OBSERVATIONS REGARDING THE AGRONOMICAL VALUE AND THE USE OF WINTER BARLEY CULTIVARS IN SOUTHERN MUNTENIA'S ECOSYSTEMS

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Abstract
The observations were effected in the experimental field of the Testing Center for Cultivars from Târgovişte, during the period 2011 - 2013 and their objective was to evaluate the capacity of adaptation of some barley genotypes and to identify genotypes with large productions and low production variations under different climatic conditions. On average, during the 3 years of study, significantly larger yields were recorded for the F 8-41-2001, DH 243-1-2005, F 8-63-2005, F 8-1-2007, Paso and F 8-19-2010 cultivars compared to the witness control. Regarding the 1000 - grains weight (M.M.B.) of the 9 barley cultivars, it can be observed that constant values were recorded during the 3 years for the Paso, F 8-41-2001 and F 8-1-2007 cultivars. In point of hectolitre weight (M.H.L.), we can say that the following cultivars were constant: Adi (Amical), F 8-63-2005 and F 8-1-2007, which means that in the years 2012 and 2013 had the same values. During the agricultural years 2010 - 2011 and 2012 - 2013 all cultivars seeds emerged within 3 and 2 days respectively, while during the agricultural year 2011 - 2012 a non-uniform seeds emergence was noticed (within 1 month). During the years 2011 and 2013 the head emergence occurred around the same date of April, and in 2012 for all cultivars the head emergence occurred slightly later compared to the other two years of testing (in May respectively). The date of technical maturity for all cultivars throughout the three years of testing was reached during the last decade of June, with slight differences caused by temperature differences from one year to the next one. We recommend, for Dâmboviţa county, the cultivation of the following cultivars: F 8-41-2001, F 8-63-2005, F 8-1-2007, DH 243-1-2005, Paso, which were remarked both in terms of production quality and quantity and for a constant behavior under different climatic conditions throughout the years of analysis.

Keywords: barley, cultivar, production, 1000 - grains weight, hectolitre weight.

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1.INTRODUCTION

Barley is one of the world's most important crops with uses ranging from food and feed production, malting and brewing to its use as a model organism in molecular research (Ullrich, 2011). Some researchers think about pressed barley grass as a potential source of some nutritional substances - e.g. vitamin C, polyphenols, phenolic compounds, proteins, amino acids, and saccharides - (Paulíčková et al., 2007). Barley (*Hordeum vulgare* L.) is the major cereal in many dry areas of the world and is vital for the livelihoods of many farmers (Alazmani, 2014). Barley is an annual cereal crop and is now grown widely in environments ranging from the desert of the Middle East to the high elevation of Himalayas (Hayes et al., 2003). To increase productions stability from one year to another, the new cultivars of cereals need to have a superior behavior both in conditions of dry years and in years with normal or excessive precipitations, namely have to combine a high production potential and a good resilience to hydro stress (Săulescu et al., 2006).

The achieving of high productions of barley, stable and of high quality, requires the cultivation of several cultivars with different features, in order to better take advantage of the specific pedoclimatic conditions of the area. The improvement works need to aim to a selection of genotypes with good tillering capacity, able to achieve high productions every year, this character being necessary to be correlated to an average number of kernels on the head, a good kernel size, in all culture conditions, and a good resistance to falling (Voica, 2008).

After the analysis of 7 autumn barley cultivars, in the central area of Bărăgan, we remarked on average during the four years of study, the Andreea, Univers and Cardinal cultivars with the highest productions under non-irrigation conditions, with 2 to 10% more than the average production of all cultivars (Voinea, 2012).
The results obtained after three years of research in the hilly area of south Romania showed a good production capacity and a good adaptation to the pedoclimatic conditions of Albota area, for the Trivale and Delabrad barley cultivars (Voica, 2008).
The research conducted at the Lithuanian Institute of Agriculture showed that the highest sum of integral assessment of grain yield, grain >2.5 mm yield and extract yield was identified for the breeding lines 7955-5 (49+); 7939-1(46+); 7661-1; 7422-3 (36+); 7101-1 (34+); 7967-2 (20+). These breeding lines are characterized by a high grain yield, extract content, starch content, grain grading and low protein content (Leistrumaite and Paplauskiene, 2005).
Regarding the 1000 - grains weight (M.M.B.) it was noticed that the 2-row feed barley cultivars were on average more stable than the 6-row feed barley cultivars.
The M.M.B. was among the most stable and grain yield the most variable traits (Hadjichristodoulou, 1990).

2. MATERIAL AND METHODS

The experiments on barley were effected in the experimental fields of the Testing Center for Cultivars from Târgoviște, in the years 2011 - 2013, for 9 barley cultivars, the experimental lot having the following parameters:

- the setting method: randomized blocks;
- altitude: 262 m;
- soil type: luvic brown;
- number of repetitions: 4 + 1,
  - 4 repetitions for production calculation;
  - 1 repetition for the biometric measurements;
- seeded area – 12 m^2;
- harvested area – 10 m^2.

The VAU test (Metodologia examinării valorii agronomice şi de utilizare) was used.
Seeds were treated during the three years at the Testing Center using Amiral Proffy 6FS in a dose of 0.5 l/t of seeds. Seeding was effected in the fall, on 13 October 2010 for the year 2011, on 18 October 2011 for the year 2012, and on 05 October 2012 for the year 2013, dates which are included in the optimal seeding period for the south-eastern region of Romania. The seeding depth was 2 - 5 cm. Herbicides were used every year, namely the product RIVAL SUPER STAR 75 GD in a dose of 20 g/ha.
The 1000 - grains weight (M.M.B.) was determined as follows:

- seeds were counted randomly and grouped into groups of 10, then groups of 100 and then groups of 500 grains
- the two 500 - grain samples were weighed separately, and the results were summarized.

The final result is the 1.000 - grains weight (M.M.B.).
The hectolitre weight (M.H.L.) is determined immediately after harvesting for each hybrid. We weighed a quantity of seeds filling a cylindrical vase having a volume of 1 liter. We used the hectolitre measure. For each sample, two determinations were made.
The observations for the main phenophases concerned the date of seeds emergence (recorded when 75% of the plants have emerged), the date of tillering (recorded when 75% of the plants have head), the technical maturity (recorded the moment when humidity of the grains has reached the level of 17% at that moment the field being ready for mechanized harvesting), the humidity dynamics (the determinations begin after the moment when grains acquired a dark-yellow color, their consistency being of advanced milk, and their humidity around 27%; the measurements are made every 2-3 days until the level of 17% humidity is reached, this percentage being considered the date of the technical maturity).

3. RESULTS AND DISCUSSION

Under conditions of a normal climatic year (2011), with short drought periods and hot days, the production level was of 4,600 - 5,200 kg/ha, a special production being noticed for the DH 243-1-2005, F 8-63-2005 and F 8-1-2007 cultivars.

Regarding the 1000 - grains weight (M.M.B.), out of the 9 barley cultivars tested, the Gerlach cultivar recorded the lowest value - 44 g, the maximum value being obtained for the F 8-41-2001 cultivar and the witness control Adi (Amical) which during the respective year had the largest and heaviest grains. In point of the hectolitre weight (M.H.L.), the 9 analyzed cultivars presented values comprised between 54 kg for the F 8-41-2001 cultivar and 57 kg for the F 8-19-2010 and Gerlach cultivars (Table 1). Analyzing the date of head emergence (Table 2) we can draw the following conclusions: all the 9 barley cultivars under analysis headed at the optimal time (the end of April); all the cultivars headed during a short time interval, namely on 26 and 27 April 2011. The 9 cultivars reached their technical maturity on 20 and 22 June.

Under the climatic conditions of the year 2012, with a long period of drought accompanied by hot days, in point of the production, remarkable were the F 8-41-2001, F 8-63-2005, DH 243-1-2005 and F 8-1-2007 cultivars. The M.M.B. values for the year 2012 were comprised between 46 g (Gerlach, F 8-63-2005 and F 8-1-2007 and for the witness Dana) and 50 g (DH 243-1-2005, F 8-41-2001 and F 8-63-2005).

The M.H.L., an important parameter for the quality of the cereals recorded the following values in 2012: the minimal value of 57 kg was recorded for the F 8-41-2001 cultivar; the maximal value of 60 kg was attained by several cultivars, namely: Gerlach, DH 243-1-2005, F 8-1-2007 and F 8-19-2010 (Table 1).

Table 1. Production data in the years 2011 - 2013

Crt. no.	Barley cultivars	Parcel area (m^2)				Production/parcel (kg)				MMB (g)	MHL (kg/hl)
		R1	R2	R3	R4	R1	R2	R3	R4		
2011											
1	DANA (witness control)	10	10	10	10	5.4	5	4.3	4.6	45	55
2	ADI (AMICAL) (witness control)	10	10	10	10	4.3	4.5	5.1	4.4	47	56
3	GERLACH	10	10	10	10	5.7	4.9	5	4.9	44	57
4	PASO	10	10	10	10	4.8	5.1	5.6	4.3	46	55
5	DH 243-1-2005	10	10	10	10	5.9	5	5.1	4.8	46	56
6	F 8-41-2001	10	10	10	10	5.1	4.3	4.9	4.2	47	54
7	F 8-63-2005	10	10	10	10	5.2	5.3	5.2	5.1	45	56
8	F 8-1-2007	10	10	10	10	4.9	5.2	5.3	5.4	46	56
9	F 8-19-2010	10	10	10	10	5	5	5	5.3	45	57
2012											
1	DANA (witness control)	10	10	10	10	4.5	4.4	4.2	3.6	46	58
2	ADI (AMICAL) (witness control)	10	10	10	10	4.4	3.9	3.9	4.2	48	59
3	GERLACH	10	10	10	10	4.9	3.5	3.9	3.7	46	60
4	PASO	10	10	10	10	5.1	4.5	4.2	4.4	47	58
5	DH 243-1-2005	10	10	10	10	5.4	5.7	4.8	4.9	50	60
6	F 8-41-2001	10	10	10	10	5.8	5.4	4.4	5.6	50	57
7	F 8-63-2005	10	10	10	10	5.2	5.3	5.3	5	50	59
8	F 8-1-2007	10	10	10	10	5.3	5.2	5.1	5	46	60
9	F 8-19-2010	10	10	10	10	4	4.2	4.5	4.2	48	60
2013											
1	DANA (witness control)	10	10	10	10	5.7	5.1	5.6	5.8	47	60
2	ADI (AMICAL) (witness control)	10	10	10	10	5	5.6	4.9	5.4	49	59
3	GERLACH	10	10	10	10	5.2	5.4	5.8	5.2	50	58
4	PASO	10	10	10	10	6	6.3	6.1	6.4	50	60
5	DH 243-1-2005	10	10	10	10	5.2	5.4	5.8	6.1	49	59
6	F 8-41-2001	10	10	10	10	6	6	6.2	5.9	47	59
7	F 8-63-2005	10	10	10	10	5.4	5.6	5.7	6	48	59
8	F 8-1-2007	10	10	10	10	5.8	5.9	6	5.4	50	60
9	F 8-19-2010	10	10	10	10	6	6.4	6.5	6.4	50	61

The plant emergence of barley cultivars under analysis was in total opposition compared to the uniform emergence that occurred during two days a year before that.

Namely, in 2012 the plant emergence of cultivars began on 4 November 2011 (DH 243-1-2005 cultivar) a date situated within the optimal plant emergence time and ended on 20 December 2011 (witness Adi and Paso cultivar). We can say that the following cultivars also emerged during the optimal time period: Dana (11 November 2011), Gerlach (7 November 2011) and F 8-19-2010 (21 November 2011). A very late emergence was recorded for the cultivars F 8-1-2007, namely 28 November 2011; F 8-63-2005, namely 6 December 2011 and F 8-41-2001, namely 13 December 2011. The grains of barley cultivars tested in the year 2012 reached a percentage of 17% humidity, a ratio corresponding to technical maturity during the interval 22 – 26 June 2012 (Table 3).

The year 2013, considered very favorable for agriculture, yielded significant growth for all cultivars under analysis, the largest production being recorded for the F 8-19-2010 cultivar (6 325 kg/ha).

At the same time, the values of M.H.L. increased in 2013 in comparison with the previous years. The maximal value of 61 kg was recorded for the F 8-19-2010 cultivar, while the minimal value of 58 kg was registered for the Gerlach cultivar (Table 1). The plant emergence, in the agricultural year 2012 - 2013, was uniform and took two days, namely on 15 and 16 October 2012.

Table 2 Morphological characters in the year 2011

Crt. no.	Barley cultivars	PHENOLOGICAL DATA							Humidity dynamics at the date:				Humidity (%)			
		Plant emergence	Head emergence	Technical maturity	Size (cm)	Plants density			10.06	16.06	20.06	22.06				
						at fall	in spring	at harvest								
1	DANA (witness control)	25.10.2010	26.04	22.06	81	320	406	408	23.6	18.6	15.7	-	11	12	12	12
2	ADI (AMICAL) (witness control)	25.10.2010	27.04	22.06	80	360	421	424	22.5	18.2	17.2	-	11	12	12	11
3	GERLACH	25.10.2010	26.04	20.06	78	300	396	398	22	18	13.3	-	12	11	11	11
4	PASO	26.10.2010	26.04	20.06	76	304	391	393	24.3	19.1	13	-	11	12	12	11
5	DH 243-1-2005	27.10.2010	26.04	20.06	73	365	423	425	22.4	18.2	14.2	-	12	11	12	11
6	F 8-41-2001	25.10.2010	27.04	20.06	71	340	416	419	21.2	17.3	13.6	-	11	12	11	12
7	F 8-63-2005	26.10.2010	27.04	22.06	70	325	410	415	23.7	18.7	15.6	-	11	11	11	11
8	F 8-1-2007	26.10.2010	27.04	20.06	71	305	400	403	22.1	18.1	13.4	-	11	11	11	11
9	F 8-19-2010	26.10.2010	27.04	20.06	72	350	411	414	24.2	19	12.9	-	11	11	11	11

Table 3. Morphological characters in the year 2012

Crt. no.	Barley cultivars	PHENOLOGICAL DATA							Humidity dynamics at the date:			Humidity (%)			
		Plant emergence	Head emergence	Technical maturity	Size (cm)	Plants density			18.06	22.06	26.06				
						at fall	in spring	at harvest							
1	DANA (witness control)	11.11.2011	03.05	23.06	68	358	423	424	20.1	17.7	-	12	11.9	11.3	11.6
2	ADI (AMICAL) (witness control)	20.12.2011	07.05	22.06	64	284	359	361	19.5	17.2	-	11.3	11.6	11	11.2
3	GERLACH	07.11.2011	03.05	24.06	61	326	410	412	22.6	18.8	16	11.2	11.6	11.9	11.4
4	PASO	20.12.2011	07.05	24.06	63	297	383	384	22.1	18.4	15.8	13	11.6	11.1	11.5
5	DH 243-1-2005	04.11.2011	03.05	25.06	49	372	430	431	22	18.8	16.6	11.6	11.8	11.2	11.5
6	F 8-41-2001	13.12.2011	08.05	26.06	70	323	412	415	24.1	20	17.4	11.8	11	11.1	11.4
7	F 8-63-2005	06.12.2011	03.05	24.06	65	360	425	427	22.3	18.6	16	12.1	12.2	12	11.9
8	F 8-1-2007	28.11.2011	06.05	25.06	67	285	360	362	22.2	19	16.9	11.3	11.4	11.2	11.3
9	F 8-19-2010	21.11.2011	10.05	26.06	63	325	409	360	24	19.7	17.8	11.3	11.4	11.2	11.3

Table 4. Morphological characters in the year 2013

Crt. no.	Barley cultivars	PHENOLOGICAL DATA							Humidity dynamics at the date:				Humidity (%)			
		Plant emergence	Head emergence	Technical maturity	Size (cm)	Plants density			06.06	10.06	14.06	18.06				
						at fall	in spring	at harvest								
1	DANA (witness control)	15.10.2012	26,04	13,06	92	315	410	412	22.8	19.1	16.6	-	11.2	11.1	11.7	11.9
2	ADI (witness control)	15.10.2012	26,04	14,06	87	330	417	418	23.1	19.9	17.3	-	11	11.7	11.3	11.1
3	GERLACH	15.10.2012	29,04	13,06	76	361	421	422	22.5	19.1	16.4	-	11.2	11.1	11	11
4	PASO	16.10.2012	03,05	16,06	72	372	427	428	24.5	21.8	18.3	15.7	11.6	11.6	11.6	11.7
5	DH 243-1-2005	15.10.2012	26,04	13,06	77	365	423	425	22.6	18.9	16.3	-	11.5	11.6	11.4	11
6	F 8-41-2001	15.10.2012	26,04	14,06	78	320	415	417	23.3	20.2	17.6	-	11.3	11.3	11.4	11.3
7	F 8-63-2005	15.10.2012	26,04	13,06	80	332	419	420	22.7	19.4	16.8	-	11.2	11.4	11.2	11.5
8	F 8-1-2007	16.10.2012	29,04	16,06	79	360	420	423	23.5	20.8	19.3	16.7	11.4	11.2	11.3	11.4
9	F 8-19-2010	16.10.2012	29.04.	13,06	79	364	426	428	22.7	19	16.4	-	11.3	11.3	11.4	11.5

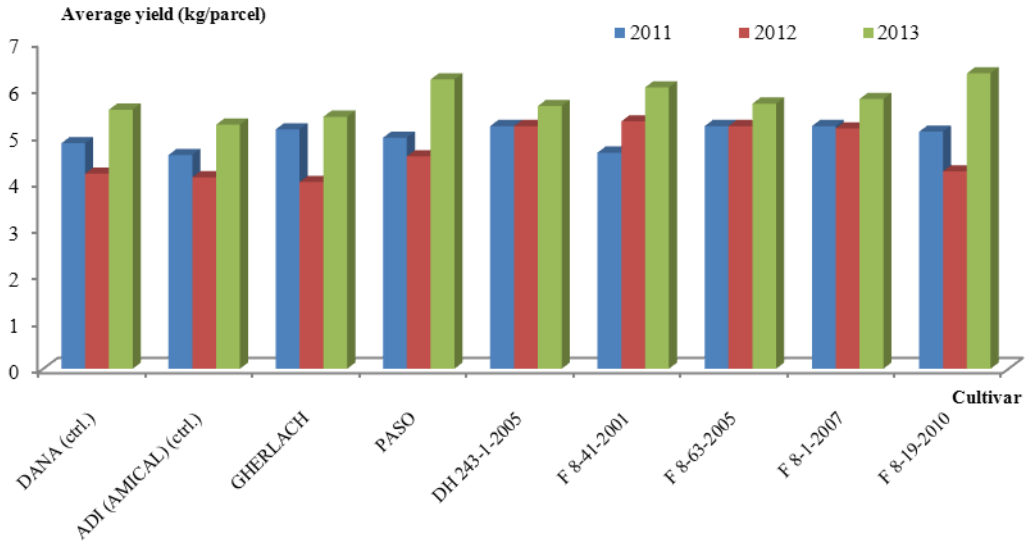

Fig. 1 - Average yields of barley cultivars in the years 2011, 2012 and 2013

In point of M.M.B., for all cultivars we observed an increase of at least one gram compared to the previous years, the maximum value of 50 g being recorded for the Gerlach, Paso, F 8-1-2007 and F 8-19-2010 cultivars. Heading occurred for all nine analysed cultivars during the optimal period, namely between the dates of 26 April 2013 and 3 May 2013. At the same time, the technical maturity was uniform and adequate (Table 4).Constant cultivars in point of average yields during the 3 years of observations were DH 243-1-2005, F 8-63-2005, but also F 8-1-2007. The cultivars with the lowest average yields in one year were Adi (Amical) and Gerlach (Figure 1). Regarding the M.M.B., it can be observed that in the year 2011, the lowest values were recorded for all cultivars under analysis, while the cultivars that recorded the same value in two different years were Paso, F 8-41-2001 and F 8-1-2007. The cultivar with the lowest M.M.B. was Gerlach (Figure 2).

Regarding the plant emergence, in the years 2010 - 2011 and 2012 - 2013 all cultivars emerged in the first year in an interval of 3 days, in the second year, in just 2 days, whereas the agricultural year 2011 - 2012 can be characterized by a non-uniform plant emergence in an interval of a whole month (Table 5).

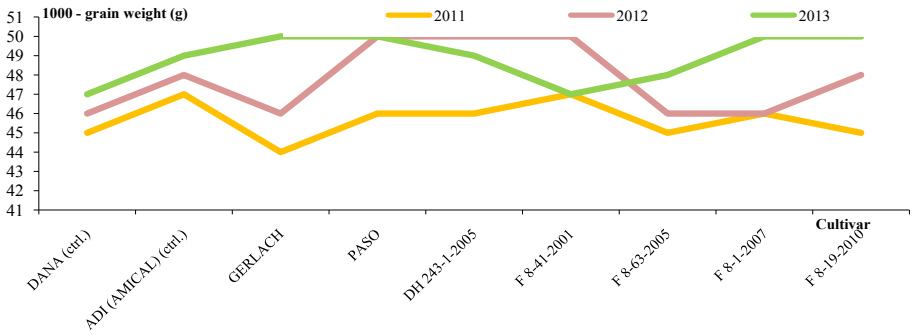

Fig. 2 - 1000 - grain weight (M.M.B.) of barley cultivars in the years 2011, 2012 and 2013

The date of technical maturity for all cultivars during the three years of testing was reached in the last decade of June, with slight differences caused by temperature differences recorded from one year to another (Table 7).

In point of heading date, we can notice the following aspects: in the first year (2011) and the last one (2013, the heading of the cultivars started around the same date in April; in the middle year (2011-2012) the heading started slightly later, in May (Table 6).

Table 5. Plant emergence dates for barley cultivars in the years 2011, 2012 and 2013

Year / Plant emergence date			Cultivar
2011	2012	2013	
25.10.2010	11.11.2011	15.10.2012	Dana (witness control)
25.10.2010	20.12.2011	15.10.2012	Adi (Amical) (witness control)
25.10.2010	07.11.2011	15.10.2012	Gerlach
26.10.2010	20.12.2011	16.10.2012	Paso
27.10.2010	04.11.2011	15.10.2012	DH 243-1-2005
25.10.2010	13.12.2011	15.10.2012	F 8-41-2001
26.10.2010	06.12.2011	15.10.2012	F 8-63-2005
26.10.2010	28.11.2011	16.10.2012	F 8-1-2007
26.10.2010	21.11.2011	16.10.2012	F 8-19-2010

Table 6. Head emergence dates for barley cultivars in the years 2011, 2012 and 2013

Year / Head emergence date			Barley cultivar
2011	2012	2013	
26.04.2011	03.05.2012	26.04.2013	Dana (witness control)
27.04.2011	07.05.2012	26.04.2013	Adi (Amical) (witness control)
26.04.2011	03.05.2012	29.04.2013	Gerlach
26.04.2011	07.05.2012	03.05.2013	Paso
26.04.2011	03.05.2012	26.04.2013	DH 243-1-2005
27.04.2011	08.05.2012	26.04.2013	F 8-41-2001
27.04.2011	03.05.2012	26.04.2013	F 8-63-2005
27.04.2011	06.05.2012	29.04.2013	F 8-1-2007
27.04.2011	10.05.2012	29.04.2013	F 8-19-2010

Table 7. Technical maturity dates for barley cultivars in the years 2011, 2012 and 2013

Year / Technical maturity date			Barley cultivar
2011	2012	2013	
22.06.2011	23.06.2012	13.06.2013	Dana (witness control)
22.06.2011	22.06.2012	14.06.2013	Adi (Amical) (witness control)
20.06.2011	24.06.2012	13.06.2013	Gerlach
20.06.2011	24.06.2012	16.06.2013	Paso
20.06.2011	25.06.2012	13.06.2013	DH 243-1-2005
20.06.2011	26.06.2012	14.06.2013	F 8-41-2001
22.06.2011	24.06.2012	13.06.2013	F 8-63-2005
20.06.2011	25.06.2012	16.06.2013	F 8-1-2007
20.06.2011	26.06.2012	13.06.2013	F 8-19-2010

4. CONCLUSIONS

On average, during the three years of study, significant production yields, in comparison with the witness control, were registered for F 8-41-2001, DH 243-1-2005, F 8-63-2005, F 8-1-2007, Paso and F 8-19-2010 cultivars.
Regarding the 1000 - grains weight (M.M.B.) constant values were recorded in the three years of observations for the Paso, F 8-41-2001 and F 8-1-2007 cultivars.
In point of hectolitre weight (M.H.L.), we can say that same values had the Adi (Amical), F 8-63-2005 and F 8-1-2007 cultivars, in the years 2012 and 2013.
In the agricultural years 2010 - 2011 and 2012 - 2013, all cultivars emerged during 2 and 3 days respectively, whereas the agricultural year 2011 - 2012 can be characterized by a non-uniform plant emergence (during 1 month).
Regarding the head emergence date, the following important aspects were noticed: in the years 2011 and 2013, the head emergence occurred around the same date of April, while in 2012 all cultivars headed slightly later compared to the other two years of testing (in May respectively).
The technical maturity date for all cultivars during the three years of testing was reached during the last decade of June, with slight differences caused by temperature differences from one year to another.
We recommend for Dâmboviţa County the cultivation of the F 8-41-2001, F 8-63-2005, F 8-1-2007, DH 243-1-2005 and Paso cultivars outstanding both by the quality and quantity of their production and by their constant behavior in different climatic conditions throughout the years of study.

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