sense (H) was calculated after relations proposed by **BURTON (**1951**)** and **MAHMOUD** and **KRAMER** (1951) and coefficient of heritability in the narrow sense (h2) was calculated after being used the relation proposed by **WARNER** (1952). Dominance (D) was deducted as a percentage as a ratio between the mean of F1 hybrid and the best parent average (**ROMERO** and **FRAY** 1973).

Cultivars chosen for this study were represented by two domestic genotypes (JUBILEU – SCDA Turda; PRIMA – SCDA Suceava) and ten foreign genotypes (THURINGIA, VICTORIANA, VIENA – Saaten Union; ODISEY, CHRONICLE, SALOME– Limagrain; MAGNIF, ANABELLE – genotypes the Czech origin).

RESULTS AND DISCUSSIONS

Analysis of variance series for the length of the flag leaf of 185 genotypes and the check variant are presented in Table 1. If you compare the variability parameters of genotypes with the check cultivar, it can be seen that there is a significant variability in the collection regarding the genotype, this is illustrated by the difference in amplitude, superior for the genotypes compared to the check. The values of variation coefficient of approximately 13%, highlights what we said above, indicating a middle variability of this important morphological traits. Similar studies have been made by **PEROVIC** et al. (2001); from the values shown in Table 1 one can see similarities drawn from the two studies.

XUE et al., (2008) report that for the flag leaf length control were identified genes placed within the chromosomes 3H, 5H and 7H.

Table 1

Variability parameters for flag leaf length (cm) at spring barley collection of genotypes and to check Romaniţa (Turda 2016)

		Genotypes	Check
1	Count	185	10
2	Range	10.26	1.38
3	Mean	12.31 (11.68*)	12.90
4	Minimum	7.50 (4.5*)	12.25
5	Maximum	17.76 (20.55*)	13.63
6	Sample variance	2.50	0.24
7	Coefficient of variation s (%)	12.84	3.80
8	Standard Deviation	1.58	0.49

* The values in parentheses are for comparison (by Perovic et al., 2001)

In table 2 are presented the variability parameters at flag leaf. Coefficient values of variation and genotypes difference between minimum and maximum compared to the check, it reflects considerable variability of this trait in the collection. Relatively values have been obtained and Serbian breeders **PEROVIC** et al., (2001).

In 1993 **SICHER** says that for the small grains, the first three leaves on the stem below the ear, are the primary source for the carbohydrate production. According to statements by **CHEN** et al., 1995; **HIROTA** et al., 1990, morphological and physiological traits of leaf have special importance in the formation of grain yield, so that it can be concluded that the flag leaf is one of the most important components in the determination of grain production of small grains.

Figure 1 shows relation between the flag leaf length and width of the 185 analyzed genotypes. It can be seen that between the two variables there is a strong positive relation, which results from the inclination of the regression line as well as the very significant correlation coefficient (0.47). Also the determination coefficient values of approximately 22%, indicates the strong connection between these two leaf morphological traits.

Similar results were reported on a study of 154 dihaploid lines, from the crossing of two genotypes with evident differences of flag leaf traits, by **XUE** et al., (2008), which showed that between the two variables of leaf flag, there is a significant positive correlation. Grouping points around the regression line reflect a close correlation between the two traits.

As already stated, regarding the role of flag leaf in achieving grain production, it can be seen from Figure 2 significant positive correlation between leaf flag area and grain weight / plant. Points spreading around the regression line and quite low values of the coefficient of determination R2 (8%), suggests a lower relation between the two traits.

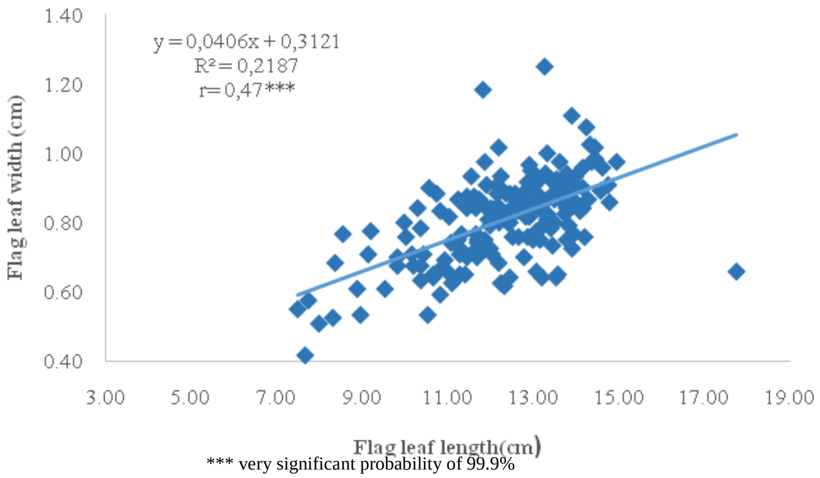
All this would draw the conclusion that the use of leaf area as a selection criterion, would not have the most effective results in increased grain weight / plant.

Table 2

Variability parameters for flag leaf width (cm) at spring barley genotypes collection and to check Romanița (Turda 2016)

		Genotypes	Check
1	Count	185	10
2	Range	0.83	0.15
3	Mean	0.81 (0.91*)	0.87
4	Minimum	0.42 (0.45*)	0.81
5	Maximum	1.25 (1.76*)	0.96
6	Sample variance	0.02	0.001
7	Coefficient of variation s (%)	14.81	4.60
8	Standard Deviation	0.12	0.04

* The values in parentheses are for comparison (by Perovic et al., 2001)

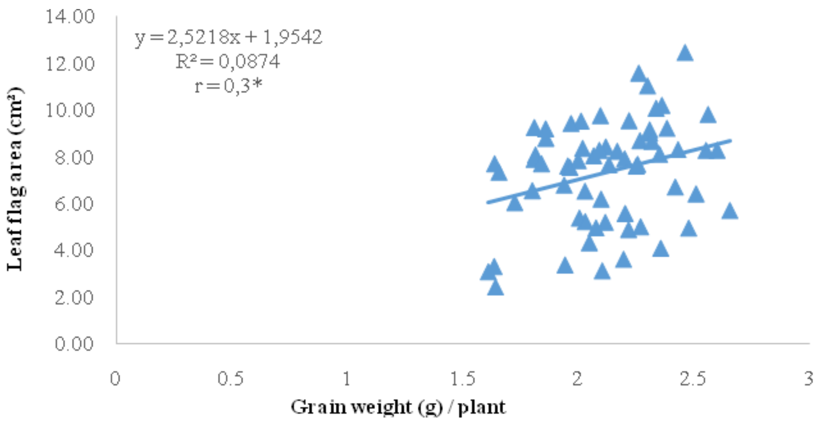


*** very significant probability of 99.9%

Fig 1. Relation between length and width of flag leaf (Turda 2016)

The differences between the minimum and maximum values the plant height of the 481 genotypes analyzed (Table 3), as well as the variation coefficient values of 7%, shows that in the germplasm collection from Turda, there is an important source of genotypic variability which may be used effectively in future hybridization programs. Quite large fluctuation between the highest and lowest values of check, shows the important influence of environment on plant height, Romaniţa being a genotype with high plants.

BAUM et al. (2003) maintains that the height of the plants is influenced by environmental conditions. Compared with obtained values from Serbian breeder Perovic, we can say that the genotypes from Turda collection have a higher average of plant height, however there can be identified genotypes with low plant height that may be used in crosses system to obtain genotypes resistant to lodging.



*** very significant probability of 99.9%

Fig 2. Regresion between leaf flag area and grain weight/plant

Table 3

Variability indicators for the height of the plant at spring barley genotypes collection and to check Romanița (Turda 2016)

		Genotypes	Chek
1	Count	481	27
2	Range	39	29
3	Mean	101 (77*)	105
4	Minimum	78 (56*)	86
5	Maximum	116 (94*)	115
6	Sample variance	49.66	33.23
7	Coefficient of variation s (%)	7	5
8	Standard Deviation	7.05	5.76

* The values in parentheses are for comparison (by Perovic et al., 2001)

Reduction of plants height in order to prevent crop losses, due to plant lodging, is an important objective of many breeding programs.

Variability parameters for two important production traits namely: grain weight / plant and thousand kernel weight are shown in Table 4.

Table 4

Variability indicators for the thousand kernel weight at genotypes of spring barley collection and to check Romanița (Turda 2016)

		Grain weight/plant (g)		T.K.W. (g)	
		Genotypes	Chek	Genotypes	Chek
1	Count	63	3	63	3
2	Range	1.05	0.07	10.4	1.4
3	Mean	2.12	2.56	43.88	45.2
4	Minimum	1.61	252	3804	44.6
5	Maximum	2.66	2.59	4808	46
6	Sample variance	0.07	0.01	6.14	0.52
7	Coefficient of variation s (%)	12	1.5	6	1
8	Standard Deviation	0.26	0.04	2.48	0.72

Coefficient of variation values and differences between minimum and maximum, reflects an important variability of grain yield/plant, registered at the 63 genotypes analyzed.

A significant variability can be observed in the T.K.W. case, the differences between minimum and maximum values. It may be observed the check variety Romaniţa with high values for grains/plant production and including TKW, approaching the maximum values of the genotypes studied.

The plant height average of parental populations and descendants (F1, F2, BC1 and BC2) for the six hybrid combinations are listed in Table 5. The average height of the parents is between 87 and 112 cm, F1 generation values are intermediate between the two parents, for three out of the six hybrid combinations. In F2 generation, for the first four combinations, the plant height recorded was higher than F1 generation values and in two combinations even higher than the highest parent which indicates the presence of transgressive segregations. For plant height is desired the presence of negative transgressive segregation, which in this case can be seen in the combinations 5 and 6, plant height values of F2, being inferior to the F1 generation and even to the shorter parent.

Table 5

The mean values of plant height (cm) for the parental populations, F1, F2, BC1 and BC2 in backcrossing system at spring barley (Turda 2016)

POPULATION						
CROSS	P1	P2	F1	F2	BC1	BC2
1. (Thuringia x Jubileu)	101	112	97	103	108	100
2. (Prima x Victoriana)	109	90	103	111	113	95
3. (Magnif x Odisey)	106	92	95	108	103	101
4. (Victoriana x Anabelle)	92	102	81	96	100	103
5. (Chronicle x Salome)	92	87	92	88	96	95
6. (Viena x Anabelle)	100	98	99	97	103	100

The average heritability coefficient in the narrow sense for plant height in six hybrid combinations indicate the important role of genotype in controlling plant height, higher values of 0.97 and 0.72 have been reported by other researchers **ADDISU** and **SHUMET** (2015); **ESHGHI** and **AKHUNDOVA** (2009). In this regard, selection works for plant height could begin as early as F2 or F3 generations but with a selection pressure reduced. However, this selection criterion must be necessarily associated with per se production. Degree of dominance (91.5) for plant height, indicate a partial dominance (towards a complete dominance) associated with a lower level of heterosis of F1 generation (table 6).

Differences in value between the two calculation methods for broad sense heritability are probably due to participation of the F1 generation, in the formula proposed by **BURTON**, however, at this generation in addition to phenotypic variability there could exist a genotypic variability due supradominance phenomens.

Correlation coefficients presented in Table 6, shows that between plant height and other agronomic production traits there are direct correlation very significant and significant, such as the association between plant height and ear length.

Table 6

The correlation coefficients and genetic parameters derived for plant height

<table>
<tr><td>Corelated traits</td><td>Ear lenght (cm)</td><td>Grain number/ear (g)</td><td>Grain weigh/ear (g)</td><td>T.K.W (g)</td></tr>
<tr><td rowspan="4">Plant height</td><td>0.48*</td><td>0.57***</td><td>0.95***</td><td>0.87***</td></tr>
<tr><td rowspan="2">Dominance (D)
$\frac{F1}{MP}$ * 100</td><td colspan="2">Heritability coefficient in a broad sense (H)</td><td rowspan="2">Heritability coefficient in narrow sense Warner (1952)</td></tr>
<tr><td>Burton (1951)</td><td>Mahmoud and Kramer (1951)</td></tr>
<tr><td>91.5</td><td>0.22</td><td>0.75</td><td>0.57</td></tr>
</table>

r 5% = 0.4 r 1% = 0.52

CONCLUSION

From those presented above, emerges the idea that the analyzed spring barley genotypes in collection in Turda, there is an important source of variability for the studied quantitative traits, and the useful portion can be found in future hybridization programs.

However it is necessary to continuously improve the collection field with new entries, which finally lead to increased genetic variability to avoiding utilization of common genitors in new genotypes.

Plant height negative transgression are very important because it could lead to new genotypes with a lower plant hight.

As could be seen, between plant hight and yield elements, there is a direct relation, so we can say that between plant hight and production and there is a positive connection.

A special importance for plant breeding, is the identification of deviations from this correlation, for obtaining a new genotypes with a production capacity of good, resistant to lodging.

Through a smaller selection pressure, selection works for plant height could begin from early generations and to be held successively, by checking descendants. By associating this criterion with per se production it can be obtained favorable results on new genotypes.

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