Volume 15(2), 79- 84, 2011
JOURNAL of Horticulture, Forestry and Biotechnology

Influence of different climatic conditions on phenotype observations regarding some yield elements in some barley genotypes

Velicevic Giancarla[1]*, Madosa E.[1], Ciulca S.[1], Ciulca Adriana[1], Petolescu Cerasela[1], Bitea Nicoleta[1], Cretescu Iuliana[1], Ropciuc Sorina[2]

[1]Banat University of Agricultural Sciences and Veterinary Medicine, Faculty of Horticulture and Forestry, Calea Aradului, 119, 300645, Timisoara, Romania; [2]University Stefan cel Mare ,Street University, 13, 720229 ,Suceava, Romania

*Corresponding author. Email: giancarlavely2000@yahoo.com

Abstract Drought considered as the combination of water stress plus high irradiance and temperature stresses, is the main abiotic factor limiting yield. The improvement of the yields under drought conditions therefore must combine the high yield potential and specific factors which are able to protect the crop against reduction due to this stress conditions. The objective of this study was to evaluate influence of different climatic conditions on phenotype observations regarding some yield elements of 25 genotypes of winter barley . The genotype were tested in non stressed and stressed conditions.

Key words

barley, yield elements , drought stress

Barley represents an important species worldwide and situates among the tenth most important crop species and on the fourth position among the cereal crops, representing approximately 11% from the overall cereal production. Barley was known as one of the species less demanding in terms of soil and climate conditions being cultivated in the temperate regions and Polar Circle (up to 70° latitudes) and also to highest altitudes (1,4). Barley is a crop of major economic importance and also a model species for genetics and physiology (Koornneef *et al*., 1997). Drought, like many other environmental stresses, has adverse effects on crop yield. Low water availability is one of the major causes for crop yield reductions affecting the majority of the farmed regions around the world. As water resources for agronomic uses become more limiting, the development of drought-tolerant lines becomes increasingly more important (Duvick, 1997).During evolution, plants managed to adapt to certain environmental conditions which later became specific for their natural habitats. The spreading of different plant species on Earth did not occur occasionally but evolved in an organized manners such as ecological communities and associations, very well defined and with a common trait represented by the ability to cohabitate in similar environmental conditions. Unfavourable climate conditions are manifested as stress factors which affect the normal development of vital process generating metabolic, structural and functional changes that diminish the plant bio-productive potential. Yield potential of crop species may be entirely evaluated whether favourable and stable climate conditions are maintained during the whole vegetation period. Drought is the main environmental constraint, which occurs in many parts of the world every year, often having devastating effects on crop productivity. Hence, improved tolerance to drought has been a goal in crop improvement programs since, the dawn of agriculture (2). Drought tolerance is not a simple response, but is mostly conditioned by many component responses, which interact and may different for crops, in relation to types, intensity and duration of water deficit. Moreover, most agronomical characters are expressed differently in normal and stress conditions and are known to be affected by environmental factors. Therefore, selection based on the phenotype would be difficult for such traits (3). The effect of water shortage occurs ultimately on plant productivity. The reduction in intensity of biosynthetic processes leads to a decrease in growth of the plants that has direct effects on their production capacity (5.6) Estimation in the drought conditions and under very favorable statistical parameters of some characters that are determinative for the production capacity is important from two points of view. The first aspect is related to show some genotypes that have a hight variability of the traits in stress and that may be a soure for the detection of resistance to drought, and some genotypes that have a low variability-important when seeking trait stability. The second aspect is to reduce / increase the value of these characters on a background of lack of precipitation to the values obtained under favorable conditions and are important for establishing a breeding program aimed and poor characters. Selection based on a combination of indices may provide a useful criteria for improving drought resistance of barley, but study of correlation coefficients are useful in finding out the degree of overall linear association solely between any two considered attributes (7).

Material and Methods

The biological material taken into study was represented by a collection consisting in 25 different autumn barley genotypes *(Hordeum vulgare)*, representing doubled haploid lines from I.C.D.A. Fundulea and several autumn barley varieties cultivated in Banat Field. During the experimentation period, the obtained results were compared with Dana variety used as control variant.

The cultivars was placed in experimental plots 7m^2 , in three repetitions, by randomized blocks method.

The genotypes was cultivated in normal conditions and unfavourable climate conditions manifested as stress factor. We determined the influence of the unfavourable climate conditions on components of productivity.

Among the components of productivity were studied: plant height, number of grains / main spike, grain weight / spike and principally thousand grain weight.

For these characters to determine the average error of the mean, standard deviations, variance and coefficient of variation.

Since the statistics of these parameters, the average and coefficient of variation are the most suggestive, throughout this paper we discuss these two indices.

Results and Discussions

The results of measurements on the effects of water shortage on barley plant size show important differences between genotypes. (Table 1.1)

In hydric deficit conditions, plants had an average height of 72.48 cm, the highest DH line was 20-1, with 85.04 inches, and the shortest line was DH 26-4 (60.24 cm)

Regarding the coefficient of variation is apparent that for most genotypes plant size variability was medium. The average coefficient of variation for this character was 14.22%.

Low variability was found at DH 16-41 line (7.20%), and the only line with high variability was DH 24-3 (22.11%).

Regarding the statistical parameters determined for the plant height in favorable weather conditions for growing barley is noted that previous values for plant height were much lower than the values in these conditions

The average height for the studied genotypes was 101.37 cm. The limits between varied between 90.40 cm and 114.12 cm. The highest genotypes were: 20 to 1 DH line (114.12 cm) and Adi varieties (113.36 cm) and Horizon (113.08 cm), while those with the lowest height were: DH 7 - 2 (90.40 cm), DH 22-1 (90.44 cm) and DH 24-3 (92.24 cm).

The average coefficient of variation for plant height: it was 7.46%. Genotypes with low variability for this character were: Dana (4.44%), DH 16-41 (4.48%), and DH 8-8 (4.51%), and genotypes for which the coefficient of variation had maximum values were: DH 24-3 (15.44%), Horizon (13.18%) and DH 22-5 (11.01%). In general, the variability of plants height in these conditions was small.

It is noted that there is a group of lines (DH 26-4, DH 20-2, DH 8-4, DH 20-3, DH 7-2, AD 8-5)with a the coefficient of variation in both normal conditions as and drought conditions. Varieties were distinguished by high coefficient of variation both in hydric deficit and under normal conditions. In general, there is a mean variability of the character in hydric deficit conditions (below 20%) and low in normal conditions (below 10%). DH 24-3 line came out due to its very high coefficient of variation compared with other genotypes, both under normal conditions as well as the fluid deficit.

The values of the statistical parameters calculates for the number of grains per main spike under hydric defficite conditions are shown in the table. The average number of grains was 23.23 grains / ear, and limit values were: 20.16 grains / ear and 28 grains / ear. Genotypes with a large number of grains per main spike were DH 19-1 (28 grains / ear), DH 8-8 (27.08 grains / ear), DH 20-3 (26.04 grains / ear). A small number of grains / ear were found in DH lines 22-5, DH 22-1 (20 grains / ear) and HD 8-3 (20.16 grains / ear).

The average coefficient of variation for the number of grains / ear was 17.30% - variability for this character being middle. There is some genotypes with high variability: DH 20-1 (20.41%), DH 22-5 (20.10%) and genotypes with low values of coefficient of variation may include: DH 20-3 (13 , 12%), DH 33-1 (13.18%) and HD 7-2 (14.58%). For most genotypes variability in this character was middle.

Main statistical parameters values for the number of grains / main spike in barley crop weather conditions are presented in table 1.1 The average number of grains per main spike was 36.67 grains / spike. In these conditions on average the coefficient of variation had a value of 7.66%. With the lowest coefficient of variation was recorded DH line 7-2 (4.48%), followed by Dana variety (5.06%), DH 8-4 (5.62%) and DH 33-1 (5, 79%).

Among genotypes with high coefficient of variation is remarkable: DH 8-5 (11.3%), variety Mădălin (9.85%) and DH line 22-4 (9.18%). It may be noted that in general, the variability of this trait was low. Firstly we can see that between the coefficients of variation recorded there is a big difference, in most cases amounts recorded in conditions of hydric deficit are two times higher than those recorded in normal conditions, which means that this character is strongly influenced by environmental conditions.

Most genotypes have coefficients of variation between 5% and 10% in normal conditions – a small variability is indicative for the number of grains / main spike and between 15% and 20% in conditions of hydric deficit, variability was medium. The analysis of the results on the effects of soil water shortage on grain weight in the main spike (Table 1.1.) shows important distinction between the genotypes tested.

In less favorable weather conditions barley grain weight in the main spike was in average 1.18 g.

Highest values of grain weight were recorded for DH 8-4 (1.32 g), DH 20-1 (1.29 g) and DH 19-1 (1.29 g) and lowest values were determined from DH 26-8 (1.04 g), DH 8-3 (1.05 g) and Mădălin (1.05 g). Regarding the variability in grain weight per main spike one can say that in these genotypes there was a mid variability, except for few genotypes with a coefficient of variation that exceeded 20%.

With high values of the coefficient of variation were recorded genotypes DH 20-8 (28.79%), DH 26-8 (26.58%) and Horizon (22.19%) and low values were recorded in: DH 20-1 (13.37%), DH 24-3 (13.9%) and Adi (14.58%)
The average coefficient of variation was 18.59%; variability for grain weight being medium. For barley genotypes studied, in the year with favorable climatic conditions the grain weight was 1.70 g. A high grain weight is noted in the lines: DH 26-8 (1.90 g), DH 19 - 1 (1.88 g), DH 20-2 (1.87 g) and the lowest grain weight have: HV line 1-1 (1.44 g), DH 8-8 (1.45 g), DH 20-3 (1.52 g) and variety Mădălin (1.53 g).

Regarding the coefficient of variation, the table shows that on average, it had a value of 7.96%, corresponding to a reduced variability.

However, there are some genotypes with medium variability: DH 8-8 (14.23%), Madalina (14.21%) and Early (11.79%). The lowest values of the coefficient of variation had the lines: DH 26-2 (4.68%), DH 24-3 (4.73%) and DH 22-1 (4.76%). It can be seen the same downward trend in the coefficient of variation in favorable year compared with the dry year as well as for plant height and number of grains / main spike. This means that grain weight is a character strongly influenced by environmental conditions. For this character, which has a complex genetic determinism, it was calculated in conditions of hydric deficit a mean value of 44.57 MMB (Table 1.1).

Thousand grain mass ranged from 39.40 g to 49.01 g values and the highest MMB genotypes were: Precoce (49.01 g) Adi (48.00 g) and DH 20-1 (47.30 g) and the genotypes with the lowest MMB were: DH 8-3 (39.4 g), HV 1-1 (40.4 g) and DH 20-2 (42.5 g).

Average coefficient of variation determined in these conditions; was 12.83%. High values were determined for HV 1-1 (15.08%), DH 22-4 (14.62%) and DH 22-1 (14.15%) and low values for genotypes DH 26-4 (10 , 10%), DH 24-3 (10.29%) and DH 20-2 (10.40%).

In favorable conditions, MMB varied in quite wide limits between 36.5 g - 47.6 g and the mean of the genotypes was 41.6 g (Table 1). A first observation that can be done is that in the favorable conditions one thousand grain mass values were lower than those recorded in conditions of hydric deficit, the explanation consists in the fact that in drought conditions there is less grain in the spike and their weight was higher.

The high values of MMB were noted in: Adi variety (47.6 g), DH 20-1 line (45.68 g), DH 8-5 (44.7 g) and Horizon variety (45.5 g) . The pole stands lines: DH 8-3 (36.5 g), DH 24-1 (37.5 g), DH 26-8 (38.7 g) and HV 1-1 (38.7 g). Average coefficient of variation determined for the studied genotypes was 7.15% - in favorable conditions there is a low variability for this character.

The limits between which ranged the coefficient of variation were 4.05% and 11.41%. Maximum values were calculated for lines: HV 1-1 (11.41%), DH 8-3 (10.29%) and Dana variety (9.14%). Among the genotypes at one thousand grain masses variation was reduced were distinguished DH lines 19-1 (4.05%), DH 26-2 (5.12%) and variety Adi (5.20%). One can observe the inconsistent behavior of the genotypes in drought conditions, variety Mădălin showing a high variability in this character. Under normal conditions the coefficient of variation was less and the same variation is observed in wide limits.

Table 1

Nr crt.	Genotypes	Plant height *(cm)*				Number of grains in principal spike				Grain weight/ main spike				Thousand grain weight			
		In drought conditions		*In normal conditions*		*In drought conditions*		*In normal conditions*		*In drought conditions*		*In normal conditions*		*In drought conditions*		*In normal conditions*	
		x ± s$_x$	**S%**	**x ± s$_x$**	**S%**	**x ± s$_x$**	**S%**	**x ± s$_x$**	**S%**	**x ± s$_x$**	**S%**	**x ± s$_x$**	**S%**	**x±s$_x$**	**S%**	**x±s$_x$**	**S%**
1	Dana (Mt.)	80,08 ±2,36	14,72	112,20 ± 1,00	4,44	24,00± 0,77	16,05	36,08± 0,36	5,06	1,211 ± 0,044	18,13	1,65 ± 0,027	8,06	45,96 ±1,06	11,55	38,20 ±0,70	9,14
2	Precoce	74,00 ±2,13	14,42	101,72 ± 1,99	9,78	22,08± 0,77	17,34	36,00± 0,52	7,17	1,094 ± 0,039	17,70	1,55 ± 0,037	11,79	49,01 ±1,27	12,96	43,90 ±0,61	6,93
3	Adi	63,48 ± 2,33	18,37	113,36 ± 1,88	8,30	23,00± 0,77	16,84	36,00± 0,64	8,93	1,208 ± 0,035	14,58	1,72 ± 0,037	10,72	48,00 ±1,28	13,31	47,60 ±0,49	5,20
4	Madalin	69,64 ±2,46	17,66	108,12 ± 2,08	9,63	24,00± 0,82	17,10	36,00± 0,71	9,85	1,053 ± 0,042	20,05	1,53 ± 0,044	14,21	43,30 ±1,87	21,61	40,50 ±0,66	8,11
5	Orizont	72,24 ±2,50	17,34	113,08 ± 2,98	13,18	22,12± 0,83	18,70	38,00± 0,47	6,22	1,241 ± 0,055	22,19	1,65 ± 0,035	10,64	46,20 ±1,11	12,02	45,50 ±0,59	6,50
6	DH 22-5	62,00 ±1,96	15,82	98,00 ± 2,16	11,01	20,00± 0,80	20,10	35,04± 0,57	8,18	1,120 ± 0,036	16,26	1,55 ± 0,022	7,02	48,93 ±1,31	13,41	45,80 ±0,76	8,30
7	DH 24-3	71,00 ±3,14	22,11	92,24 ± 2,85	15,44	22,36± 0,70	15,65	38,00± 0,51	6,71	1,240 ± 0,035	13,99	1,84 ± 0,017	4,73	43,38 ±0,89	10,29	41,72 ±0,41	4,95
8	DH 26-4	60,24 ±1,43	11,91	95,08 ± 1,38	7,27	24,92± 0,94	18,89	37,00± 0,70	9,46	1,157 ± 0,041	17,92	1,72 ± 0,028	8,20	46,57 ±0,94	10,10	44,20 ±0,62	7,07
9	DH 20-2	80,32 ±2,03	12,63	111,44 ± 1,38	6,17	24,20± 0,85	17,65	36,00± 0,58	8,06	1,266 ± 0,040	15,74	1,87 ± 0,026	7,00	42,50 ±0,88	10,40	40,20 ±0,68	8,51
10	DH 8-8	78,08 ±1,76	11,24	104,32 ±0,94	4,51	27,08± 0,87	16,06	36,00± 0,56	7,73	1,098 ± 0,063	28,79	1,45 ± 0,041	14,23	43,00 ±1,05	12,22	40,50 ±0,62	7,68
11	DH 20-3	77,20 ±1,80	11,64	92,88 ± 1,26	6,79	26,04± 0,72	13,82	36,00± 0,61	8,52	1,097 ± 0,048	21,90	1,52 ± 0,026	8,47	45,20 ±1,08	11,99	42,00 ±0,61	7,28
12	DH 7-2	61,28 ±1,43	11,63	90,40 ± 1,06	5,86	24,08± 0,70	14,58	38,08± 0,34	4,48	1,242 ± 0,044	17,61	1,68 ± 0,037	10,88	46,80 ±1,17	12,53	41,20 ±0,40	4,89
13	DH 8-4	82,00 ±2,35	14,30	103,60 ± 1,35	6,52	26,00± 0,90	17,34	35,20± 0,40	5,62	1,322 ± 0,043	16,12	1,68 ± 0,024	7,12	43,81 ±1,09	12,46	39,80 ±0,53	6,63
14	DH 33-1	68,00 ±1,72	12,64	84,04 ± 1,20	7,14	22,28± 0,59	13,18	38,00± 0,44	5,79	1,280 ± 0,051	20,08	1,74 ± 0,032	9,31	43,52 ±1,03	11,84	42,54 ±0,50	5,84
15	HV 1-1	63,00 ±1,47	11,68	92,44 ± 0,69	3,75	21,04± 0,77	18,28	35,00± 0,46	6,55	1,084 ± 0,043	19,91	1,44 ± 0,019	6,41	40,40 ±1,22	15,08	38,70 ±0,88	11,41
16	DH 8-3	84,32 ±3,72	22,07	112,20 ±1,08	4,82	20,16± 0,77	19,03	36,04± 0,46	6,33	1,052 ± 0,040	19,13	1,75 ± 0,020	5,61	39,20 ±1,22	15,54	36,50 ±0,75	10,29
17	DH 8-5	80,72 ±1,79	11,08	110,92 ±1,48	6,68	24,08± 0,76	15,72	37,00± 0,88	11,93	1,252 ± 0,049	19,67	1,84 ± 0,027	7,37	45,40 ±0,95	10,44	44,70 ±0,69	7,76
18	DH 16-41	74,04 ±1,07	7,20	102,64 ±0,92	4,48	23,00± 0,84	18,19	39,00± 0,48	6,10	1,273 ± 0,047	18,44	1,82 ± 0,021	5,72	42,60 ±0,95	11,15	40,50 ±0,58	7,13
19	DH 24-1	71,64 ±2,21	15,42	96,12 ±1,18	6,14	22,00± 0,78	17,70	37,00± 0,66	8,86	1,296 ± 0,044	16,95	1,75 ± 0,022	6,23	39,10 ±0,94	12,07	37,50 ±0,65	8,65

20	DH 20-1	85,04 ±2,81	16,55	114,12 ±1,34	5,88	22,00± 0,90	20,45	38,00± 0,69	9,12	1,299 ± 0,035	13,37	1,74 ± 0,020	5,87	47,30 ±1,22	12,86	45,68 ±0,44	4,87
21	DH 22-1	72,36 ±1,88	12,98	90,44 ± 1,70	9,37	20,00± 0,79	19,84	36,00± 0,64	8,93	1,148 ± 0,040	17,43	1,68 ± 0,016	4,76	44,20 ±1,25	14,15	40,50 ±0,65	8,08
22	DH 22-4	65,12 ±1,98	15,18	94,96 ±1,46	7,70	22,12± 0,75	17,03	35,00± 0,64	9,18	1,104 ± 0,034	15,43	1,70 ± 0,036	10,44	43,40 ±1,27	14,62	40,30 ±0,53	6,61
23	DH 26-8	62,08 ±2,10	16,92	94,00 ± 1,57	8,33	24,00± 0,83	17,26	38,28± 0,60	7,78	1,048 ± 0,056	26,58	1,90 ± 0,016	4,26	45,60 ±1,25	13,76	38,70 ±0,60	7,70
24	DH 19-1	84,44±2,34	13,88	106,00 ±1,67	7,86	28,00± 1,08	19,26	38,00± 0,53	6,96	1,298 ± 0,046	17,56	1,88 ± 0,020	5,18	46,92 ±1,20	12,82	40,50 ±0,33	4,05
25	DH 26-2	69,64 ±2,58	18,56	100,04 ±1,11	5,54	22,28± 0,74	16,52	36,08± 0,58	8,00	1,210 ± 0,046	19,16	1,75 ± 0,016	4,68	43,90 ±1,02	11,62	42,69 ±0,44	5,12
	Media experienței	**72,48** ± **2,13**	**14,72**	**101,37** ± **1,51**	**7,46**	**23,23**± **0,80**	**17,30**	**36,67**± **0,56**	**7,66**	**1,188** ± **0,044**	**18,59**	**1,70** ± **0,027**	**7,96**	44,57 ±1,14	12,83	41,60 ±0,59	7,15

References

1.Drăghici L,., Bude Al., Şipos Ghe., Tuşa Corina.,1975 – Orzul, ed. Acad. RSR Bucureşti.

2.Ludlow , M.M. and R.C. Muchow, 1990. A critical evaluation of traits for improving crop yields in water limited environments. Adv.Agron, 43:107-153.

3. Hittalmani, S., N. Huang, B. Courtois, R. Venuprasad andH.E.Shashidhar *et al*., 2003. Identification of QTL for growth and grain yield-related traits in rice across nine locations of Asia. Theor. Applied Genet., 107: 679-690.

4. Salontai Al., Luca E., lateş Maria 1996 - Hameiul-Orzul şi berea, Ed. ICPIAF, Cluj-Napoca.

5. Şumălan R., 1998 - *Cercetări privind rezistența la condiții nefavorabile a ovăzului (Avena sativa L)* Teză de doctorat USAMVBTimişoara.

6. Şumălan R., Carmen Dobrei, Adelina Pop,2005 - The influence of drought conditions on some physiological process in four oat (Avena sativa L) cultivars. Lucrări ştiinț. Vol VI seria Horticultură.

7.Velicevici Giancarla, Madosa E. , Ciulca S.,Ciulca Adriana, Petolescu Cerasela, Bitea Nicoleta – 2010-Assessment of Drought tolerance in some barley genotypes cultivated in west part of Romania.