

GENETIC AND ENVIRONMENTAL EFFECT ON THE GRAIN YIELD OF SPRING BARLEY VARIETIES CULTIVATED IN THE REPUBLIC OF MACEDONIA



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INTRODUCTION

Among the cereal crops, barley is a species with the greatest adaptability to a wide range of environments. Barley is cultivated from arctic latitudes to tropical areas, grown at the highest altitudes and adapted to specific sets of agro-ecological areas (Alemayehu and Parlevliet, 1997). After wheat, rice and maize, barley is the fourth most significant crop (Abebe, 2010). Barley is used as a livestock feed, for malt and for preparing foods.

Successful growing of spring barley depends on many factors. Productivity is the final result of the effect and interactions of several yield-related traits, which are basically polygenic, (Madic et al., 2014). The grain yield and quality traits of barley are determined by its genetic makeup and environment conditions during growth, harvest and storage. Variation of yield and major chemical components of barley grain is genetically controlled (Eagles et al., 1995), but it is also influenced by environmental factors (Helm, 1992; Paynter and Young, 2004). The yield formation can be define as the interaction effect of soil and climatic conditions, genotype, fertilization and growing technology (Barczak and Majcherczak, 2008).

Grain yield is made up of three main different yield components, the number of spikes, the number of grains per spike and the thousand-kernel weight. On the National variety list in Republic of Macedonia, besides autumn forms of barley, only one variety is registered as a spring domestic variety (*Makedo*).

The objective of this study was to determine the influence of variety and environment on grain yield on spring barley varieties.

MATERIAL AND METHODS

Location

The experiment was conducted during two years on the field areas in Probistip, eastern part in Republic of Macedonia



Fig. 1. Location of the study area, Probistip

Methods

The experimental material was placed by using randomized block design in three replications. The size of experimental plots was 5m². The sowing was made by hand with 20 cm space within rows. The standard growing measures were applied during the vegetation



Fig. 2. Experimental material placed in randomized block design

Experimental material

Five spring barley varieties (*Makedo*, *Xanadu*, *Josefin Variety*, *Gladys* and *Scarlet Variety*) were used as an experimental material. *Makedo* is Macedonian variety and the other barley varieties are introduced



Fig. 3. Standard growing measures applied during barley vegetation

Data processing

The results were calculated by statistical softer Stat Soft, 8.0 and tested using LSD. ANOVA was performed to analyzes the data.



RESULTS

Due to short vegetation period extending for about 100 days and poorly developed root system, spring barley is very sensitive to drought stresses, even if they are temporary (Pecio and Wach, 2015). Increasing temperature, even without significant changes in precipitation may cause the deepening of the already negative water balance (Kozyra et al., 2009).

The average air temperature during the first year of study was 29,6° C, while for the second testing year was 29,2° C, which means that the temperature values were favorable for optimal plant development and high yield.

In Table 1 are given the average values for some yield-related traits and grain yield for the both years of tasting. LSD test showed significant difference between tested varieties and traits.

Makedo variety had the highest number of spike per m² (672) but also the highest value for grain yield (6 844 kg/ha). This Macedonian variety has the largest number of grain per spike (22) and the other barley varieties have average 20 grains per spike.

1000 grain weight is a quality trait and it is indicator for the size and grain thickness. This property deepens of variety genetic, but also of environmental conditions. On the other hand, 1000 grain weight is less sensitive to climatic factors compared to grain yield. The highest average value for 1000 grain weight had *Gladys* variety.

Average value for grain yield for all tested varieties during the period of study was 6 544 kg/ha.

Table 1. Average values for some yield-related traits and grain yield of barley varieties during the period of study

Variety	Number of spike per m ²				Plant height (cm)				Number of grain per spike				1000 grain weight (g)				Grain yield (kg/ha)			
	Average	Max	Min	CV (%)	Average	Max	Min	CV (%)	Average	Max	Min	CV (%)	Average	Max	Min	CV (%)	Average	Max	Min	CV (%)
<i>Makedo</i>	672a	659	688	1,40	64,8c	64,0	65,5	0,95	22a	22	20	3,77	49,4a	50,0	48,0	1,62	6 844a	6 895	6 774	0,72
<i>Xanadu</i>	617c	611	624	0,73	64,4c	62,0	67,0	2,62	20b	22	20	4,02	43,5c	45,0	40,0	4,30	6 638a	6 730	6 480	1,52
<i>Gladys</i>	576b	570	584	0,88	68,8b	67,0	70,0	1,70	20b	22	20	4,02	50,1a	51,0	49,0	1,70	5 841a	6 120	5 117	6,34
<i>Scarlet</i>	638b	626	650	1,57	69,8b	69,0	71,0	1,08	20b	21	20	2,02	46,3b	47,8	45,0	2,09	4 949b	5 032	4 904	1,04
<i>Josefin</i>	517e	497	543	3,70	76,3a	74,5	78,0	1,93	20b	21	20	2,02	45,8b	47,3	44,0	2,80	5 279ab	5 405	5 119	2,38
Average	604				68,8				21				47,1				6 544			
LSD_{0,05}	20,32				1,32				1,05				1,81				1 922,3			
CV (%)	1,85				1,05				2,80				2,12				18,72			

In order to see how changes of environmental conditions influence to the genetic potential of a variety, it is necessary to assess the interaction between variety and the environmental conditions. Today, there are many papers in which it is explained the influence of variety, year conditions and their interaction on grain yield (Markova Ruzdik et al., 2015). According results of ANOVA (Table 2), grain yield was significantly affected by the variety (98,79 %). The effect of year conditions and the interaction between variety and year had lower impact on grain yield (0,08 % and 1,13 %, successively).

CONCLUSION

From the performed research it can be concluded that *Makedo* variety had the highest value for grain yield, followed by *Xanadu* variety. Also, *Makedo* variety had the highest number of spike per m² and number of grain per spike.

The study had proved that the variety has the strongest impact over grain yield during the period of research.

Except *Makedo* variety, also *Xanadu* and *Gladys* varieties can be introduced in barley production or to be chosen as the most suitable varieties for new parents in any future breeding process, in order to get the new high yielding varieties suitable for cultivation in Republic of Macedonia.

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