

THE INFLUENCE OF GENOTYPE - ENVIRONMENT RELATION IN EXPRESSING THE YIELD ABILITY OF SOME BARLEY AND TWO-ROW BARLEY CULTIVARS

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ABSTRACT

The researches were performed at A.R.S. Livada, during 1995-1999. The behaviour of four barley cultivars (Dana, Adi, Mădălin and Orizont) and two-row barley cultivars (Laura and Andra) was analysed as regards the yielding ability and its stability under different environmental conditions, estimated by Seleaninov index for the main phenophases. It has been also taken in view the resistance of the analysed cultivars to the main pathogens attack, as a decisive factor of both quality and level of the achieved yields. The obtained results pointed out the barley cultivars Orizont, Dana and Adi and the two-row barley cultivar Andra, as being very productive and well adapted to the pedoclimatic conditions from the North-Western zones of Romania. The reaction of barley cultivars to the main pathogens attack has been different from one year to another, temperature and rainfall in the main phenophases influencing the attack degree. The experimental data permit the extension of these genotypes for replacing the existing cultivars in North-Western of Romania.

Key words: barley, two-row barley, yielding ability

INTRODUCTION

Barley is considered the fourth cereal of the world after wheat, rice and maize, especially as forage crop. As compared with maize, barley presents a lot of advantages, such as the economic one, the grain barley tone being obtained at a lower cost price. The progress achieved in barley breeding led to the development of some valuable genotypes with great yielding ability, superior qualitative traits, resistance to the diseases and well adapted to the different environmental conditions. In the North-Western area of Romania, barley occupies an important place into crop structure. In order to obtain great, stable and qualitatively superior barley yields, it is necessary to cultivate the most adequate varieties which have the ability to use the specific pedoclimatic conditions of this area.

MATERIALS AND METHODS

During 1995-1999, on the basis of the results obtained in competitive trials, the behaviour of four barley and of two-row barley cultivars was analysed regarding the yielding ability, the variability of the main productivity elements and the resistance to diseases, depending on the specific pedoclimatic conditions from the North-Western part of Romania.

The climatic conditions evolution, was estimated by Seleaninov synthetic index ($K = P / \sum t \times 10$) calculated for different phenophases of vegetation period. Under different environmental conditions, the genotype stability was estimated by the variability coefficient (C.V.%). Data processing was performed by variance analysis and the significance of differences between cultivars was tested against the error variance (Ceapoiu, 1968).

RESULTS AND DISCUSSIONS

The barley cultivars Dana, Adi, Mădălin, Orizont as well as the two-row barley cultivars Laura and Andra, are characterized by a very good yielding ability, achieving on an average, 6,000 - 7,000 kg/ha during the five years of experimentation (Figure 1).

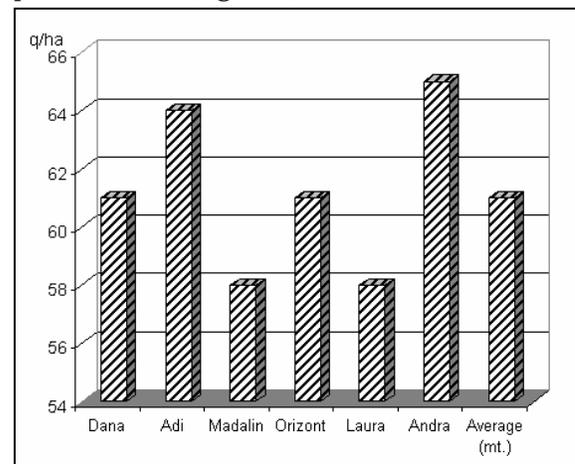


Figure 1. Grain mean yields (q/ha)

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The variance analysis for the investigation period (Table1) relieves, on the basis of the F test, significant differences of the ecological factors from one year to another. Both the differences among cultivars as well as the reciprocal action between cultivars and years are very significant.

Table 1. Variance analysis of yield trials with flax cultivars

Variability cause	SS	GL	s ²	F
Blocks	54.54	10		
Years	4692.97	4	1173.24	243.41***
Variants	568.17	5	113.63	23.57***
Variants x years	1494.71	20	74.73	15.50***
Error	241.28	50	4.82	
Total	7051.67	89		

The yield stability under different environmental conditions represents an important criterium for choosing genotypes to be cultivated in a certain area (Săulescu and Handra, 1987). The stability of a genotype can be defined as variability to the different culture media, the variability coefficient (C.V.%) being considered as the most adequate measure of stability (Lin et al., 1986; Huhn, 1987, quoted by Popescu et al., 1997).

The variability coefficients for yield and the main productivity elements point out that all the genotypes, except Laura, have superior values (Table 2).

Table 2. Values of variability coefficients for yield and the main productivity elements (C.V.%)

Productivity elements	Cultivars					
	Dana	Adi	Mădălin	Orizont	Laura	Andra
Spikes number	6.9	9.4	27.8	21.2	18.8	15.0
Grain number/spike	15.4	7.0	17.7	13.8	11.2	11.5
g/spike	17.9	7.6	19.2	10.9	10.6	2.9
TKW	6.1	10.8	6.2	3.0	23.3	11.4
Yield	17.9	19.8	13.6	14.5	8.9	21.7

The main cause of yield instability of the investigated genotypes is the great fluctuation of spikes number/m² for Mădălin, Orizont, Laura and Andra, as well as of grains number/spike and their weight for Dana cultivar.

Thousand kernels weight presents the greatest C.V. value in the case of Laura cultivar.

The graphic presentation of the relation between grain yield (q/ha) and stability (C.V.%) stands out Orizont cultivar as the most stable under North-Western conditions of Romania (Figure 2).

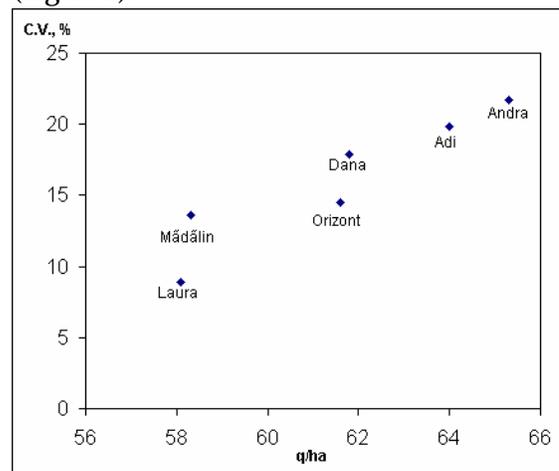


Figure 2. Relation between grain yields (q/ha) and stability (variability coefficient %)

With greater fluctuation from year to year but with a very good yielding ability, Dana, Adi, and Andra cultivars can be also mentioned. Mădălin and Laura cultivars are adapted to less favourable conditions and under these circumstances have a good stability. The mean yields obtained by the analysed barley and two-row barley cultivars are different from one year to another (Table 3).

Table 3. Annual mean yields (q/ha)

Cultivars	Years				
	1995	1996	1997	1998	1999
Dana	46.9	63.2	67.8	75.3	55.1
Adi	49.1	63.3	69.6	81.8	55.6
Mădălin	47.4	57.9	69.5	61.2	56.5
Orizont	51.7	66.1	67.9	69.5	51.8
Laura	57.4	63.6	62.4	57.5	50.5
Andra	54.7	67.2	75.6	67.8	60.1

The experimental results are obviously influenced by the climatic conditions during the vegetation period. In order to characterize the ecological conditions, the Seleaninov synthetic index calculated for the main phenophases was used (Figure 3).

A simultaneous comparison between the annual yields obtained with Seleaninov index values underlines that under drought conditions, especially during flowering and heading phenophases (1995, 1996 and 1999), the yields are much smaller, confirming the existing data regarding barley requirements to humidity during the flowering phenophase (Drăghici et al., 1975). In 1997 and 1998, under extremely favourable conditions for barley, the yields exceeded 6,500 or even 7,000 kg/ha.

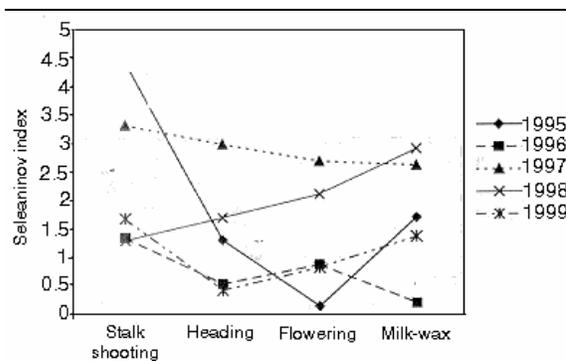


Figure 3. The values of Seleaninov index in various phenological phases

Table 4. Reaction of barley and two-row barley cultivars to the main pathogens attack (% attack degree)

Cultivars	Years				
	1995	1996	1997	1998	1999
<i>Erysiphe graminis f. hordei</i>					
Dana	0	12.2	12.0	0	5
Adi	0	8.4	17.5	0.75	0
Mădălin	0	8.7	2.76	0	0
Orizont	0	12.2	28.2	0.75	0
Laura	3	2.2	3.2	0	1
Andra	0	4.7	1.2	0	1
<i>Rynchosporium secalis</i>					
Dana	3	7.5	7.4	11.2	50
Adi	10	1.1	20.0	12.6	50
Mădălin	10	1.9	15.6	11.2	50
Orizont	10	1.1	3.2	2.0	25
Laura	10	0.3	27	12.5	50
Andra	25	2.2	17.0	1.5	25
<i>Helminthosporium reticulatum</i>					
Dana	3	7.6	5.0	9.0	25
Adi	3	14.3	9.0	7.6	25
Mădălin	3	19.3	5.0	7.6	10
Orizont	3	14.1	4.6	9.0	10
Laura	3	16.8	8.0	12.5	25
Andra	3	6.2	4.6	5.0	5
<i>Helminthosporium sativum</i>					
Dana	3	11.0	5.2	16.8	25
Adi	3	11.0	8.7	16.8	25
Mădălin	10	11.8	15.7	16.8	10
Orizont	3	18.5	11.2	15.6	10
Laura	10	8.8	4.0	5.0	1
Andra	3	12.5	3.2	1.5	1
<i>Puccinia hordei</i>					

Dana	0	17.5	2.5	0	0
Adi	0	0	0	0	0
Mădălin	0	1.5	0	0	0
Orizont	0	3.0	0	0	0
Laura	0	25.0	0	0	0
Andra	0	3.0	0	0	0

Besides the climatic conditions, the attack of different pathogens represents a limiting factor of barley yield and its quality. The barley and two-row barley reaction is different depending on ecological conditions of each year (Table 4).

In rainy years (1997) barley is attacked by powdery-mildew and rust, the others pathogens registering a medium attack degree, depending on genotypes.

The influence of climatic conditions on barley pathogen virulence has been expressed by the correlation coefficient between Seleaninov index value during different phenophases and the attack degree value (Table 5).

Table 5. Influence of climatic conditions (correlation coefficient) on main pathogens attack of barley in different phenophases

Pathogens	Phenophases			
	Stalk shooting	Heading	Flowering	Milk-wax
<i>Erysiphe graminis f. hordei</i>	0.96	0.54	0.21	-0.07
<i>Rynchosporium secalis</i>	-0.95	-0.89	-0.77	-0.44
<i>Helminthosporium reticulatum</i>	-0.77	-0.98	-0.99	-0.90
<i>Helminthosporium sativum</i>	0.89	0.99	0.97	-0.34
<i>Puccinia hordei</i>	-0.46	-0.83	-0.94	-0.99

The experimental values confirm the fact that powdery-mildew occurs preponderantly in stalk shooting stage and the attack degree is influenced by the climatic conditions. Barley leaf rust occurs by the end of vegetation period and the other diseases can be observed during the whole vegetation period, if adequate manifestation conditions are met.

CONCLUSIONS

The investigated genotypes are characterized by a good yielding ability.

The cultivars reaction to the conditions of distinct years is significantly different.

Orizont cultivar is the most stable to the environmental fluctuation conditions. Dana, Adi and Andra cultivars have a good yielding ability but a lower stability. Mădălin and Laura cultivars are adapted to the less favourable conditions but with a good stability.

The climatic conditions during the flowering and milk-wax stages, especially barley requirements for humidity, have the greatest influence in obtaining increased yields.

The reaction of the analysed genotypes to the main pathogens attack is different from one year to another, temperature and rainfall during the main phenophases influencing the attack degree.

The investigated genotypes are well adapted to the specific pedoclimatic conditions from the North-Western zones of Romania, allowing their extension into production, in order to replace the existing cultivars.

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