

GENOTYPE INFLUENCE UPON PRODUCTION AND QUALITY OF WHEAT GROWN IN GĂVANU-BURDEA PLAIN

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Abstract

In order to know the production and quality potential of the wheat grown in a crop system adapted to climatic changes, in 2011 we organised an experiment based on 6 Romanian varieties, 11 foreign varieties and a wheat hybrid grown in two soil tillage variants. The genotypes tested belonged to the very early – medium early varieties that are highly resistant to drought, heat and winter conditions.

The experimental field consisted in reddish preluvosoil at an altitude of 130 m and was part of SC Polirom Prod SRL located in the Găvanu-Burdea Plain, the village of Scurtu Mare, Teleorman County.

All experimental variants were fertilized with N60 P₂O₅-60 at the time of sowing preparation and N100 on early spring vegetation. The specific weed, disease and pest control was based on herbicide and insecto-fungicide treatments, according to the conventional farming technology.

In terms of climate, the crop year 2011-2012 was dry, with uneven rainfall during the growing season. 374 mm rainfall was recorded from sowing to harvesting, and 252 mm at the end of winter and during the growing season.

The results obtained under a dry year highlighted the following: very high production potential of the wheat genotypes under study (4457 kg/ha on average); better soil tillage, compared with the conventional system (38% higher production). The hybrid Hystar ranked first in production: 4925 kg/ha (32% higher than the genotype average) in the conventional tillage variant and 6349 kg/ha (22% increase, compared with the average) in the minimum tillage variant; however, its quality for bread-making was low. The variety Izvor recorded the highest quality and production (4457 kg/ha) of the Romanian varieties.

Based on the results recorded in 2012, in terms of productivity under similar growing conditions, we recommend the Romanian early varieties Izvor, Litera, Glosa, Boema 1, Gruia and Faur F, and the foreign varieties Felix, Renata, Kalasz, Akrotos and Csillag.

Key words: production, quality, tillage, varieties.

INTRODUCTION

Once with the evolution of climate changes, which occur more and more frequently lately, there are requested cropping technologies adjusted to new conditions. On the one side, these cropping technologies take into account the use of the biological material with important tolerance to hydric and thermal stress (determined by high temperatures and water shortage), and on the other side the cropping system which ensures water preservation in soil and its effective valorization.

In our country, there is made important progress in the field of creating wheat varieties with high production potential and of good quality, but which are earlier and

resistant to drought and extreme temperatures (Saulescu, 2007, 2010; Ittu, 2012).

Research effected until nowadays in Romania (Mustatea et al., 2008; Sin et al., 2010; Lupu et al. 2010; Meluca et al., 2011; Voinea, 2011; Neacsu, 2012) and in other countries (Cailliez, 2008; Egesel, 2012; Favre, 2012) have assured only an extremely insignificant solution to the ever complex issues generated by cropping environment conditions complexity, of genotypes assortment and their genetical vulnerability to ecological factors, with consequences on quality and stability of production.

In this work, we present the first experimental results obtained in the Plain Găvanu-Burdea, in 2012, with an assortment of 18 autumn wheat types from the newest Romanian and European creations.

MATERIALS AND METHODS

In order to know the production potential and quality of the wheat crop in the cropping system adapted to climate change, in the year 2011 there has been organized a field bifactorial experiment, in 4 repetitions within SC Polirom Prod SRL, located in the commune of Scurtu Mare, Teleorman County, Romania. Scurtu Mare is located in the North of Teleorman County, inside Gavanu-Burdea Plain, at an altitude of 130 m.

The soil on which it has been made the experiment is of the type preluvosol, characteristic to the area of Gavanu-Burdea Plain.

Overall climate. From climate point of view, we find here, a region of interference between the Romanian Western Plain climate and that of the Romanian Eastern Plain, bounded by the Arges River.

The climate of the experimental period. Agricultural year 2011-2012 has been a dry year (Figure 1).

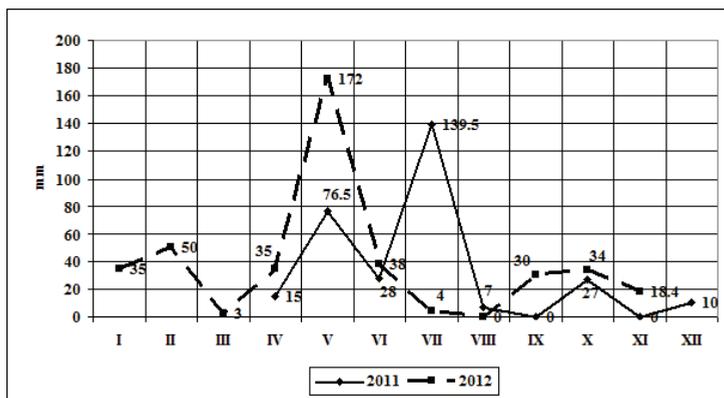


Figure 1. Precipitations regime from the experimental field during 2011-2012

In the fall of 2011 (September-November) fell only 27 mm precipitation. To these, there were added 95 mm in winter (December-February), 210 mm in spring 2012 (March-May) and 42 mm further up to harvesting (June-July).

It appears that from sowing to harvesting 374 mm precipitation fell, and during the growing season after coming out of winter, 252 mm. As it results from Figure 1, rainfall was very unevenly spread over the months of the year. Thus, there has been an excess of precipitation in May 2012 (172 mm) and in July 2011 (139.5 mm), while in the other months from 2012, the quantities of water from rainfall ranged between zero and 50 mm.

Although the pluviometric regime was generally found to be ineffective (252 mm during the spring-summer growing season, compared to a minimum of 350-450 mm, which would ensure the daily water consumption of about 4 mm/day during this period), rainfall during May and June (which

totalized 210 mm) have assured environmental consumption of 3.5 mm/day in the last two months of vegetation. In these circumstances, the majority of wheat varieties are characterized by superior precocity, high-efficiency valued water from rainfall, and as you will see ahead, there have been achieved in non-irrigated, production performance that make them competitive with the most intensive cropping technologic.

Experimental variants. There have been studied 6 varieties of winter wheat created in INCD Fundulea over the past decade, from very early and half-precocious varieties, with increased resistance to drought, hot climate and winter, compared to 11 foreign and hybrid varieties, all from the same groups of precocity. In the experiment, there was introduced as a separate factor, the soil tillage system in two variants (conventional and minimum tillage).

Experimental variants are presented in Table 1.

A Factor: Soil tillage system

a1 – Conventional tillage system

a2 – Minimum tillage system

B Factor: Variety

Table 1. Experimental variants

Levelling	Variety (Hybrid)	Origin	Precocity
b1	Boema 1	RO	Very early varieties
b2	<i>flinca</i>	HR	
b3	Glosa	RO	Early varieties
b4	Litera	RO	
b5	Gruia	RO	
b6	Faur F	RO	
b7	Izvor	RO	
b8	<i>PKB Kristina</i>	SRB	
b9	<i>Genius</i>	DE	
b10	<i>Hystar</i>	FR-Hybrid	
b11	<i>GK Petur</i>	HU	Medium early varieties
b12	<i>GK Csillag</i>	HU	
b13	<i>Felix</i>	HR	
b14	<i>GK Kalasz</i>	HU	
b15	<i>BC Renata</i>	HR	
b16	<i>Mulan</i>	DE	
b17	<i>Akratos</i>	DE	
b18	<i>Quebon</i>	DE	

The run-up was rapeseed plant.

For the variants with the conventional system of soil tillage, there has been carried out a ploughing at the depth of 20-30 cm, after which there was prepared a growing bed with disc harrows and combinator.

In the system of minimum tillage the first mechanical work was carried out with slight disc harrows (GD-7) for vegetal debris chopping, after which it followed a soil tillage with heavy disk harrows (GD-4.2) at about 15-17 cm. Before sowing, there was prepared the seed bed with the combinator.

In both systems of soil tillage, fertilizing and maintenance works during the vegetation, there were uniformous for all variants.

Before sowing there was fertilized with complex fertilizers (20:20:0) in the dose of N60 P₂O₅-60, after which the bed was prepared with the combinator. In the spring, at the beginning of vegetation, N100 was applied as urea (during the last snow).

Sowing was carried out between 1 and 20 October, for the period of research.

After all weeds growth, the sprayer with 0.5 l/ha Sekator (amidosulfuron 100 g/l + iodosulfuron-methyl-Na 25 g/l + mefenpyr-diethyl 250 g/l), along with a leaf with the fungicid Falcon 0.6 l/ha (tebuconazol 167 g/l+ triadimenol 43 g/l + spiroxamina 250 g/l).

In blossoming and grains formation stage, there was effected a second treatment for foliar diseases, with 0.8 l/ha from Nativo fungicide (200 g/l tebuconazol+100 g/l trifloxystrobin), simultaneously with Faster insecticide (cypermethrin 100 g/l), at a dose of 0.2 l/ha. There was determined the grains production, and in the laboratory, some indexes of baking value (MH, moist gluten content and gluten deforming index).

RESULTS AND DISCUSSIONS

Soil tillage system influence on production.

On average, for all varieties in the experiment, in the system of minimum tillage, there was achieved a production with 38% higher than in the conventional system, in other words a gain in production of 1428 kg/ha, statistically significant (Table 2).

This superior effect on production of soil without ploughing is due to the conservation and recovery of water into the soil for the vegetation period of autumn and it ensures normal growth and development of plants until harvest.

Table 2. Soil tillage system influence on wheat production (2012)

Soil tillage system	Production		Differemce	
	kg	%	kg	%
Conventional tillage	3723	100	Control	Control
Minimum tillage	5151	138	1428	***

The influence of genotype on production.

Table 3 compares the output of all the genotypes with their media.

Compared with the average, we remark Hystar hybrid, with the largest production (5637 kg/ha), with difference in addition, which is statistically very significant (26% or 1180 kg/ha). With above-average yields, with very significant differences (485-828 kg/ha) we meet Felix, Renata and Kalasz foreign varieties.

The lowest production was obtained from Quebon and Genius varieties (3646 kg/ha), which represents only 82% of the average yield of all genotypes; the difference in minus compared to the average represents 811 kg/ha, mirroring a very significant negative statistical point of view.

Table 3. Genotype influence on wheat production (2012)

Variety (Hybrid)	Average production for two working systems		Production difference	
	kg/ha	%	kg/ha	Signification
1. Boema 1	4196	94	-261	oo
1. Ilinca	3949	89	-508	ooo
1. Glosa	4354	98	-103	
1. Litera	4511	101	54	
1. Gruia	4156	93	-301	oo
1. Faur F	4088	92	-369	ooo
1. Izvor	4785	107	328	***
1. Kristina	4541	102	84	
1. Genius	3646	82	-811	ooo
1. Hystar	5637	126	1180	***
1. Petur	4328	97	-129	
1. Csillag	4542	102	85	
1. Felix	5285	119	828	***
1. Kalasz	4942	111	485	***
1. Renata	5239	118	782	***
1. Mulan	3741	84	-716	ooo
1. Akrotos	4645	104	188	
1. Quebon	3646	82	-811	ooo
AVERAGE	4457	Control	100	

LSD 5% =190 kg/ha; LSD 1% =252 kg/ha; LSD 0.1% =325 kg/ha.

Also, below-average production, with very significant differences in minus (508-716 kg/ha) were obtained from foreign varieties such as Ilinca and Mulan.

Among Romanian varieties, only Izvor variety is superior to the average, having a production difference statistically assured (7% or 328 kg/ha). Other Romanian varieties either are below average, with distinctly significant production differences (Boema 1, Gruia) or very significant (Faur F) or are non-differentiated statistically compared to the average (Glosa, Litera).

Out of the 18 genotypes studied in this experiment, 6 varieties yield productions at the level of the average yields (4457 kg/ha) : the two Romanian varieties already mentioned, Glosa and Litera, plus Kristina, Petur, Csillag and Akrotos varieties.

Multiple comparisons among the genotypes used in the experiment, conducted with the help of Duncan test, are presented in table 4. In this table the genotypes are in descending order of productions achieved and according to the significance of the experimental differences between them. Variants (varieties/hybrid) which do not differ significantly between them

are marked with the same letter. Table 4 analysis shows the following conclusions:

- Hystar hybrid achieves production gains statistically provided compared with any of the experiment varieties, up to 55%;
- depending on the statistical significance absence of the differences between the different production types, these are grouped as 2 species with similar productions (Felix-Renata, Izvor-Kalasz, Ilinca-Mulan), 3 varieties with similar yields (Mulan-Genius-Quebon), up to 5 varieties;
- there are two different groups of five varieties, not different significantly, comprising Romanian varieties too:
 1. **Izvor** - Akrotos - Csillag - Kristina - **Litera** (4500-4700 kg/ha);
 2. **Glosa** - Petur - **Boema 1** - **Gruia** - **Faur F** (4000-4300 kg/ha).

Genotype influence on production depending upon the soil tillage system (Table 5).

Table 5 emphasizes the followings:

- in the conditions of a dry year, the wheat experienced genotypes are characterized by very high production potential, between 3117 kg/ha and 6349 kg/ha;

- in the same climatic conditions, the minimum tillage system is superior compared to the conventional system; on average, version with minimum tillage realized production of 5191 kg/ha, compared with 3723 kg/ha for the conventional system of working the soil;
- within each variant of tillage system, Hystar hybrid ranks first in the production with 4925 kg/ha, respectively 6349 kg/ha.

Increases production of Hystar hybrid in comparison with the the average of variants in the experiment represent 32% in conventional tillage and 22% in the version with minimum tillage. These relative differences are equivalent to increases of over 1.1-1.2 t/ha from all variants within each system of soil tillage, differences that are addured very significantly statistically.

Table 4. Multiple comparisons among variants (Duncan test)

Variety (Hybrid)	Average production		Signification
	kg/ha	%	
10 Hystar	5637	155	a
13 <i>Felix</i>	5285	145	b
15 <i>Renata</i>	5239	144	b
14 <i>Kalasz</i>	4942	136	c
7 <i>Izvor</i>	4785	131	cd
17 <i>Akratos</i>	4645	127	de
12 <i>Csillag</i>	4542	125	def
8 <i>Kristina</i>	4541	125	def
4 <i>Litera</i>	4511	124	def
3 Glosa	4354	119	efg
11 <i>Petur</i>	4328	119	fg
1 Boema 1	4196	115	gh
5 <i>Gruia</i>	4156	114	gh
6 <i>Faur F</i>	4088	112	gh
2 <i>Ilinca</i>	3949	108	hi
16 <i>Mulan</i>	3741	103	ij
9 Genius	3646	100	j
18 Quebon	3646	100	j

Table 5. The influence of genotype on production, according to the work of the soil

Variety (Hybrid)	Production				Production difference (kg/ha)	
	kg/ha		%		Conventional tillage	Minimum tillage
	Conventional tillage	Minimum tillage	Conventional tillage	Minimum tillage		
l. Boema 1	3431	4960	92	96	-292 ^o	-231
l. <i>Ilinca</i>	3335	4563	90	88	-388 ^{oo}	-629 ^{ooo}
l. Glosa	3557	5151	96	99	-166	-41
l. <i>Litera</i>	3267	5754	88	111	-456 ^{oo}	563 ^{***}
l. <i>Gruia</i>	3351	4960	90	96	-372 ^{oo}	-231
l. <i>Faur F</i>	3215	4960	86	96	-508 ^{ooo}	-231
l. <i>Izvor</i>	3618	5952	97	115	-105	761 ^{***}
l. <i>Kristina</i>	3725	5357	100	103	2	166
l. Genius	3125	4166	84	80	-598^{ooo}	-1025^{ooo}
l. Hystar	4925	6349	132	122	1202^{***}	1158^{***}
l. <i>Petur</i>	3498	5158	94	99	-225	-33
l. <i>Csillag</i>	3726	5357	100	103	3	166
l. <i>Felix</i>	4617	5952	124	115	894 ^{***}	761^{***}
l. <i>Kalasz</i>	4329	5555	116	107	606 ^{***}	364 ^{**}
l. <i>Renata</i>	4725	5753	127	111	1002^{***}	562 ^{***}
l. <i>Mulan</i>	3117	4365	84	84	-606^{ooo}	-826 ^{ooo}
l. <i>Akratos</i>	3735	5555	100	107	12	364 ^{**}
l. Quebon	3720	3571	100	69	-3	-1620^{ooo}
AVERAGE	3723	5191	100	100	Control	Control

LSD 5% =269 kg/ha; LSD 1% =357 kg/ha; LSD 0.1% =460 kg/ha

The lowest yields were obtained from *Mulan* and the *Genius* varieties with conventional tillage (3117-3125 kg/ha) and from *Quebon* and *Genius* varieties for the version with minimum tillage (3571-4166 kg/ha).

The influence of genotype on the baking value in the system of minimum tillage (Table 6).

Hectolitical mass. The data in table 6 show that the minimum value for the bakery of the hectolitical mass (70 kg/hl) is achieved in all

Romanian varieties from the experiment, as well as the majority of foreign varieties. Of all the varieties of experiment, only Izvor has over 78 kg/hl hectolitrical mass, being included in the varieties class with very good bakery value according to this criterion.

Romanian varieties are generally good, with the exception of Boema 1 variety, which is satisfactory.

Most of foreign varieties have satisfying baking value, Kalasz has good value and Kristina, Petur and Quebon varieties have unsatisfactory bakery value.

Table 6. Indexes concerning baking value of experienced genotypes

Variety (Hybrid)	Hectolitrical mass (kg/hl) - MH	Moist gluten content (%) - Gu	Gluten deformation index (mm) - Id	Baking value		
				MH	Gu	Id
1. Boema	73.0	28.0	10.5	S	FB	FB
1. Ilinca	73.5	31.0	13.5	S	FB	B
1. Glosa	75.6	29.0	13.0	B	FB	FB
1. Litera	75.7	30.4	13.0	B	FB	FB
1. Gruia	76.2	31.4	8.0	B	FB	FB
1. Faur F	77.1	32.0	12.5	B	FB	FB
1. Izvor	78.3	27.6	12.0	FB	FB	FB
1. Kristina	69.6	27.0	12.0	N	FB	FB
1. Genius	74.8	29.0	10.5	S	FB	FB
1. Hystar	72.3	25.0	12.5	S	B	FB
1. Petur	68.6	30.8	12.0	N	FB	FB
1. Csillag	73.3	30.2	10.5	S	FB	FB
1. Felix	70.4	30.0	12.0	S	FB	FB
1. Kalasz	76.7	32.5	12.0	B	FB	FB
1. Renata	74.8	30.8	10.0	S	FB	FB
1. Mulan	73.1	31.2	12.0	S	FB	FB
1. Akratos	73.0	30.0	10.0	S	FB	FB
1. Quebon	67.5	31.6	13.0	N	FB	FB

It is interesting to note that Hystar hybrid is the most productive and it is just satisfactory as bakery value according to the MH criterion.

Moist gluten content is very good for all varieties, except Hystar hybrid, which has the lowest content (25%), being characterized as having good bakery value.

The index of the gluten deformation. On the basis of this criterion, with the exception of Ilinca variety (good bakery), all other varieties have very good bakery value (deformation index comprised between 3 and 13 mm).

CONCLUSIONS

Experimental results obtained under the conditions of a dry year highlights:

- very high production potential of studied wheat genotypes (3117-6349 kg/ha);
- the superiority of soil minimum tillage system in comparison with conventional systems; on average, the version with minimum tillage realized production

of 5191 kg/ha, compared with only 3723 kg/ha in the conventional system of working the soil, which means a difference of production in addition to 1428 kg/ha (38%), statistically very significant;

- within each variant of tillage system, Hystar hybrid ranks first in the production with 4925 kg/ha, respectively 6349 kg/ha. Increases production of Hystar hybrid in comparison with the average of variants in the experiment represent 32% in conventional tillage and 22% in the version with minimum tillage.

On average for the two variants of working the soil, the experienced varieties are grouped as follows:

- with productions over the experiment average, with very significant differences (328-828 kg/ha): Felix Kalasz, Renata and Izvor; these include the Hystar hybrid, with a difference of production of 1180 kg/ha compared to the average;

- with productions at the level of the average (4457 kg/ha): Glosa, Litera, Kristina, Petur, Csillag and Akrotos;
- with production below average, with differences statistically provided: Quebon, Genius, Ilinca, Mulan, Boema1, Gruia, Faur F (261-811 kg/ha).

According to the statistical significance of the differences between the different production types, there are two different groups of 5 varieties (with similar productions), where we include the Romanian varieties too:

- Izvor – Akrotos – Csillag – Kristina-Litera (4500-4700 kg/ha, on average for the two tillage systems);
- Glosa – Petur - Boema 1 – Gruia - Faur F (4000-4300 kg/ha, on average for the two tillage systems).

From a qualitative point of view, the most appreciated is Izvor variety, which is characterized by a very good bakery value for all 3 determined indicators: hectolitrical mass, the content of moist gluten, deformation gluten index.

The trait which differentiates the varieties studied in terms of the amount of bread is the hectolitrical mass, the other indicators being usually recorded in the category of very good value.

According to the hectolitrical mass, the Romanian varieties are generally good, with the exception of

Hybrid Hystar, the most productive one, is just satisfactory as bakery value according to hectolitrical mass, good gluten content and very good deformation index criteria.

Based on the results obtained in 2012, in similar conditions, there are recommended early Romanian varieties, in the order of productivity: Izvor, Litera, Glosa, Boema 1, Gruia, Faur F, as well as the foreign varieties: Felix, Renata, Kalasz, Akrotos, Csillag.

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