BEHAVIOUR OF TRITICALE CULTIVARS IN THE YIELD TRIALS AT ARDS TURDA (2011 AND 2012)

I. RACZ[1,2], M. DUDA[1], S. I. BRĂILEANU[1], ROZALIA KADAR[2], V. MOLDOVAN[2]

[1]*University of Agricultural Science and Veterinary Medicine Cluj Napoca*
[2]*Agricultural Research and Development Station Turda*
Turda, str.Agriculturii, nr.27, Cluj county
E-mail: racz_ionut@yahoo.com

Abstract: *Triticale is the first man-made cereal grain crop species resulting from the hybridization of wheat (Triticum aestivum) with rye (Secale cereale), the name of which combines the scientific names of the two genera involved (Triticosecale or Triticale) . As a hybrid species, it combines rusticity from rye with productivity from wheat as well as other many attributes of both of its parents.Being a plant exclusively done by humans Triticale sp. inherited from parents specific agricultural skills but most important these herb valuable features incorporated into its genome in terms of resilience to adverse conditions. The most important components in triticale production are the number of grains / spike and grain weight / spike, the last being determined as a result of grain filling rate and the duration it was made.The aim of this study was to test the performance of the genotypes studied by analyzing the main elements of productivity and their behaviour under the influence of environmental factors and depending on agro-technical treatment used. The experiments were conducted over two years, 2010-2011 and 2011-2012, at Agricultural Research and Development Station from Turda. The biological material used, consist of 25 winter triticale genotypes from different sources. Yield and yield component values were different from year to year due to climatic conditions of each growing season.The trial was set in three replication arranged by quadratic balanced latice method with repeated basic scheme which allow us to use two levels of fertilization, respectively lower fertilization applied at plant emergence and additional fertilization at stem elongation stage. At maturity, before harvest plant height was measured. Also in order to determine the influence of additional fertilization level the yield components have been determined. So, were collected from each experimental plots 25 ears which were determined based on the main elements of productivity (number of grains per spike, grain weight per ear (g), one thousand grains weight (TKW), specific weight (Kg/hl), etc.)Based on the results obtained were established some relationships between the main components of production and their influence on other factors apply.*

Key words: *triticale, yield, grains per spike, grain weight; thousand-kernel weight;*

INTRODUCTION

Triticale (*Triticosecale Wittmack*) is the first man-made cereal grain crop species resulting from the hybridization of wheat (*Triticum aestivum*) with rye (*Secale cereale*), the name of which combines the scientific names of the two genera involved in its genome (*Triticosecale or Triticale*) . As a hybrid species, it combines rusticity from rye with productivity from wheat as well as other many attributes of both of its parents (Furman, 2004).

Being a plant exclusively done by humans Triticale sp. inherited from parents specific agricultural skills but most important these herb valuable features incorporated into its genome in terms of resilience to adverse conditions. The most important components in triticale production are the number of grains / spike and grain weight / spike (Kamaluddin and all.,2007), the last being determined as a result of grain filling rate and the duration it was made. Characters like plant height, ear length or number of grains / ear are positively correlated with grain yield (ZEĆEVIĆ & KNEŹEVIĆ, 1998).

MATERIALS AND METHODS

The experimental date from this paper is about adaptability of 24 winter triticale local varieties in two years and two level of fertilization on the local conditions at Turda. The experiments were conducted over two years, 2011 and 2012, at Agricultural Research and Development Station Turda, which are characterized with a high rainfall and temperatures favourable for winter triticale crop. The biologic material used in our study is quite varied, consisting of 24 winter triticale varieties and breeding lines of local origin.

Table 1

Origin of the winter triticale cultivars used in the yield trials at ARDS Turda

Country	Place of origin	Cultivars
Romania	Fundulea	Plai; TF2; Nedeea; Nera; Negoiu; Matraz; Migrator; Cascador F; Haiduc; Gorun 1; Stil; Titan; Oda; 02029T5-22; 03292T1-1; 02511T6-2; 00159T1-101; 95574T1-1020; 99574T1-131; 96137T8-420201; 02086T2-1; 02124T3-11; 02365T2-01; 02511T5-2.

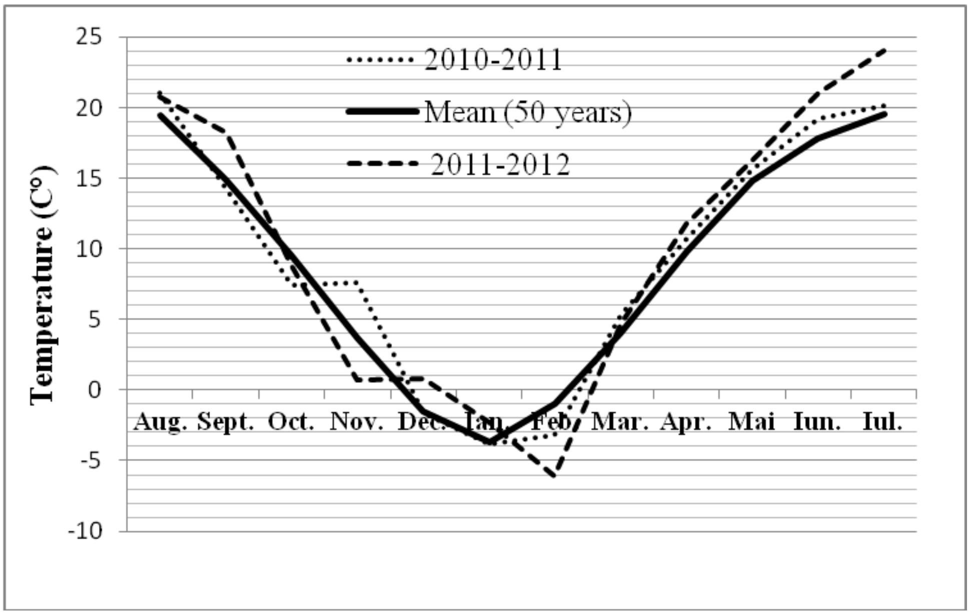

Figure 1.- Monthly temperatures for wheat in the years 2010- 2012 .
(Source: Meteorological station Turda)

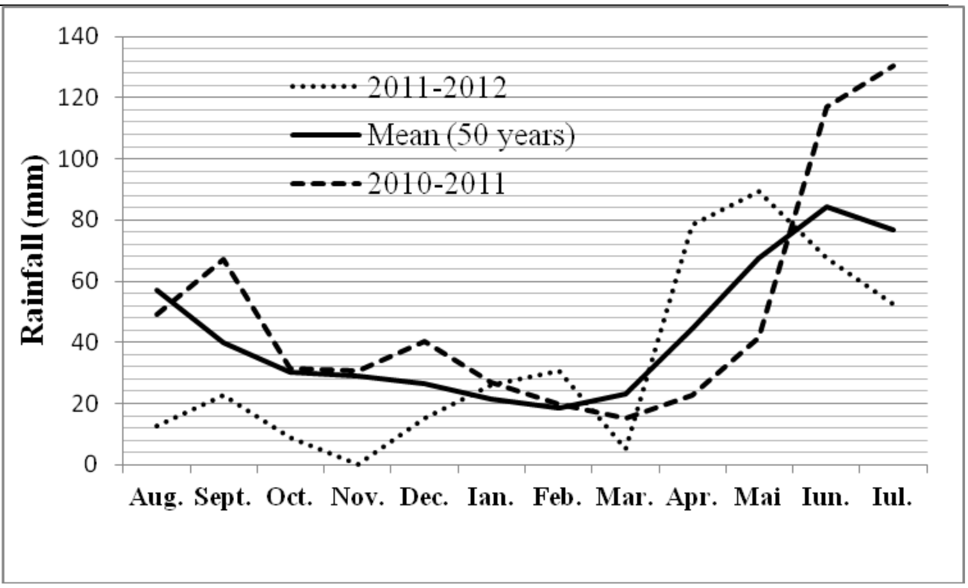

Figure 2- Monthly rainfall regime for wheat in the years 2010- 2012
(Source: Meteorological station Turda)

The two experimental years were different in terms environment conditions, especially regarding rainfall, which was much under multiannual mean, especially in the first part of the second experimental year, and during the grain filling period which have a negatively influence on final grain production and thus the main elements of productivity. Drought stress may cause a reduction in all the yield components, but particularly in the number of fertile spikes per unit area and in the number of grains per spike (GIUNTA et al., 1993; SIMANE et al., 1993; ABAYOMI and WRIGHT, 1999), while kernel weight is negatively influenced by high temperatures and drought during ripening (CHMIELEWSKI and KOHN, 2000).

The trials were conducted under quadratic lattice design with repeated the basic scheme. Each of both basic scheme consisting of 3 replications permitted to create two levels of fertilization. So, including the years as factors was possible to consider our experiment as an three factorial one (years- cultivars- fertilization).

The seeding rate was adjusted to 500 viable seeds per m^2. The seeding date was optimal to our area. The plot size was 5 m^2 (eight rows). Before harvesting from each plot were harvested 25 ears to determinate main productivity elements. Plant height was determinate at full ripening by means of graduated ruler. The density was determined as the number of spikes per m^2. The number of grains per spike was determined as the average spikelet number of 25 spikes randomly selected from the plots. The weight grains per spike were the result of dividing total weight of grains by number of spike. Thousand-kernel weight (TKW) was also determined in each plot. Plots were mechanically harvested at ripening and yield was expressed at 14% grain moisture content. _To test the ability to capitalize the fertilization, to experimental trials was applied two level of fertilization; one level NPK (50:50:0 Kg/ha) given to emergence plant and the other level before the anthesis phases N (50 kg/ha s.a.). The weed control were made in the spring, when the plants were in stem elongation stage, with a mixture between an herbicide (2,4

D +25 g/l iodosulfuron metil sodiu +10 g/l amidosulfuron + 250 g/l mefenpir dietil) and insecticid (alfa cipermetrin 100 g/l).

RESULTS AND DISCUSSION

In the table 2 it represent behavior of 24 triticale genotypes in the two experimental years and two level of fertilization regarding grain yield and the other characters studied.

Table 2

Yield and yield components for the triticale group at two years and two fertilization levels

	Basic fertilization	Additional fertilization	Average
Grain Yield (kg ha $^{-1}$)			
2010-2011	4490	5321	4906
2011-2012	4789	5840	5315
Grains per spike			
2010-2011	29.8	33.6	31.7
2011-2012	29.7	31.9	30.8
Grain weight per spike (g)			
2010-2011	2.22	2.24	2.23
2011-2012	2.37	2.42	2.40
Thousand-kernel weight (g)			
2010-2011	43.7	45.8	44.8
2011-2012	44.3	44.4	44.4
Plant height (cm)			
2010-2011	79.8	83.2	81.5
2011-2012	85.2	90.5	87.9
Number of spikes per m^2			
2010-2011	391.8	421.3	406.6
2011-2012	410.7	493.9	452.3

Analyzing the date from table, showed the small differences between yields, which means as although environmental conditions were quite different the triticale variety had the same behavior, capacity due to high adaptability of this species. So in 2011 the mean yield of 24 triticale varieties was 4906 kg ha^{-1} whereas in 2012 this was 5315 kg ha^{-1}.

Similar results were obtains by VOICA (2011) and NEFIR and TABĂRĂ (2012). Between the two levels of fertilization the differences was about 1000 kg ha^{-1} for additional fertilization. Regarding characters like number of grains per spike the differences from two years were also low, somewhat larger differences being recorded between the two levels of fertilization. Being direct related by number of grain per spike, and influenced by environmental conditions from grain filling period the weight grain per spike encountered higher values in the second experimental year due to climatic conditions from the grain filling period. Also from table 2 can be seen the small differences between grain weight per spice values (2.22 g/ear for basic fertilization and 2.24 g/ear for additional fertilization in 2011, at time what in 2012 grain weight per spike was between 2.37 g/ear and 2.42 g/ear for basic fertilization respectively additional fertilization). Reduced differences between the two years for TKW suggest that the natural conditions have low influence on this character which is mainly under genetic control (WANG, L. and all., 2012). About plant height in 2012 can be seen superiority to 2011 thanks to favourable environmental conditions especially good rainfall conditions which were over multiannual mean in stem elongation period. Thus the plant height values was 79.8 cm to basic fertilization and 83.2 cm to additional fertilization in 2011, at time what in 2012 they were 85.2 cm and 90.5 cm to basic fertilization respectively additional fertilization. Regarding number of spikes per square meter it was influenced by no rainfall from first part of vegetation period in 2012 and less rainfall from 2011 after winter dormancy.

In table 3, there are compared the grain yield and main its components. For each year it can be seen reduce differences from each to other. So the differences for grain yield between 2012 and 2011 were 8.34 %, for number of spike per m^2 11.24 % and for plant height 7.85 %. The other characters studied recorded little differences from year to year, as it can be seen from the table 3 data.

Table 3

Mean values of yield and yield components of winter triticale genotypes

	2010-2011		2011-2012		Difference	
	Average	Range	Average	Range	a-b	(a-b) /a x 100 (%)
Yield (kg. ha $^{-1}$)	4906	3600-5880	5315	4467-6244	-409	-8.34
Number of grains per spike	31.7	25.5-39.8	30.8	27.1-34.8	0.9	2.84
Grain weight per spike (g)	2.23	1.81-3.07	2.40	2.02-2.83	-0.17	-7.62
Thousand-kernel weight (g)	44.8	39.3-49.6	44.4	40.2-49.6	0.4	0.89
Number of spikes per m^2	406.6	324-464	452.3	354.7-530.7	-45.7	-11.24
Plant height (cm)	81.5	67-108.3	87.9	71-117.3	-6.4	-7.85

Analyses of variance (ANOVA) have allowed the influence of factors years, variety and fertilization on production and the interaction between them (Table 4). Thus, testing the significance giving by F- test values, shows the existence of significant differences within the graduation of each factor and interactions of certain factors.

Table 4

ANOVA for the experiment Year × Genotypes × Fertilization in triticale at ARDS Turda

Source of variation	Sum of square (SS)	Degree of freedom (DF)	Mean square (MS) (s^2)	Test F
A (year)	2083.23	1	2083.23	9.929**
B (genotypes)	2307.73	24	96.16	9.321**
A x B	2762.61	24	115.11	11.158**
C (fertilization)	6671.55	1	6671.55	270.396**
A x C	51.29	1	51.29	2.079
B x C	274.06	24	11.42	0.463
A x B x C	735.38	24	30.64	1.242
Error A	419.63	2	209.81	
Error B	990.39	96	10.317	
Error C	2467.33	100	24.67	
T o t a l	20741.35	299		

Based on analyzes of coefficient of determination (r^2) from the linear regression equation between yield and yield components as well as other phenological traits from 2011 revealed the variation of grain yield have largest influence by the variability of number of grain per spike (30.3 %), grain weight per spike (49.7 %) and number of spikes per square meter (35.7 %) at basic fertilization (table 5). To additional fertilization the most influence on grain yield had number of grain per spike whit 30.1 %, grain weight per spike (38 %), number of spikes per square meter (20.1 %) and plant height (21.9 %).

Table 5

Linear regression equations for the relationship between yield (Y) as dependent variable and yield components and phenological traits as independent variables (X), in 2011

Independent variable (x)	Regression coefficient (b)		Intercept (a)		Coefficient determination (r^2)	
	Basic. f.	Add. f.	Basic. f.	Add. f.	Basic. f.	Add. f.
Number of grains per spike	116.9	90.69	921.8	2219.3	0.303	0.301
Grain weight per spike (g)	4432.1	3058.1	-1201.5	1052.1	0.497	0.38
Thousand-kernel weight (g)	-0.0372	-0.0028	53.55	56.51	0.037	0.0703
Number of spikes per m^2	10.23	7.90	408.4	1916.4	0.357	0.201
Plant height (cm)	-0.0027	-0.0148	91.82	161.75	0.0093	0.219

Table 6 shows the parameters of linear regression, and the values of coefficient of determination (r^2). In 2012, the main elements of productivity which have a high influence on variation of production were number of spikes per m^2 with 61.2 % and number of grain per spike with 11.6 % at basic fertilization, while to additional fertilization the main important characters which have influenced was number of grain per spike (23.17 %) and plant height (16.87 %).

Table 6

Linear regression equations for the relationship between yield (Y) as dependent variable and yield components and phenological traits as independent variables (X), in 2012

Independent variable (x)	Regression coefficient (b)		Intercept (a)		Coefficient determination (r^2)	
	Basic. f.	Add. f.	Basic. f.	Add. f.	Basic. f.	Add. f.
Number of grains per spike	-0.0029	0.0029	43.33	14.751	0.1161	0.2317
Grain weight per spike (g)	-0.5	7.28	1.5213	1.137	0.0324	0.0289
Thousand-kernel weight (g)	0.0028	-0.0027	30.79	58.75	0.0517	0.0866
Number of spikes per m^2	5.77	0.018	2426.1	388.9	0.612	0.0411
Plant height (cm)	-0.0011	0.0177	90.40	-12.93	0.0007	0.1687

CONCLUSION

The results express that in the 2011 and 2012 at experimental field of Turda have been obtained good results in the production of triticale.

The experimental factors taken into this study (variety, year and fertilization) had strong influences on triticale grain production.

The interaction between factors year, variety and fertilization have also strongly influences on production and its components.

Being a plant which a large adaptability the triticale has a high capacity to buffer against unfavorable natural conditions and give good production under large array of environments.

BIBLIOGRAPHY

1. ABAYOMI,Y., WRIGHT, D., (1999), Effects of water stress on growth and yield of spring wheat (Triticum aestivum L.) cultivars, Trop.Agric. 76, 120–125.
2. CHMIELEWSKI, F., KOHN, W., (2000), Impact of weather on yield components of winter rye over 30 years, Agric. Forest Meteorol. 102, 253–261.
3. FURMAN, B.J., (2004), Triticale, In Encyclopedia of Grain Sience, p. 298 - 303, ISBN 0-12-765490-9.
4. GIUNTA, F., MOTZO, R., DEIDDA, M., 1993, Effect of drought on yield and yield components of durum wheat and triticale in a Mediterranean environment, Field Crops Res. 33, 399–409.
5. KAMALUDDIN; RISHI M. SINGH; LAL C. PRASAD; MALIK Z. ABDIN, ARUN K. JOSHI, (2007), Combining ability analysis for grain filling duration and yield traits in spring wheat (*Triticum aestivum* L. em. Thell.), Genet. Mol. Biol. vol.30 no.2 São Paulo Mar.
6. MARIA VOICA, (2011), Behavior of some triticale cultivars in hilly region of Muntenia, Analele. I.N.C.D.A. Fundulea, vol. LXXIX, nr. l.
7. PAVEL NEFIR AND VALERIU TABĂRĂ, (2012), *Behavior of some varieties of triticale (Triticosecale Wittmack) in the climatic conditions of Caraş-Severin Răcăşdia*, Buletinul AGIR nr. 3/2012 iulie-septembrie.
8. SIMANE, B., STRUIK, P.C., NACHIT, M., PEACOCK, J.M., (1993), Ontogenic analysis of yield components and yield stability of durum wheat in water-limited environments, Euphytica 71, 211–219.
9. WANG, L., GE, H., HAO, C., DONG, Y., ZHANG, X., (2012), Identifying Loci Influencing 1,000-Kernel Weight in Wheat by Microsatellite Screening for Evidence of Selection during Breeding. PLoS ONE 7(2): e29432. doi:10.1371/journal.pone.0029432
10. ZEČEVIĆ VESELINKA, KNEŽEVIĆ, D., (1998), Variability of grain weight per spike in wheat. Proc. of Int. Symp., Breeding of Small Grains', Kragujevac, Serbia 1: 139-143.