CRIŞANA, A NEW WHEAT VARIETY WITH GOOD BACKING QUALITIES AND DROUGHT TOLERANCE

Bunta Gheorghe *

**Agricultural Research and Development Station Oradea, 5, Calea Aradului St. 410048, Oradea, Romania , e-mail: buntag@rdslink.ro*

Abstract

In this paper are presented some results regarding the yielding potential of a new own wheat variety, Crisana comparative to another 18 Romanian wheat varieties in last three years, 2007 and 2009 being very drought years in western part of country. Also, we present some results regarding the backing qualities of this new variety comparative to another ones, in last years. The results confirm that our new variety, Crisana, registered in 2005, is one of the best wheat varieties, regarding the yielding potential, drought tolerance and backing qualities, with or without nitrogen fertilization.

This paper presents the qualities indicators and yields potentials of the cultivars in two comparative variants, fertilized and unfertilized with nitrogen.

The results demonstrate that Crisana has a good yielding potential in the years with very drought spring and summer (like 2007 and 2009). In the same time, its quality indicators are stable from a year to another and it is competitive to another Romanian and foreign cultivars.

Keywords: wheat, variety, backing quality, drought tolerance.

INTRODUCTION

In Romania, the average area cultivated with winter wheat reaches about 2 million ha, with a total production between 7 and 12 million tones per year, bun only 2- 5 million tones have an acceptable quality.

In western Romania (Tisa Plain), one of the most important area for the winter wheat there are cultivated some cultivars created at National Institute for Agricultural Research and Development Fundulea (Dropia, Boema, Flamura 85, Glosa), Agricultural Research and Development Station Lovrin (Alex, Romulus, Ciprian, Lovrin 34), Agricultural Research and Development Station Turda (Arie□an) and Agricultural Research and Development Station Oradea (Cri□ana), all being appreciate like good quality ones (Tabără et al., 2009). In 2008, the most cultivated cultivars in this area were: Alex, Romulus, Dropia, Arieşan (Romanian), Serina, Josef and Renesansa (foreign).

In Hungary, also in Tisa Plain, are registered more than hundred cultivars, some of them being better in numerous quality parameters: Lupulus (Austrian cultivar), Mv. Palotás, G. K. Memento. Fatima (Romanian cultivar registered in Hungary) and Lupulus show high wet gluten content in non fertilized conditions (Győri and Sipos, 2006).

Nutrition value and bread-making quality in winter wheat (Tabără et al., 2009) depends on:

- Starch from the endosperm;
- Fats from the embryo and aleuronic layer;
- Mineral substances in pericarp;
- Vitamins in tegument and pericarp;
- Proteins, witch varies between 8- 26%.

Proteins are very important for human body because they are vital in constitutions substances, amino acids, antibodies, and hormones.

Generally, wheat quality (Győri and Sipos, 2006) is defined by:

- Physical properties: hectoliter weight, one thousand kernels weight (TKW), grain hardness,
- Protein-linked properties: total protein and gluten contents, gluten index, expansiveness, sedimentation volume, protein and amino acid composition;
- Reologic properties: farinograph or valorigraph test, alveograph value, extensograph test;
- Enzymatic properties: Hagberg falling number, amilograph test;
- Other examinations: test backing, micotoxin content, residues of pesticides and insecticides.

Wheat quality, especially protein content and bread-making quality is influenced by type of soil, climate conditions, nitrogen fertilization, plant protection and genotype (Ranieri, 2000; Pepó, 2002; Tanács et al., 2004; Szentpétery et al., 2004). The mineral fertilization can increase the protein content with 26- 42% comparative to non fertilized (control).

In *durum* wheat (Tabără and Olteanu, 2008), rising the nitrogen rate, rise too the protein content in grain by 15- 17, 3%. Very important are, in the same time, the crop, storage and milling management.

Amri and co-worker (2000) appreciate that the stability of wheat quality is strongly dependent on genotypes, agricultural production technology, soil fertility, nitrogen fertilization and water availability.

High yielding ability with good bread-making quality is the main aim in bread wheat breeding programs (emun, 2008). It is known that the baking quality of wheat is under genetic as well as environmental control (Lupton, 2005). Another authors (Kadar et al., 2009) concluded that the heritability coefficients are small for protein content, but large for sedimentation index, gluten content and deformation index. The cultivars created at A. R. S. Turda (Apullum, Turda 95 and Turda 2000) are considered to be a new level of quality in Central and North Romania.

The genetic and molecular control of cereal quality and methods for its manipulations is possible by conventional breeding methods or by genetic engineering (Snape et al., 2005). Using genetic maps, they concluded that the increase of grain protein content is associated with markers on chromosomes 1A, 2B, 2D, 3B 5BS/7BS and 6B. Another allele situated on chromosomes 3A, 6A and 7A have a smaller effect in wheat. So, the genetic control of quality in wheat is very complex, cereals having around of 50.000 genes.

Tabără and co-worker (2008) present the standard values for wheat quality in Romania (812- ISO 7970/2001): hectoliter weight more than 75 kg/hl, falling number between 180-260 seconds, wet gluten more than 22%, gluten index between 65 and 80%.

MATERIAL AND METHODS

In this paper are presented the results regarding the yield potential of some cultivars during the last three years in The Cri urilor Plain, respectively at Oradea, Diosig and Carei. Also, are presented results regarding the quality of these cultivars in correlation with nitrogen fertilization, location and clime.

The total number of cultivars tested during 2007-2009 in these three locations is 31, 18 from these being from Romania, 5 from Austria, 4 from France, 3 from Hungary and 1 from Serbia. We were tacked in study these cultivars because they were the most spreader in our zone in last years.

The year 2007 was very droughty (minus 45 mm during April, May and June) and warmly, with a difference cumulated of + $11,3^0$C comparative to a multi annual average.

Also, 2009 was more droughts than 2007, the difference of rains being -119, 0 mm, especially in April, May, and July. It was wormer than in 2007, the difference comparative to a multi annual average being $+16,8^0$C.

Regarding to the climatic conditions, the year 2008 was on of the most favorable for winter wheat. These data are reflected in grain yields.

All 30 cultivars are compared with Cri□ana, our new cultivar created at Agricultural Research and Development Station Oradea and registered in 2005.

By official quality analyses, Cri□ana variety was classified in A2 (B1) valuable group, being appreciated like an ameliorative one. It is recommended to be cultivating in hill zone from Cri□ana, Maramures, Transylvania and Bucovina counties and in western Romania plain zone.

The field experiences were done at Oradea conforms to a Latin rectangle scheme, in 5 replications and two factors: cultivar and fertilization. The variant without nitrogen is concept to show its role in protein accumulation. The variant with nitrogen fertilization consists in 100 kg/ha active substance (300 kg/ha of ammonium nitrate), administrated in two fazes.

The statistical analyze is conformer to ANOVA (analyze of variance). The dates from Diosig and Carei proceed from a demonstrative plot with winter wheat cultivars. The quality testes and determinations were done in Wheat breading laboratory of A.R.S. Oradea.

RESULTS AND DISCUTIONS

In 2009, an extremely droughty year, the grain yield varied between only 2881 kg/ha and 4706 kg/ha, our cultivar Crişana demonstrating thus his tolerance to drought and scorching heat. It exceed very significant experimental average, with more than 850 kg/ha (22.4%).

Its tolerance to drought is done by its very well developed roots, well adapted for the soils with low fertility from hill zone.

Its tolerance to scorching heat against to the fact that its leaves are very broad is explicable by the fact that its leaves, stem and ear are covered by powder.

Table 1

Grain yield of some winter wheat tested at Oradea in 2008/2009.

(Fertilized)

Class.	Cultivar	Yield (kg/ha)	Relative yield (%)	Differences to experimental average (kg/ha)	Significance of differences
1	CRIŞANA	4706	122.4	+862	***
2	ROMULUS	4480	116.5	+636	**
3	DELABRAD	4219	109.8	+375	
4	LOVRIN 34	4215	109.7	+371	
5	CIPRIAN	4188	108.9	+344	
6	GRUIA	4057	105.5	+213	
7	GLOSA	3992	103.9	+148	
8	LITERA	3989	103.8	+145	
	EXPERIMENTAL AVERAGE	3844	100.0	0	-
9	ARDEAL	3819	99.3	-25	
10	MIRANDA	3797	98.8	-47	
11	FLAMURA 85	3692	96.0	-152	
12	BRIANA	3601	93.7	-243	
13	BOEMA	3591	93.4	-253	
14	DROPIA	3584	93.2	-260	
15	ARIEŞAN	3573	93.0	-271	
16	ALEX	3164	832.3	-680	00
17	IZVOR	3073	79.9	-771	000
18	FAUR	2881	74.9	-963	000

$LSD_{5\%}$ = 398 Kg/Ha
$LSD_{1\%}$ = 539 Kg/Ha
$LSD_{0,1\%}$ = 722 Kg/Ha.

The same range of cultivars tested without nitrogen fertilization yielded less with about 1500 kg/ha (table 1 and 2). The biggest yield of our cultivar without fertilization have the same explication, its ability to explorer a large volume of soil, looking for food elements, thanks to its large root system.

A good yielding potential in same conditions have to: Ciprian, Miranda, Flamura 85 and Delabrad.

Analyzing the results of grain yield during the last three years (2007- 2009), it is evident that yield is very dependent of climatically conditions of year (table 3). In 2007 and 2009, years with deficit of precipitations, the yield averages don't exceeded 4000 kg/ha, in the fertilized variant. In 2008, a normal climatic year, the average grain yield was more than 5500 kg/ha.

Regarding the level of averages yields of cultivars is close: 3957 (Faur) kg/ha to 4562 kg/ha (Lovrin 34). It is interesting tat this relative old cultivar has the best yield stability. Cri□ana has a good place four by 18 variants.

In 2009, the drought affected some of morphological characters of wheat cultivars (table 4). The numbers of grains/ear varied between 34.0 and 49.3 in fertilized variant and 27.7 to 40.7 in no fertilized one. The average of number of grains/ear is, normally, bigger in fertilized variant (39.37 to 34.19).

The weight of grains/ears in fertilized is between 1.79 and 2.40, respectively between 1.44 and 1.98 in no fertilized, the averages of this character being grater in first variant.

The thousand grain weight is very dependent of genotype, the cultivar Arie□an demonstrating its strong character: 58.4 grams in fertilized and 59.1 grams without nitrogen. The difference between averages of these two variants is under 1%.

Hectoliter mass varied in the same manure, alls cultivars in both variants being in conformity to state standard (STAS): minimum 77.8 kg/hl to maximum 83.1 kg/hl.

In order to determine the quality of cultivars and the influence of nitrogen to them, the samples of grain were tested in order to se: wet gluten, protein content and sedimentation index (Zeleny index).

Is evident that (table 5): Alex, Arieşan, Dropia, Lovrin 34 and Crişana (all of them exceeding 30% wet gluten) are very good for baking, according with the researches of Tabără and co-workers (2008). Even without nitrogen, some of cultivars were able to cumulate more than 25% wet gluten: Alex, Delabrad, Dropia, Faur, Gruia and Briana.

Table 2

Grain yield of some winter wheat tested at Oradea in 2008/2009.

(No fertilized)

Class.	Cultivar	Yield (kg/ha)	Relative yield (%)	Differences to experimental average (kg/ha)	Significance of differences
1	CRIŞANA	3698	157.2	+1345	***
2	CIPRIAN	3287	139.7	+934	***
3	MIRANDA	2821	119.9	+468	***
4	FLAMURA 85	2704	114.9	+351	**
5	DELABRAD	2609	110.9	+256	*
6	ALEX	2490	105.8	+137	
7	LOVRIN 34	2420	102.8	+67	
8	BOEMA	2385	101.4	+32	
9	FAUR	2369	100.7	+16	
EXPERIMENTAL AVERAGE		2353	100.0	-	-
10	IZVOR	2171	92.3	-182	
11	DROPIA	2170	92.2	-183	0
12	ARDEAL	2155	91.6	-198	0
13	BRIANA	2147	91.2	-206	00
14	GLOSA	2068	87.9	-285	00
15	ROMULUS	2027	86.1	-326	00
16	ARIEŞAN	1947	82.7	-406	000
17	LITERA	1894	80.5	-459	000
18	GRUIA	1837	78.1	-516	000

$LSD_{5\%}$ = 281 Kg/Ha; $LSD_{1\%}$ = 381 Kg/Ha ; $LSD_{0,1\%}$ = 511 Kg/Ha

Table 3

Grain yields of some winter wheat cultivars tested in the last three years.
Oradea, 2007-2009

Fertilized)

Class.	Cultivar	Grain yield, kg/ha			Yield average of cultivar, kg/ha
		2007	2008	2009	
1	LOVRIN 34	3603	5867	4215	4562
2	ROMULUS	3463	5697	4480	4547
3	DELABRAD	3513	5729	4219	4487
4	CRIŞANA	3413	5177	4706	4432
5	GLOSA	2952	6323	3992	4422
6	ALEX	3490	6109	3164	4254
7	CIPRIAN	2874	5645	4188	4236
8	ARIEŞAN	3726	5140	3573	4146
9	GRUIA	3024	5319	4057	4133
10	IZVOR	3033	6263	3073	4123
11	BOEMA	3250	5382	3591	4074
12	ARDEAL	3221	5166	3819	4069
13	FLAMURA 85	2921	5580	3692	4064
14	DROPIA	3107	5416	3584	4036
15	BRIANA	3268	5146	3601	4005
16	FAUR	3426	5563	2881	3957
Annual yields averages, kg/ha		3268	5595	3802	4222

The difference between the two variants is evident: 29, 7% comparative to 23.2% wet gluten, demonstrating that nitrogen fertilization is very important for bred-making quality.

The total proteins (%) varied in optimal limits in fertilized variant: 10.6% to 13.0% (Alex), another 4 cultivars exceeding 12.0%.

Without nitrogen fertilization, the content of grains proteins is with 1.2% under fertilized variant.

Zeleny index is strongly different in the two variants: 31.7 versus only 19.6, resulting that is very important to assure an optimal fertilization for good protein content. Again, Alex has the highest value: 45, fallowed by Dropia and Delabrad.

Table 4

Results regarding some morphologicaly characthers of the cultivars tested.
Oradea, 2009.

Nr.	Cultivar	Number of grains/ear		Weight of grains/ear (g)		Thousand grain weight (g)		Hectoliter mass (kg/hl)	
		fertilized	non fertilized	fertilized	non fertilized	fertilized	non fertilized	fertilized	non fertilized
1	FLAMURA 85	37.3	33.3	2.06	1.89	55.2	57.5	79.4	79.3
2	LOVRIN 34	36.3	27.7	1.88	1.44	52.5	52.3	82.0	77.8
3	ARIEŞAN	34.0	30.7	2.01	1.86	58.4	59.1	79.8	79.6
4	DROPIA	35.0	31.0	1.86	1.66	53.2	54.0	82.2	80.8
5	ALEX	40.3	33.3	1.85	1.53	45.8	46.2	79.4	81.0
6	ARDEAL	40.0	34.0	1.85	1.58	46.8	46.4	82.4	81.7
7	ROMULUS	35.7	33.7	1.79	1.75	49.8	51.9	80.9	79.5
8	BOEMA	42.7	40.7	1.99	1.87	46.7	46.1	81.9	80.9
9	DELABRAD	37.0	32.0	1.88	1.70	50.5	53.8	83.1	82.9
10	FAUR	43.3	33.7	2.10	1.73	47.9	50.8	81.2	79.6
11	GLOSA	49.3	38.7	2.40	1.98	48.6	51.5	82.9	81.4
12	GRUIA	37.3	38.0	1.85	1.80	48.9	47.4	81.5	79.8
13	IZVOR	36.7	30.0	1.82	1.49	49.4	49.6	81.3	81.6
14	CIPRIAN	39.3	36.3	1.97	1.72	49.4	47.3	81.5	80.4
15	BRIANA	45.7	35.7	2.05	1.73	43.7	48.4	81.4	79.5
16	CRIŞANA	44.7	35.0	2.40	1.96	53.9	55.8	81.9	78.4
17	LITERA	38.7	39.0	1.99	1.81	50.6	46.5	81.1	79.4
18	MIRANDA	35.3	32.7	1.79	1.55	51.1	48.1	81.3	79.8
Experimental averages		39.37	34.19	1.97	1.72	50.13	50.71	81.40	80.19

Tablel 5

Results regarding some baking quality characthers of the cultivars tested. Oradea, 2009

Nr.	Cultivar	Fertilized			No fertilized		
		Wet gluten (%)	Protein (%)	Zeleny index	Wet gluten (%)	Protein (%)	Zeleny index
1	FLAMURA 85	30	11,5	33	24	10,3	19
2	LOVRIN 34	29	11,3	27	21	10,7	26
3	ARIEŞAN	32	12,1	36	21	10,2	12
4	DROPIA	32	12,3	39	25	10,5	23
5	ALEX	34	13,0	45	26	11,0	32
6	ARDEAL	29	11,4	27	22	10,3	13
7	ROMULUS	27	10,6	19	21	10,1	16
8	BOEMA	26	10,6	18	23	10,1	13
9	DELABRAD	30	11,8	38	26	11,0	31
10	FAUR	29	11,4	32	25	10,8	26
11	GLOSA	30	11,6	32	24	10,2	20
12	GRUIA	32	12,3	35	25	11,0	22
13	IZVOR	30	12,0	37	22	10,3	23
14	CIPRIAN	28	11,4	31	19	9,2	14
15	BRIANA	29	11,6	29	25	10,5	19
16	CRIŞANA	30	11,6	32	24	10,2	19
17	LITERA	28	11,2	23	21	9,9	10
18	MIRANDA	29	11,6	37	23	10,2	15
Experimental averages		29,7	11,6	31,7	23,2	10,4	19,6

During a very good climatically year (2008) and with a high level of fertilization and technology, the yield of cultivars Apache and Azimut exceeded 8.000 kg/ha, but hectoliter mass, wet gluten and protein content are reduced. In the same time, Crişana realized a good yield performance (up to 7.000 kg/ha), but his qualitative indicators are better, comparable to Iustus and Lupus.

The good tolerance to drought of Crişana cultivar vas confirmed too in a demonstrative plot in Carei (Satu Mare county), beside of another five forign cultivars being single that exceded 5.000 kg/ha (table 7). In adition, its quality indicators were superiors: 36.8% wet gluten, 246 seconds for falling number, the list deformation (10 mm) and very good W and PPL indexis.

Table 6

Results regarding the grain yield and quality of Crisana comparative to another winter wheat cultivar. Diosig, 2008.

Class.	Cultivar	Grain yield (kg/ha)	Hectoliter mass (kg/hl)	Wet gluten (%)	Protein (%)
1	APACHE	8.400	74,5	23	10,2
2	AZIMUT	8.164	69,8	25	10,8
3	CRI□ANA	7.198	88,8	29	12,2
4	IUSTUS	6.604	73,5	30	13,4
5	RENAN	6.467	73,5	26	12,3
6	EUROJET	6.335	71,8	28	10,4
7	LUPUS	6.225	75,6	31	12,8
8	ALEX	6.200	77,0	25	11,4
9	BRUTUS	6.166	76,3	28	12,8
10	TOBORZO	5.958	71,8	27	13,3
	Averages	6.772	75,3	27,2	11,9

Table 7

Qualities index of some winter wheat cultivars in a droughty year.
Carei, 2007.

Nr.	Cultivar	Gluten (%)	Falling number (sec)	Deformation (mm)	W index	PPL index
1	CRIŞANA	36,8	246	10	362	0,80
2	MAGDALENA	34,4	138	15	316	0,69
3	EDISON	38,0	242	14	348	0,51
4	KRISTINA	37,2	173	11	336	0,84
5	EXCLUSIV	42,2	236	22	400	0,36
6	SÜVEGES	38,4	148	18	342	0,75
	Averages	37.8	197	15	351	0.66

CONCLUSIONS

1. The new cultivar Cri□ana has a good yielding potential, even in a very drought year, like 2007 and 2009, because of its tolerance to drought, large root system and scorching heat.
2. The baking quality of this cultivar is demonstrated by his good wet gluten, protein content, Zeleny index, falling number and deformation.
3. Crişana cultivar responds well to the nitrogen fertilization, but even without, its yield potential and bread making quality are superior.

REFERENCE

1. Amri A.-Boujnah M.-Nsarellah N.-Taghouti M.-Nachit M.M. (2000): Genetic and agronomic approaches to improve durum wheat in Morocco. Seminar on Durum wheat improvement in the Mediterranean region: New challenges, 12-14 April, Zaragoza, Spain, 543-547.
2. Győri Z.-Sipos P. (2006): Investigation of wheat quality on different samples. Buletin USAMV-Cluj-Napoca, 62. 258-263.
3. Kadar R.-Moldovan V.-Moldovan M. (2009): Genetic progress in breeding of bread-making quality in winter wheat at ARS Turda: opportunities and constrains. Annual Wheat Newsletter, 47. 139-140.
4. Lupton, F. (2005): Advances in work on breeding wheat with improved grain quality in the twentieth century. The J. of Agric. Science., 143. 113-116.
5. Pepó P. (2002): Őszibúza-fajták trágyareakciója eltérő évjáratokban. Növénytermelés, 51. 189-198.
6. Ranieri R. (2000): Durum wheat quality management. CIHEAM- Options Mediterranean's. 555-557.
7. Snape J.-Fish L.-Leader D.-Bradburne R-Turner A. (2005): The impact of genomics and genetics on wheat quality improvement. Turk J. Agric. 29. 97-103.
8. Szentpétery Zs.-Hegedűs Z.-Jolánkai M. (2004): Impact of agrochemicals on yield quality and pesticide residues of winter wheat varieties. Cer. Res. Comm., 32. 2. 635-642.
9. Şemun T. (2008): Grain yield and agronomic characteristics of Romanian bread wheat varieties under the condition of Northwestern Turkey. African J. of Biotechnology, 7 (10). 1479-1486.
10. Tabără V.-Olteanu G. (2008): Principalele însu□iri de calitate ale grâului *Triticum durum* (soiul Pandur) sub influen□a unor măsuri agrotehnice. Buletinul Agir, 1-2. 9-13.
11. Tabără V.-Pu□că I.-Wagner L.-Pop G.-Ni□ă S.-Gorinoiu G.-Prodan M. (2008): Calitatea panificabilă a unor soiuri de grâu de toamnă în condi□iile Sta□iunii de cercetări Agricole Lovrin. Buletinul AGIR, 1-2. 3-6.
12. Tabără V.-Ni□ă S.-Pop G.-Prodan M.-Duma C.-Tabără C. G.-Pa□ca M.-Nedelcu F. (2009): Breadmaking quality of some winter wheat cultivars in western Romania. Buletinul AGIR, 1-2. 182-185.
13. Tanács L.-Matuz J.-Gerő L. Petróczi I. M. (2004): Effect of NPK fertilizers and fungicides on the quality of bread wheat in different years. Cer. Res. Comm., 32. 2. 627-634.