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BEHAVIOR OF SOME ROMANIAN TRITICALE VARIETIES IN THE CLIMATIC CONDITIONS OF THE CENTER OF MOLDAVIA, ROMANIA

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ABSTRACT. Knowledge of the particularities of the new varieties response to environmental conditions is important for the best possible territorial zoning and site stating that they need to occupy in varieties structure for each area. This paper presents research results of environmental testing of six Romanian triticale varieties at the Agricultural Research-Development Station (A.R.D.S.) Secuieni, Neamţ county, Romania, during 2007-2012 and followed the zoning of the most adapted and performing genotypes, increasing their biodiversity, so as to diminish the genetic and environmental vulnerability of agroecosystems. On average for the five years of experimentation, triticale yields achieved ranged from 6984 kg/ha (Cascador) and 8439 kg/ha (Haiduc). Of the five years of experimentation, the crop years 2008-2009 and 2010-2011 were normal in terms of rainfall, the yields achieved in these years being the highest. Depending on the average yield achieved in the five years of experimenting, the top three varieties were ranked Haiduc (8439 kg/ha), Stil (8320 kg/ha) and Plai (7961 kg/ha), the first two varieties having a very low coefficient of variability (<10). During the experiment, Romanian triticale varieties showed good resistance to winter, lodging and diseases.

Key words: Climatic conditions; Yield; Ecological testing; Triticals.

REZUMAT. Comportarea unor soiuri romaneşti de triticale în condiţiile pedoclimatice din centrul Moldovei, Romania. Cunoaşterea particularităţilor reacţiei soiurilor noi la condiţiile de mediu este importantă pentru o cât mai judicioasă zonare în teritoriu şi pentru precizarea locului pe care acestea trebuie să-l ocupe în structura soiurilor pentru fiecare zonă. Lucrarea prezintă rezultatele cercetărilor de testare ecologică a şase soiuri de triticale la S.C.D.A. Secuieni, judeţul Neamţ, în perioada 2007-2012, şi a urmărit zonarea celor mai adaptate şi performante genotipuri, creşterea biodiversităţii lor, în aşa fel încât să se diminueze vulnerabilitatea genetică şi ecologică a agroecosistemelor. În medie pe cei cinci ani de experimentare, producţiile de triticale realizate au variat

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între 6984 kg/ha (Cascador) şi 8439 kg/ha (Haiduc). Dintre cei cinci ani de experimentare, anii agricoli 2008-2009 şi 2010-2011 au fost normali din punct de vedere al precipitaţiilor, producţiile realizate în aceşti ani fiind cele mai ridicate. În funcţie de producţia medie realizată în cei cinci ani de experimentare, pe primele trei locuri s-au clasat soiurile Haiduc (8439 kg/ha), Stil (8320 kg/ha) şi Plai (7961 kg/ha), primele două soiuri având şi un coeficient de variabilitate foarte mic (<10). În perioada de experimentare, soiurile româneşti de triticale au prezentat o rezistenţă foarte bună la iernare, cădere şi boli.

Cuvinte cheie: condiţii climatice; producţie; testare ecologică; triticale.

INTRODUCTION

The creation and identification of lines and varieties more valuable than those in culture are features of modern agriculture, as the variety participate directly in increased of yield, better using the other technical measures (Leş and Oproiu, 1987). The results of the multiannual field experiences are influenced by the differentiated conditions of rainfall and thermal regime, and by the physical and chemical characteristics of the soil.

The strong interaction between genotype and environment require the creation of varieties with specific adaptability to climatic conditions both favorable and unfavorable (Tessemma *et al.,* 1998). Interactions are complex, both because of very different environmental factors and the variety characters and qualities. The climate change from the last years emphasized the extreme variations, with serious consequences on the agricultural production (Săulescu *et al.,* 2006).

The stability of the yield is given by the sum of varietal resistance to adverse biotic and abiotic environmental conditions (Săulescu *et al.,* 1995; Gaşpar and Butnaru, 1985) and by the interaction of characters with compensatory effect (Timariu, 1975).

The triticale crop allows less productive land use for wheat and corn, those acid, affected by drought, ponding, poor in nutrients. Although the main purpose of triticale grain is in animal nutrition, laboratory tests have indicated that it may be used in bakery (in human nutrition), by applying a special technology.

New triticale varieties have lower quality characteristics that Dropia wheat variety, which is the best variety of wheat in terms of quality bakery, but by using in bread making a mixture of 50% triticale flour and 50% flour from Dropia variety the bread obtained had quality parameters similar to those of bread produced from the variety wheat flour used in the blend (Ittu and Săulescu, 2000; Ittu *et al.,* 2001).

The research conducted at A.R.D.S. Secuieni, Neamţ county, aimed to setting the behavior, in the climatic conditions of the area of influence, of the latest creations of triticale.

MATERIALS AND METHODS

In A.R.D.S. Secuieni, Neamţ county, during 2007-2012 period, were

conducted multiple and complex ecological testing (comparative culture for competition) at the triticale culture in order to zoning the most adapted and efficient genotypes, increase their biodiversity, so as to reduce the genetic and environmental vulnerability of agroecosystems. From the republican comparative culture of perspective triticale varieties and lines are presented the results obtained in six Romanian varieties.

The experiment was located on a cambic chernozem typical, with pH in water of 6.29, 2.3 humus content, nitrogen index - 2.1, mobile P_2O_5 - 39 ppm, K_2O - 161 ppm, in terms of non irrigated, and was fertilized with 200 kg/ha complex fertilizer (20:20:0) in fall and with 200 kg/ha ammonium nitrate in spring. The density provided was of 500 germinable seeds/sqm, and the sowing depth was of 4-5 cm. Previous plant was winter rape.

There were determinated, in every year, the yield capacity and some morphological characteristics. The experimental results were processed by analysis of variance (Ceapoiu, 1968), and the stability of yield and of some productivity factors was assessed on the variation coefficients. Plant resistance to winter, lodging and diseases was appreciated by note in the FAO scale (1-9).

RESULTS AND DISCUSSION

The experimental period (2007-2012) was characterized by years of less favorable climatic conditions (crop years 2007-2008, 2009-2010, 2011-2012) and very favorable (crop years 2008-2009 and 2010-2011) (*Figs. 1 and 2*). The climatic conditions during this period had marked effects on the main character and qualities that led the production, genotypes studied behave differently depending on their genetic constitution.

On the average, in the five years of experimentation, the varieties showed good resistance to winter, lodging and diseases (snow mold, mildew, yellow, brown and black rust, *Septoria*, *Fusarium*). Average customer rating was 1. Weight of 1000 grains (WTG) was between 44 and 48 g, and the values of hectolitre mass (HM) were lower, ranging between 68 and 72 kg/hl specific nature of this plant. Varieties analyzed were different in size (*Table 1*).

The yields obtained were determined by rainfall during autumn-winter period and during intensive growth-blooming period. Triticale had excess moisture requirements, the critical phase being during grain formation. In times of drought ears sterility occurs at the top of the ear. Early forms are more resistant to drought, but production potential is low.

In the 2007-2008 crop year, except December-February period, rainfall were well distributed throughout the entire growing season, which is reflected in higher yields obtained. In the next agricultural year was recorded an almost identical amount of rainfall agricultural as in the year 2007-2008, but the difference appears to better distribution of these precipitation on the triticale vegetation phases. In both agricultural years there was recorded an amount of

rainfall during the triticale growing period lower than the multiannual average. The year 2009-2010 was characterized as a rainy year, the total rainfall was unevenly distributed on the plant growing phases, but in the agricultural year 2010-2011 the rainfall on the plant growth stages were almost identical to the multiannual average and were evenly distributed. The last year of testing, 2011-2012, registered a negative deviation higher than the multiannual average, characterized as a dry year (*Fig. 3*).

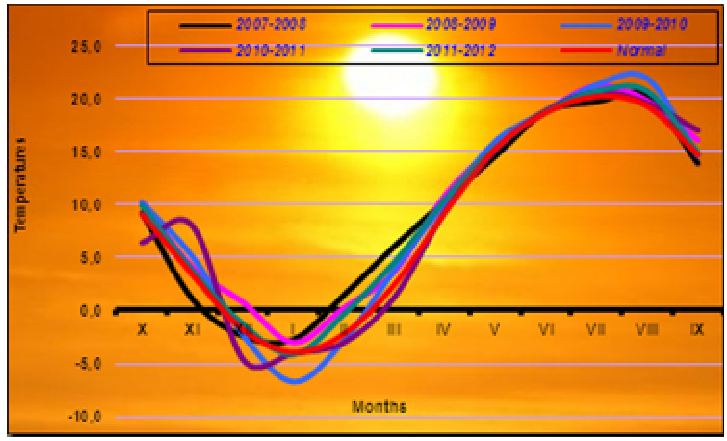

Figure 1 - Monthly temperatures recorded at A.R.D.S. Secuieni, Neamţ county (2007-2012)

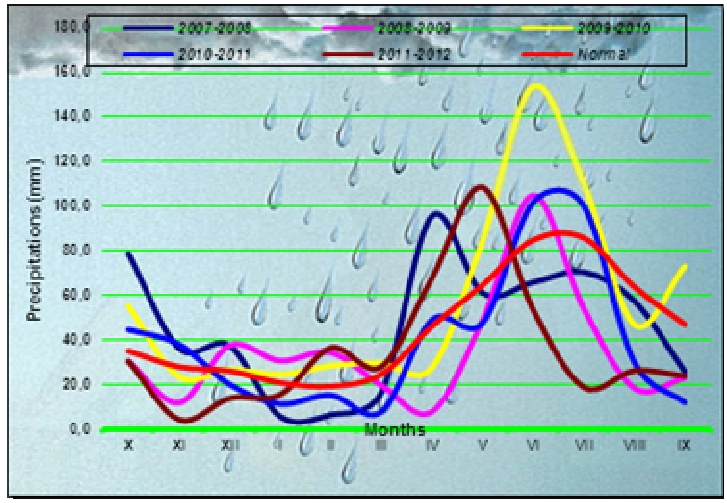

Figure 2 - Monthly rainfall recorded at A.R.D.S. Secuieni, Neamţ county (2007-2012)

Table 1 – Some characteristics of the studied varieties (2007-2012 average)

Variety	Plant size (cm)	No. ears/ m^2	Resistance in winter	Lodging resistance	Disease resistance	WTG (g)	HM (hl)
Plai	109	501	1	1	1	44	71
Titan	110	525	1	1	1	48	71
Stil	109	543	1	1	1	44	72
Gorun 1	104	545	1	1	1	48	70
Haiduc	108	535	1	1	1	47	68
Cascador F	89	515	1	1	1	45	69

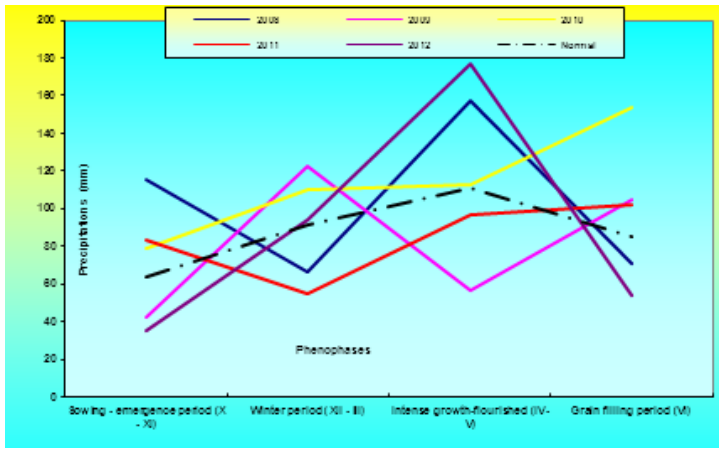

Figure 3 - The rainfall distribution on vegetation stages

Due to the fluctuations of the environmental factors, there was a wide variability in yield from one year to another, from 6087 kg/ha (Cascador, in 2008) to 9008 kg/ha (Haiduc, in 2011) (*Table 2*). The lowest yields were obtained in 2010, characterized as rainy, with rainfall totally unevenly distributed on the triticale vegetation stages. The highest yields were obtained in 2011, normal rainy year, in which the rainfall was evenly distributed throughout the entire growing season.

Triticale yields obtained in these years have been directly influenced by the amount of rainfall during sowing - rising, by the water reserve from winter and by the rainfall during grain filling. Yields lower than the average of all varieties, throughout the entire experimental period, were recorded at the varieties Cascador F, Gorun 1 and Titan (*Table 3*).

On average, over the five years of experimentation, yields ranged from 6984 kg/ha (Cascador F) to 8439 kg/ha (Haiduc). The yields stability was determined by the different

response of the varieties to very different climatic conditions during testing period. Thus, differences greater than 2000 kg/ha between the minimum and maximum yield of the same variety, in the five years of experimentation, there were recorded at the varieties Plai, Titan, Gorun 1 and Cascador F, and the smallest differences in yield, in various environmental conditions, were found at the Haiduc (1071 kg/ha) and Stil (1072 kg/ha) varieties. The average yield of the Haiduc variety was the highest, compared with the varieties analyzed (*Table 3*).

Table 2 - The yields of triticale varieties (2008-2012)

Variety	Yield obtained (kg/ha)				
	2008	2009	2010	2011	2012
Plai	8493***	8740**	7007	8847	6716^{ooo}
Titan	6640^{ooo}	7568	6628^{ooo}	8783	7491
Stil	8056***	8759**	7782***	8854	8149*
Gorun 1	6453^{ooo}	7034^{oo}	6235^{ooo}	8537	7914
Haiduc	8102***	8529**	7937***	9008	8618***
Cascador F	6087^{ooo}	6526^{ooo}	6674^{ooo}	8516	7117^{o}
Average	7305	7859	7044	8796	7668
DL 5%	73	441	133	316	439
DL 1%	104	627	189	450	624
DL 0,1%	151	908	273	651	904

Table 3 - Average, minimum and maximum yields and yield amplitude at triticale varieties and the variation coefficients (2008-2012)

Variety	Yield obtained (kg/ha)			Amplitude (kg/ha)	Variation coefficient
	Average	Maximum	Minimum		
Plai	7961	8847	6716	2131	11,4
Titan	7422^{o}	8783	6628	2155	10,6
Stil	8320***	8854	7782	1072	5,0
Gorun	7235^{oo}	8537	6235	2302	12,1
Haiduc	8439***	9008	7937	1071	4,6
Cascador	6984^{ooo}	8516	6087	2429	11,9
Average	7727	8796	6898	1898	-
DL 5%			280		
DL 1%			399		
DL 0,1%			577		

Very significant yield increases presented the Haiduc and Stil varieties, and minuses of yield, statistically assured, the varieties Cascador F, Gorun 1 and Titan.

If we analyze the variation coefficients of each variety experienced, it appears that still the two varieties, Haiduc and Stil, had a small variation yields (CV <10), which shows a great adaptability to

the climatic conditions of the area. The remaining varieties analyzed had a medium variation coefficient (<20), the largest variation was recorded at the Gorun variety yields (12.1). Large variations in yields (> 20) were not obtained in any variety analyzed, which shows that the triticale varieties analyzed responded well to the adverse environmental conditions during the experimental period (*Table 3*).

The varieties which showed a high adaptability to the climatic conditions of the area also gave the highest yields (Stil and Haiduc) (*Fig. 4*).

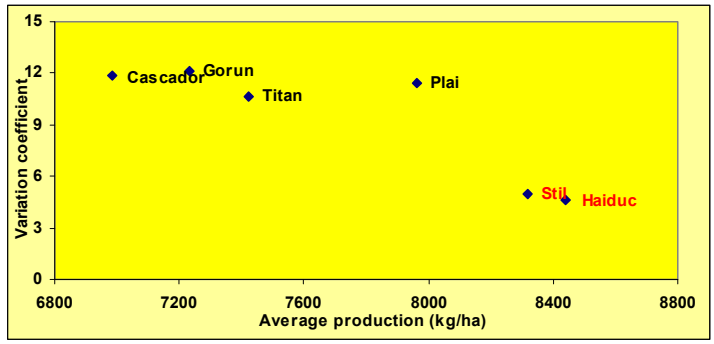

Figure 4 - The variation coefficients of the yield during the test period

Table 4 - The values of the variation coefficients for yield and the main productivity elements (C.V., %)

Variety	Productivity elements								Production	
	Ears/sqm		Grains/ear		Grain weight in ear		WTG			
	no.	CV%	no.	CV%	g	CV%	g	CV%	kg/ha	CV%
Plai	501	5,0	27,3	13,7	1,81	12,0	44	5,4	7961	11,4
Titan	525	10,4	28,2	13,1	1,80	11,0	48	4,4	7422	10,6
Stil	543	8,0	35,0	9,2	1,96	7,0	44	3,6	8320	5,0
Gorun	545	10,9	32,7	15,6	1,43	15,4	48	6,6	7235	12,1
Haiduc	535	5,7	30,5	6,2	1,78	4,7	47	4,1	8439	4,6
Cascador	515	10,0	24,9	11,0	1,60	9,6	45	4,4	6984	11,9

Varieties yields were influenced, directly, by the size of the elements of productivity. At Haiduc and Stil varieties, in a large number of ears/sqm (535 and 543) at a large number of grains/ear (30.5 and 35.0) and at a higher grain weight in ear (1.78 g and 1.96 g), the yields were high (8439 kg/ ha and 8320 kg/ha). The same can be said about the stability of production. At these two varieties, the productivity elements had variation coefficients <10%, leading to a very small variation of the yield (CV = 4.6% and 5.0%) (*Table 4*).

CONCLUSIONS

The highest yields were obtained in 2011, year normally as temperature and rainfall, and the lowest yields in 2010, year characterized as rainy.

It is recommended the cultivation of Haiduc and Stil varieties, that during the experimentation period achieved higher average yields (8439 kg/ha and 8320 kg/ha) of all varieties tested, with very small amplitudes (1071 kg/ha and 1072 kg/ha) .

All triticale varieties tested in the climatic conditions of A.R.D.S. Secuieni, Neamţ county, Romania, showed good resistance to winter, lodging and diseases.

Varieties tested have achieved good values of the mass of 1000 grains (44 g - 48 g), but low values of hectolitre mass, which represent a specific character for triticale variety (68 kg/hl -72 kg/hl).

The productivity elements of the six Romanian varieties tested were good, leading to the achievement of higher yields of 7000 kg/ha (except the Cascador variety).

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