RESULTS REGARDING THE YIELD POTTENTIAL, MORPHOLOGIC AND PHISIOLOGIC CHARACTHERS OF SOME DOUBLE HAPLOID INBREED BARLEY LINES IN WESTERN ROMANIA

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Abstract

An important crop for western Romania is autumn barley,but the clasic varieties are defficient in some important charactheres. During the last yiear, we studied a number of 20 varieties and imbreed lines of barley at Oradea, the target beeing to compare the reaction of six double haploid imbreed lines with normal cultivars. The results sugest that some double haploid imbreed lines (DH 270-24-07, DH 267-126-07), created at National Agricultural Research and Development InstituteFundulea, are comparable on yield pottential and desease resistance with the coultivars created by clasical methods. In the same time, the results sugest that the resistance to specifical desease and falling resistance are very important for barley breeding program.

Key words: barley, double haploid, disease resistance, yields.

INTRODUCTION

In the international breeding programs of barley, the main targets are the improving extract and other malting quality characteristics and increase yield over the accepted standard. Very important are the improve resistance to traditional diseases and respond to new disease pressures: scald, net blotch, fusarium head blight (***Barley Breeding Report, 2010).

Some agronomical characters focused are: straw strength, height, stress tolerance and yield stability.

Barley production has declined in the last period, primarily due to the reemergence of the disease fusarium head blight and other diseases that renders barley unusable for malting and brewing (Steffenson and Smith, 2006).

In western and central Romania conditions, barley crops are damaged by diseases that caused quantitative and qualitative yield losses, in every year (Nagy et all, 2010; Buzatu, 2009). The most frequently diseases are: powdery mildew (*Blumeria graminis* f. sp. *Hordei*), scald (*Rhynchosporium secalis*), net blotch (*Pyrenophora teres*), leaf blotch (*Septoria passerini*), leaf rust (*Puccinia hordei*), head blight (*Fusarium* spp.) and yellow dwarf virus (BIDV).

The simplest form of barley breeding involves making a cross between two parent plants and evaluate, during 8-10 generations, the descendents until undesirable material is weeded out and the good genetics are fixed in a barley line. All lines must show equal or better performance over check (standard) variety, with distinct advantages over this.

In the late 1960's, some researchers around the world began to investigate the possibility of introgression many traits in barley, using naturally occurring genetic male sterility from several sources. Barley could be made to out-cross in the field in a manner similar to that of rye (*Secale cereale* L.). In 1970, Hockett and Eslick, (cited by Therrien, 2005) observed that enough out-crossing could take place in barley, to provide for a useful tool in developing composite cross population for use in germplasm improvement. Up to

the present, many male-sterile derived composite cross populations were successfully produced.

A doubled haploid (DH) is a genotype formed when haploid cells undergo chromosome doubling. The haploid cells are often monoploid, and the term doubled monoploid is use for these. Conventional, inbreeding procedures take six generations to achieve approximately complete homozygosis, whereas doubled haploid achieves it in one generation.

The haploid cells are produced by manipulating pollen or eggs cells or other cells of the gametophyte. By induced or spontaneous chromosome doubling, a doubled haploid cell can be produced and grown into a doubled haploid plant.

The most responsive species to doubles haploid production are tobacco, rapeseed and barley.

Homozygosis of all loci may be obtained in the shortest possible time by doubling the haploid chromosome number using colchicine or anther culture in barley (Shugar, 1998).

In barley, haploids can be produced by wide crossing with the related species *Hordeum bulbosum*. Fertilization is effected, but during the early stages of seed development the *Hordeum bulbosum* chromosomes are eliminated leaving a haploid embryo. In DH method only two types of genes occur for a pair of alleles, A and a, with the frequency of ½ AA and ½ aa. Thus, the efficiency of haploid method is obviously high when the number of genes concerned is large. Most of the economic traits are controlled by genes with small but cumulative effects.

The ability to produce homozygous lines after a single round recombination saves a lot of time for the plant breeders, include development of large number of homozygous lines, efficient genetic analysis and development of markers for useful traits in much less time (Maluszynski et all, 2003).

In Romania, the surfaces cultivated with barley is around 500.000 ha, many of the cultivars being released in our country (more than 30, winter barley or spring two rowed barley). In the last years, one of the main research objectives in National Agricultural Research and Development Institute Fundulea and its own researches stations is the utilization of the *Bulbosum* system for rapid homozygosity and for barley DH lines production (Lungeanu, 2005).

The Romanian barley varieties are competitive with alien ones in specific conditions of soil and climate from different zones of country (Stroia and all, 2006).

MATERIAL AND METHODS

The biological material studied consist in 20 variants, 11 beeing six rowed barley and 9 being two rowed barley. Comparative to 11 cultivars (9 of them six rowed barley), we tested 9 imbreeding lines, 7 beeing two rowed barley. This kind of experiments are usual in our country, taing to etablish the best cultivar of barley for every areas and function of destination (Stroia et all, 2006).

Six imbreed lines, noted with DH, were created by the method „*Bulbosum''*, respective by double haploidisation. These relative new breeding method become an usual one in breeding programe of barley in Romania. Our study try to determine if these DH lines respond satisfactory to climatical conditions in Crisurilor Plain.

The experiment were conducted during 2009-2010 in the breeding field of Agricultural Research and Development Station Oradea. The 20 variants were tested in a latin square method, in 5 replications. The results were statistical processed by ANOVA (analise of variance) and LSD (limite standard difference), corelations and regressions methods.

The attack of diseases was apreciate by notes, in FAO sistem.

RESULTS AND DISCUSSION

The results regarding yield potential of variants are presented in table 1. The results are statistical ensured, the imbreeding line F 8-63-09 beeing very significant better comparative to experimental average (5.722 kg/ha). The same good results performed the six rowed barley cultivars Univers, Adi and Liliana, with yields up to five qintals.

The best double haploid line was DH 270-24-07, with yield potential comparable to the best romanian cultivars.

The DH lines situated in position 7, 8 and 11 are up of average, but the latest two are very significant inferior to average.

With a relative yield of 112,5%, respective anpositive difference of 575 kg/ha, we apreciate that DH 270-24-07 has a perspective to be registered in future like a new cultivar. This inbreed line has a sume of good morphological and phisiological characters: good resistance to scald, net blotch and spot blotch, superior to another variants (table 2a). We must mentioned that the rain fall exceded multianual average during the months April, May and June, that favorising the aparition and spreding of life and ear diseases.

Table 1

Results regarding the yield potential of some barley varieties.
Oradea, 2010.

Class.	Variety	Yield (kg/ha)	Relative yield (%)	Differences (kg/ha)	Signific. of differences
1	**F 8-63-09**	5.722	124,0	+1.107	***
2	**UNIVERS**	5.332	115,5	+717	**
3	**ADI**	5.320	115,3	+705	**
4	**DH 270-24-07**	5.190	112,5	+575	*
5	**LILIANA**	5.150	111,6	+535	*
6	**MADALIN**	4.968	107,6	+353	
7	**DH 267-126-07**	4.942	107,1	+327	
8	**DH 270-12-07**	4.828	104,6	+213	
9	**LAURA**	4.796	103,9	+181	
10	**REGAL**	4.766	103,3	+151	
11	**DH 267-30-07**	4.746	102,8	+131	
12	**ANDREEA**	4.734	102,6	+119	
13	**ORIZONT**	4.680	101,4	+65	
14	**COMPACT**	4.658	100,9	+43	
EXPERIM. AVERAGE		4.615	100,0	0	-
15	**ANDREI**	4.570	99,0	-45	
16	**DANA**	4.470	96,9	-145	
17	**F 8-1-07**	4.466	96,8	-149	
18	**F 8-111-07**	3.578	77,5	-1.037	ooo
19	**DH 263-66-07**	3.252	70,5	-1.363	ooo
20	**DH 263-19-07**	2.130	46,2	-2.485	ooo

LSD 5% =502 kg/ha; LSD 1% = 668 kg/ha; LSD 0, 1% = 865 kg/ha.

In the same time (table 2b), this line has a good falling resistance, good thousand kernel weight (45,3g) and hectoliter mass (65,4 kg/hl).

Regarding to the disease resistance we have to underline the good resistance to scald of the variants: Orizont, DH 267-126-07 and DH 263-66-07. Good resistance to net blotch has: MADALIN, DH 267-126-07 and DH 270-24-07, and to spot blotch the best resistance poses only DH 270-24-07 and DH 263-66-07.

The resistance to falling is one major objective for barley breeding program. By double haploid method, this character was enriched in inbreed lines: DH 270-12-07, DH 270-24-07 and DH 267-30-07, with good notes to this character.

Table 2a

Some morpho-physiological characters of the studied variety.
Oradea, 2010.

Variety	Precocity of: (date)		Disease resistance (notes):		
	earnest	maturity	scald	net blotch	spot blotch
DANA	05-05	20-06	7	7	7
ADI	04-05	19-06	4	6	7
ORIZONT	04-05	19-06	3	5	7
REGAL	04-05	19-06	5	5	7
LILIANA	05-05	23-06	5	6	7
UNIVERS	07-05	21-06	4	6	6
ANDREEA	07-05	21-06	4	4	6
F 8-63-09	06-05	19-06	7	4	6
F 8-1-07	04-05	20-06	4	7	4
F 8-111-07	05-05	20-06	7	6	5
MADALIN	05-05	22-06	4	3	5
DH 267-30-07	05-05	22-06	5	5	4
DH 267-126-07	05-05	20-06	2	3	7
DH 270-24-07	02-05	18-06	4	3	3
DH 263-66-07	04-05	21-06	2	4	3
DH 270-12-07	02-05	19-06	6	4	6
DH 263-19-07	03-05	21-06	3	5	5
LAURA	04-05	20-06	3	6	7
ANDREI	06-05	21-06	6	7	6
COMPACT	11-05	22-06	3	4	5

In table 3, there are presented the correlations between yield and the other characters, morphological and physiological, of the twenty variants studied. On can see that there are some significant correlations between some characters. For example, hectoliter weight correlate positive only with TKW (thousand kernel weight), the others correlations being negative and significant (except yield correlation). This suggests that quality of yield is more dependent of disease resistance than yield potential. The yield quality is very important in beer industry and for this; the genetic resistance take an important place in any barley breeding program.

Table 2b

Some morpho-physiological characters of the studied variety.
Oradea, 2010.

Variety	Height (cm)	Falling resistance (notes)	TKW (g)	Hectoliter weight (kg/hl)
DANA	77	7,4	38,5	58,6
ADI	76	6,4	42,3	59,9
ORIZONT	84	5,6	41,0	60,1
REGAL	72	5,6	38,5	59,0
LILIANA	78	5,2	35,7	57,5
UNIVERS	83	5,0	38,7	61,2
ANDREEA	76	6,2	32,7	61,7
F 8-63-09	86	4,8	39,4	56,7
F 8-1-07	78	5,2	42,7	58,2
F 8-111-07	70	4,4	48,5	62,7
MADALIN	80	6,6	40,6	56,7
DH 267-30-07	70	4,4	52,3	59,3
DH 267-126-07	78	6,6	44,0	62,8
DH 270-24-07	72	3,4	45,3	65,4
DH 263-66-07	68	6,6	41,1	64,4
DH 270-12-07	77	3,4	45,5	65,3
DH 263-19-07	65	7,4	36,5	59,7
LAURA	78	5,8	45,4	64,1
ANDREI	85	5,6	44,9	61,4
COMPACT	80	6,4	34,6	61,4

Very suggestive for the reciprocal influence of plant characters are the regression between one pair of them. In figure 1 is presented the regression between yield and height of plants. It is evident that height of plant influenced positive the yield of grains. The varieties with short height performs less grains yield that the varieties with normal height (70-80 cm).

In figure 2 is presented the regression between TKW and hectoliter weight. The varieties with big and weighty grain have in consequence high TKW. How diseases influenced strongly TKW and hectoliter weight, we can observe the big role of disease resistance for barley breeding, especial in zones with high incidence of diseases, like western Romania.

Table 3

The correlations between barley varieties studied.
Oradea, 2010.

Nr. crt	Character	1	2	3	4	5	6	7	8	9	10
1.	**Yield**	1	+0,199	-0,189	+0,216*	-0,107	+0,355**	+0,687**	-0,388^{oo}	+0,037	-0,177
2.	**Earnest**		1	+0,524**	-0,020	+0,200*	+0,105	+0,416**	+0,279**	-0,435^{oo}	-0,226^{o}
3.	**Maturity**			1	-0,149	+0,090	-0,106	-0,032	+0,329**	-0,259^{o}	-0,314^{oo}
4.	**Scald**				1	+0,376**	+0,169	+0,180	-0,391^{oo}	+0,190	-0,282^{oo}
5.	**Net blotch**					1	+0,292**	+0,123	+0,089	+0,079	-0,260^{oo}
6.	**Spot blotch**						1	+0,467**	+0,265**	-0,275^{oo}	-0,256^{o}
7.	**Height**							1	-0,074	-0,173	-0,276^{oo}
8.	**Falling**								1	-0,529^{oo}	-0,320^{oo}
9.	**TKW**									1	+0,332**
10.	**Hl weight**										1

R5% = 0,20; R1% = 0,26.

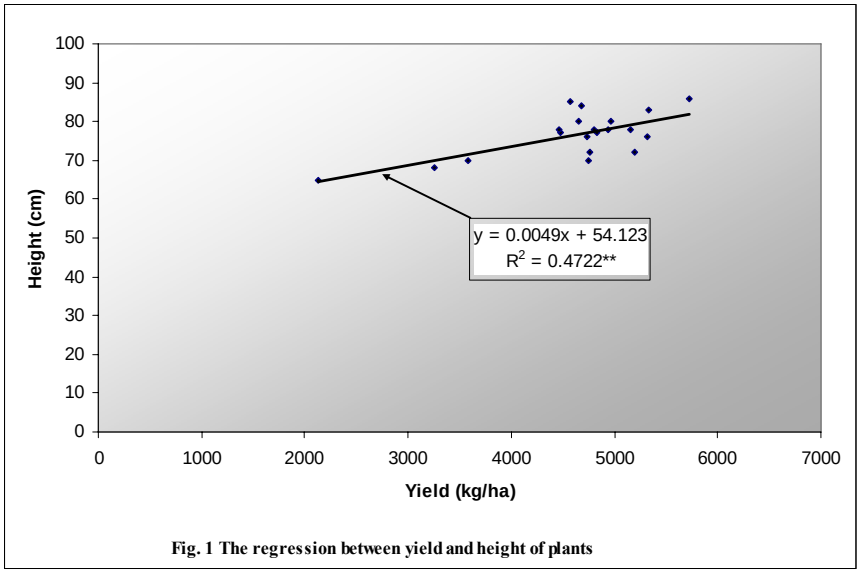

Fig. 1 The regression between yield and height of plants

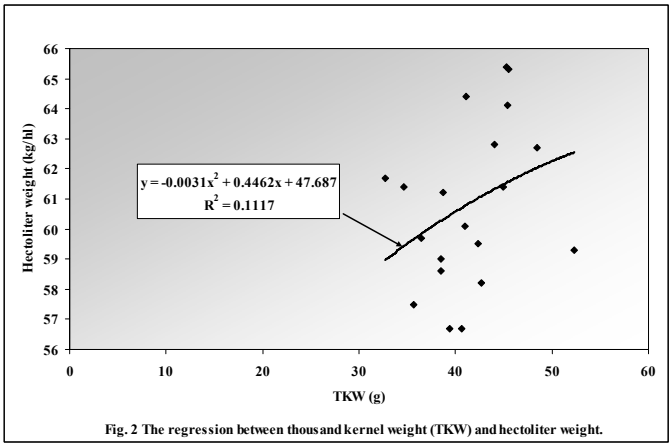

Fig. 2 The regression between thousand kernel weight (TKW) and hectoliter weight.

CONCLUSIONS

1. Some of the barley double haploid lines have good yielding pottential and can be registered in future like new cultivars.
2. The best yielding potential in 2010 has the variant F 8-63-09, a promissing clasic breeding line.
3. The diseases of barley play a very important place in quality of yield.
4. Breeding for disease resistance is easier by DH barley breeding method, an example for this beeing the inbreed line DH 270-24-07.

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