BEHAVIOUR OF SOME WINTER WHEAT CULTIVARS IN WESTERN PART OF ROMANIA

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ABSTRACT

The reaction of winter wheat cultivars in three highly different climatical years, especially regarding the temperature and rainfall, suggested the necessity of stability analyses of their yield. For cultivar recommendation in Criº Plain, we evaluated the cultivar ecological plasticity by ecological valences method (Wricke, 1965). The best yield stability had Alex, Flamura 85 and Arieºan cultivars. The highest yields have been achieved by Ardeal, Arieºan and Alex cultivars. They have a good yielding ability related to intermediate of *Septoria* resistance and pre-harvest sprouting resistance, too. The relationship between the analysed traits showed that the plant height, precocity, TKW and test weight are strongly controlled by genetical factors. The majority of relationships between the analysed traits are better described by quadratic regression than linear models.

Key words: ecovalence, wheat, yields stability.

INTRODUCTION

The main objective of agricultural acti-vity is the obtainment of great and stable yields every year, so that, the large and incalculable variations of environment does not strongly affect the yield level. Under optimum conditions, the yield stability is more important than higher productivity especially in sustainable farming (Rosielle and Hamblin, 1981).

The strong interactions between genotype and environment contribute in the breeding process to the releasing of cultivars with specific adaptation to both favourable and unfavourable climatic conditions (Tesemma et al., 1998). The interactions are complex because of very different environmental factors (soil, climate, locality) as well as of cultivar traits and features. Thus, the yield stability is given by the sum of cultivar resistances to unfavourable environmental conditions (frost, drought, diseases) as well as by the trait interactions with compensatory effect (Timariu, 1975).

In the last years, the tendency of large fluctuations from one year to another as regards the rainfall and temperatures has been emphasized. During 1997–2000, in Romania, fluctuations from one extremely rainy year (1998) to an extremely droughty one (2000), were registered.

As part of the wheat breeding programs in Romania, besides the yield level, the agronomical traits which influence the yields stability are studied, too (Saulescu et al., 1995).

The present paper emphasizes the Romanian wheat cultivars with the best yield stabi-lity during the last three years, in the North-western part of Romania and analyses the interdependence of cultivar morphophysiological traits, contributing to a better understanding of their reaction to the stress factors.

MATERIALS AND METHODS

During the last three years (1998–2000), the behaviour of 11 Romanian wheat cultivars besides the former cultivar Bezostaia, was studied. These cultivars were tested every year as regards the yield and morphophysiological traits (plant and spike density, heading and maturity time, plant height, length of grain filling period, TKW, test weight, grain number and weight of a spike) and resistance to pre-harvest sprouting in 1998 and to *Septoria tritici* attack in 1998 and 1999.

The climatic conditions of agricultural year 1997-1998 were normal, excepting the abundant rainfall during July, which encouraged the pre-harvest sprouting and late harvesting. The excessively rainy autumn of the agricultural year 1998-1999, lead to the late sowing but the very high temperatures registered at the end of the vegetation period had as efffect the grain compelled maturation. The climatic conditions of the agricultural year 1999-2000 had strong repercussions on wheat cultivar assortment, due to a very rainy au-

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tumn followed in spring by drought, especially during April-May, associated with very high temperatures – on an average, 2°C over the multiannual mean – and a very low humidity, respectively. The statistical processing of the yield results was made by ANOVA, F test and limit differences corresponding with the latin rectangle method for every year. Also, the yield data during the three years of experimentation were statistically processed in accordance with the bifactorial model, as an experiment with 12 cultivars in three different years, at the same locality.

In order to evaluate the cultivars adaptability, the ecological valences method proposed by Wricke (1965) and presented by Coles (1971), in accordance with the testing of those 12 cultivars during three years at the same locality, was used.

The analysis of the relationships between traits was performed by the simple correlations method.

RESULTS AND DISCUSSION

The ANOVA and F test emphasized the distinctly significant differences between variants (cultivars), in each of the three years of experimentation.

In the agricultural year 1997–1998, the greatest wheat yield was achieved by Delia cultivar (4,727 kg/ha), exceeding the control with 29.5%, 1,077 kg/ha respectively (Table 1). Besides this, Dropia, Lovrin 41 and Ardeal cultivars achieved distinctly significant yield gains greater than Fundulea 4 cultivar. Also, the Alex and Apullum cultivars significantly exceeded the control. The Lovrin 34 and Rapid cultivars had inferior yield levels as compared with the former cultivar Bezostaia.

The level of yields obtained in 1999 is lower, excepting the Ardeal cultivar which achieved 4,000 kg/ha. These relatively modest yields are largely explained by the late sowing because of the abundant rainfall during September – October.

In 1999, three cultivars very significantly exceeded the control (Ardeal, Ariesan and Alex) and two, distinctly significant (Flamura 85 and Rapid).

On the contrary, as regards the yield, Lovrin 34 cultivar was very significantly lower than Fundulea 4, and Apulum cultivar – significantly, achieving only 3,010 kg/ha.

In 2000 year, the greatest yield was achieved by the Ariesan cultivar (4,413 kg/ha) followed by Lovrin 34 and Rapid cultivars. Under climatic conditions of this year, especially droughty and with very high temperatures, the advantage of all cultivars was the precocity. Because of the climatic conditions, the yield difference between the first and the last cultivar was of only 920 kg/ha, proof of the fact that all cultivars were strongly affected by drought and heat. The most productive cultivar Ariesan, exceeded the control with only 17.3%.

It can be ascertained that the Ariesan cultivar was very significantly more productive than Fun-

Table 1. Wheat cultivars yields obtained at Oradea, in 1998–2000

No	Cultivars	1998		1999		2000	
		Yield kg/ha	Signif. diff.	Yield kg/ha	Signif. diff.	Yield kg/ha	Signif. diff.
1	Ardeal	4,307	**	4,000	***	4,160	**
2	Ariesan	4,000		3,950	***	4,413	***
3	Alex	4,167	*	3,743	***	4,100	*
4	Delia	4,727	***	3,443		3,797	
5	Lovrin 41	4,323	**	3,427		4,110	**
6	Flamura 85	3,987		3,667	**	3,953	
7	Dropia	4,643	**	3,187		3,493	
8	Rapid	3,197		3,607	**	4,200	**
9	Fundulea 4 (control)	3,650	-	3,553	-	3,763	-
10	Apullum	4,133	*	3,010	°	3,740	
11	Lovrin 34	3,293		2,730	°°°	4,223	**
12	Bezostaia	3,397		3,287		3,700	
LSD: 5%,	kg/ha	457		207		299	
1%,	kg/ha	621		281		406	
0.1%,	kg/ha	842		381		550	

dulea 4 and Lovrin 34, Rapid, Ardeal and Lovrin 41 were distinctly significant more valuable. Also, The Alex cultivar was significantly superior to the control.

From the above mentioned data, there are great differences between the results of the three years of experimentation as regards the yield level as well as cultivar classification.

It is necessary the analysis of the mean behaviour of the cultivars during the testing, because recommendations regarding the choosing of cultivars for each year with its specific climatic conditions, cannot be done. As the experimental years are special from the climatic viewpoint, so much, the synthetic analysis of results is more useful and recommended.

Table 2 presents the ANOVA for yields during 1998, 1999 and 2000.

Taking into account the experimental error, the F factor calculus led to the distinctly significant value for the differences between variants as well as for the variants x years interaction, meaning that the cultivars had different behaviour from one year to another.

In the case of variance of cultivars x years interaction, the F factor value is insignificant. These three years were very different and deviated from the normality, so that, it is difficult to prognosticate the future behaviour of cultivars at the same locality.

The cultivar classification regarding the yield level, when the yield average achieved during the three years was taken into account, is different vs. each year. Thus, the Ardeal cultivar had the best average behaviour, achieving 4,156 kg/ha, 113.7% respectively, vs. Fundulea 4 control, with an yield gain of 500 kg/ha. The Ariesan and Alex cultivars proved to be very productive too, exceeding, on an average, 4,000 kg/ha during the three years (Table 3).

Analysing the significance of differences vs. Fundulea 4 control, it has been ascertained that this cultivar was very significantly exceeded by Ardeal, Ariesan, Alex and Delia cultivars, distinctly significant by Lovrin 41 cultivar and significantly by Flamura 85 cultivar. Apullum and Lovrin 34 cultivars achieved yields at the level of the former cultivar Bezostaia. As a result, the Lovrin 34 cultivar was gradually eliminated and Apullum has not been extended into crop area.

Table 2. ANOVA and F test during the three years of experimentation

Source of variation	Squares sum (SS)	Free degrees (FD)	Variance (s^2)	F test vs. (s^2_E)	F test vs. (s^2_{VxA})
TOTAL	241452	101			
Blocks	691	6			
Years	62766	2			
Variants	59885	11	5444.1	13.96** (1.95-2.56)	1.26 (2.26-3.19)
Variants x years	94706	22	4304.8	11.04** (1.72-2.16)	
Error	23404	60	390.1		

Table 3. Wheat yields obtained at Oradea during the three years as compared with Fundulea 4 control

Cultivars	Yield (kg/ha)	Relative yield (%)	Diff. (kg/ha)	Diff. signif. vs.: error	Diff. signif. vs.: interaction
Ardeal	4,156	113.7	+500	***	
Ariesan	4,121	112.7	+465	***	
Alex	4,003	109.5	+347	***	
Delia	3,989	109.1	+333	***	
Lovrin 41	3,953	108.1	+297	**	
Flamura 85	3,869	105.8	+213	*	
Dropia	3,774	103.2	+118		
Rapid	3,668	100.3	+12		
Fundulea 4 (control)	3,656	100.0	0	–	–
Apullum	3,628	99.2	-28		
Bezostaia	3,461	94.7	-195	o	
Lovrin 34	3,416	93.4	-240	o	
LSD: 5%, kg/ha				186	640
1%, kg/ha				248	871
0.1%, kg/ha				322	1171

On the basis of differences analysis vs. years x cultivars interaction, it has been ascertained that the cultivars had a relatively stable behaviour from one year to another, although the years were very different.

Analysing the differences significance vs. all cultivar average in all years, the yield le-vels were established as follows: very significant – Ardeal cultivar, distinctly significant – Ariesan cultivar and significantly superior – Alex cultivar.

On the contrary, the Bezostaia and Lovrin 34 cultivars proved to be very significantly lower productive vs. the experiment average (Table 4).

Because of high values of the limit differences, there were not registered significant values vs. years x cultivars interaction. In the case of the experiment repetition during the next years with the same set of cultivars, the same locality and under the same agrotechnical conditions, it cannot be asserted, for certain, that the Ardeal cultivar will achieve significant yield gains vs. the experimental average.

In order to assess the cultivars adaptation ability to the different climatic conditions of years, their ecological valences (ecovalences) were calculated.

The analysis of the cultivar ecovalence variances, on the basis of F test (Table 5), vs. both control cultivar (Fundulea 4) and cultivar with the highest ecovalence variance (Dropia), emphasized

Table 4. Wheat yields obtained at Oradea during the three years as compared with the experiment average

Cultivar	Yield (kg/ha)	Relative yield (%)	Diff. (kg/ha)	Diff. signif. vs.:	
				error	interaction
Ardeal	4,156	109.1	+348	***	
Ariesan	4,121	108.2	+313	**	
Alex	4,003	105.1	+195	*	
Delia	3,989	104.7	+181		
Lovrin 41	3,953	103.8	+145		
Flamura 85	3,869	101.6	+61		
Experiment average	3,808	100.0	0.0	–	–
Dropia	3,774	99.1	-34		
Rapid	3,668	96.3	-140		
Fundulea 4	3,656	96.0	-152		
Apullum	3,628	95.3	-180		
Bezostaia	3,461	90.9	-347	ooo	
Lovrin 34	3,416	89.7	-392	ooo	
		LSD: 5%, kg/ha	186	640	
		1%, kg/ha	248	871	
		0.1%, kg/ha	322	1171	

Table 5. ANOVA cultivar ecovalences

Cultivar	Ecovalence value (W_i)	Ecovalence variance (w_i)	F test	Signif.	F test	Signif.
			vs. control		vs. maximum w_i	
Flamura 85	28950.7	14475.3	3.26		25.40	*
Fundulea 4 (control)	94465.0	47232.5	–	–	7.78	
Lovrin 34	624972.0	12486.0	0.15		1.18	
Lovrin 41	71383.2	35691.6	1.32		10.30	
Ariesan	134730.2	67365.1	0.70		5.46	
Rapid	635444.2	317722.1	0.15		1.16	
Dropia (max. w_i)	735389.1	367694.5	0.13		–	–
Delia	481866.4	240933.2	0.20		1.53	
Alex	10986.8	5493.4	8.60		66.93	*
Apullum	186636.2	93318.1	0.51		3.90	
Ardeal	59943.8	29971.9	1.58		12.27	
Bezostaia	92010.8	466005.4	1.03		7.99	

y 5% = 19.00; y 1% = 99.00; FD = 2.

the fact that the Alex and Flamura 85 cultivars have the best ecological plasticity. A good ecological plasticity have, also, the Ardeal and Lovrin 41 cultivars. The ecovalence significances could be positive, if many years might be analysed.

The lowest adaptation ability presents the Dropia, Rapid and Lovrin 34 cultivars, which had the largest fluctuation of yield values from one year to another.

A comparative study between the classification order depending on both obtained mean yield and ecological plasticity (ecovalence), shows that there is not a relationship between them (Table 6).The yield stability, as expression of ecological plasticity, is entirely independent of the yield ability.

Table 6. Classification order of wheat cultivars depending on both yield ability and ecovalence value

Cultivars	Classification order depending on:	
	yield	ecovalence
Ardeal	1	3
Ariesan	2	7
Alex	3	1
Delia	4	9
Lovrin 41	5	4
Flamura 85	6	2
Dropia	7	12
Rapid	8	11
Fundulea 4 (control)	9	6
Apullum	10	8
Bezostaia	11	5
Lovrin 34	12	10

Coles (1971) arrived at the same conclusions, in the case of spring wheat. This matter is very important because means that there is not a contradiction between the yielding potential and cultivars plasticity, being possible the obtainment of the yielding and stable cultivars like Ardeal and Alex.

The yield stability is the result of cultivar physiological traits sum, especially of those which can be mostly affected by the climatic variations.

In our case, these traits were: resistance to pre-harvest sprouting, to some diseases attack (septoriosis), or to drought.

Under climatic conditions of 1998 year, in which in July, 214 mm rainfall were registered, the harvest time was later with two weeks, leading to the pre-harvest sprouting appearance.The most affected cultivars were: Fundulea 4 (53%), Delia (48%) and Lovrin 41 (36%). The cultivars with the smallest percent of sprouted grains were: Ariesan (2%), Alex (3%), Bezostaia (6%), Rapid (8%) and Apullum (9%). The detailed results regarding this aspect were presented in a previous paper (Bunta, 1999).

Among foliar diseases, only *Septoria* leaf-spot manifested an enough great intensity. The Delia and Dropia cultivars were less affected by *Septoria* leaf-spot while Bezostaia, Rapid and Flamura 85 were the most affected cultivars. In 1999, the rainy spring encouraged again the *Septoria* leaf-spot attack, the most affected cultivars being Flamura 85, Lovrin 34, Fundulea 4 and Bezostaia and the most resisting - Ardeal and Apullum. On the other hand, 2000 year being extremely drought, the foliar diseases did not appear.

In order to emphasize the interdependence of morphophysiological factors and their contribution to the cultivars yield stability, the method of simple correlations between these traits was used. In the case when the traits from all experimental years have been taken into account, there was a greater number of significant correlations (Table 7).

At a high plant density/m^2, the spike number/m^2 and test weight were bigger. The cultivars with a higher plant density were the early ones, which had a shorter grain filling period, a smaller grain number and grain weight.

In the case of the late cultivars, the plant height and the test weight were more reduced. On the other hand, these cultivars achieved their grain yield especially by a bigger grain number and weight per spike.

As a result of an early heading of cultivars, the TKW and TW were bigger but the grain number and weight per spike – smaller.

The cultivars with a longer grain filling period had a more decreased TW, but a bigger grain number and weight in each spike.

Although the cultivars with a longer grain filling period are considered to be more productive, under concrete conditions of the three experimental years a reverse situation was registered, the hydric and thermic stress having a decisive role.

The increasing of field density was associated with a greater TW value and a smaller grain number and weight.

was significantly emphasized as regards the plant height, TKW and test weight, but especially the cultivars precocity, un-

Table 7. Correlations between traits during the three years of experimentation (1998, 1999 and 2000)

Correlated trait	Height (cm)	Heading time	GFP (days)	Spike density	TKW (g)	TW (kg/hl)	Grain no/spike	Grain weight/ spike	Yield (kg/ha)
Plant density	–	-0.749°°	-0.694°°	+0.540°°	+0.105	0.941**	-0.786°°	-0.715°°	+0.062
Height	0.417°	+0.515**	+0.133	-0.403°	-0.179	-0.524°°	+0.547**	+0.496**	+0.163
Heading time	–	–	+0.271	-0.282	-0.517°°	-0.802°°	+0.704**	+0.473**	-0.066
Grain filling period			–	-0.276	-0.030	-0.654°°	+0.392*	+0.396*	-0.374°
Spike density				–	-0.265	+541**	-0.74600	-0.833°°	-0.212
TKW					–	+212	-0.182	+0.216	+0.342*
Test weight						–	-0.83500	-0.734°°	+0.042
Grain number/spike							–	+0.912**	+0.195
Grain weight/spike								–	+0.290

N = 36; y 5% = 0.33; y 1% = 0.43.
GFP= Grain filling period (day number from flowering to technical maturity)

A natural relationship is between TKW and yield, in the sense that the cultivars which achieved a better grain filling, were more productive.

Test weight was conversely proportional with grain number as well as their size, between the last traits being a very strong positive correlation.

The relationships established between the cultivar traits are very complex, the grain yield having a certain stability as a result of their interactions.

The correlations between the *Septoria* leaf-spot attack and the other traits are presented in a separate table because the disease appeared only in 1998 and 1999 (Table 8). Generally, the most affected cultivars by *Septoria* leaf-spot had a reduced height and were earlier cultivars with a higher spike density. Although these cultivars were more affected by this disease, they had a bigger test weight but a smaller grain number and weight. The *Septoria* leaf-spot attack had a strong negative influence on cultivars yield, decisively determining their level.

In order to establish a comparison between the experimental years, the correlations between traits in couple of years, were performed (Table 9).

The most similar reaction of the cultivar traits were noticed in 1998 and 1999, closer years from the climatic viewpoint. A similar cultivars reaction derlined either by heading time or technical maturity time.

The 1998 and 2000 years, being very different as regards the climatic evolution, the cultivars had similar behaviour only as regards the traits with high heritability: plant height, precocity and TKW.

An aproximately similar reaction had the cultivars during 1999 and 2000, in which, the correlations between test weight were significant while those between TKW values, were not.

The most stable traits of the tested cultivars were height and precocity followed by TKW and test weight. On the other hand, the plant and spike density, diseases attack as well as the grain number and weight per spike are more dependent on the climatic factors fluctuation from one year to another.

We can appreciate that for the cultivars establishment on a certain area, besides the climatic factors, the cultivar traits such as height, precocity, TKW and test weight should be taken into consideration. The other traits are easier to influence by certain controllable agrotechnical factors.

The wheat ecological plasticity differs very much from one cultivar to another. Subsequent research to quantify the climatic factors influence on each trait as well as the cultivars behaviour in the central area of Cris Plain, in years with normal climatic evolution too, are necessary.

Table 8. Correlations between *Septoria* leaf-spot attack and some morphophysiological traits, during experimentation (1998–1999)

Correlated traits	Plant density	Height (cm)	Heading time	GFP (days)	Spike density	TKW (g)	TW (kg/hl)	Grain no/spike	Grain weight/ spike	Yield (kg/ha)
Septoria leaf-spot	-0.228	-0.567°°	-0.429°	+0.112	+0.704***	-0.341	+0.737**	-0.826°°	-0.791°°	-0.668°°

Table 9. Trait correlations between the experimental years

Traits	Correlations between years:		
	1998–1999	1998–2000	1999–2000
Plant density	+0.103	-0.057	-0.227
Height	+0.774**	+0.887**	+0.865**
Heading time	+0.917**	+0.929**	+0.796**
Technical maturity time	+0.806**	+0.587*	+0.627*
Septoria leaf-spot	+0.440	–	–
Spike density	+0.378	-0.254	+0.045
TKW	+0.746**	+0.752**	+0.518
Test weight	+0.849**	+0.550	+0.650*
Grain number/spike	+0.478	+0.322	+0.391
Grain weight/spike	+0.196	+0.132	+0.181
Yield/ha	+0.204	-0.312	+0.407

N = 12; y 5% = 0.58; y 1% = 0.71

CONCLUSIONS

On an average, during the three years, the Ardeal, Ariesan and Alex cultivars proved to be the most productive. The best yield stability had Alex, Flamura 85 and Ardeal cultivars, while Dropia, Rapid and Bezostaia cultivars were the most influenced by the climatic fluctuation of the years.

The Ariesan, Alex, Bezostaia, Rapid and Apullum cultivars were the most resisting to the pre-harvest sprouting, while Fundulea 4, Delia and Lovrin 41 were the most sensitive ones.

The Ardeal, Apullum and Ariesan cultivars are the most resisting to *Septoria* leaf-spot attack, the main wheat disease from the North-western part of Romania, while Bezostaia, Flamura 85 and Lovrin 41 are the most sensitive ones.

The most dependent traits on cultivar are the height, precocity, TKW and test weight, while the most dependent traits on environmental factors are the plant and spike density, reaction to diseases attack, number and weight grain per spike.

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Table 1. Reproduction ability of the *E. integriceps* recent generations, as compared with multiannual average (1970-2000) and with the specific years: favourable (1986) and unfavourable (1989).

Natural generation of *E. integriceps*	Prolificacy (egg/female)		
	under field conditions	under controlled conditions	
		average	maxi-mum/female
1970-2000	40.2	57.9	311
1986	56.3	71.3	298
1989	18.8	27.1	87
1996	47.1	69.9	302
1997	46.6	68.6	197
1998	37.5	53.8	209
1999	38.8	54.5	219
2000	39.3	55.7	208

Table 2. Prolificacy level of some *E. integriceps* populations (fertile females), from generations with different fat body levels, collected from

the field, at the beginning of migration and studied under controlled conditions.

Fat body	Generation	Prolificacy (egg/female)	
		aver-age	maxi-mum
23.4	1989-1990	32.1	97
22.5	1972-1973	33.4	127
26.5	1971-1972	46.4	148
27.9	1977-1978	67.5	186
28.0	1984-1985	83.6	210
29.7	1985-1986	95.3	234
29.8	1994-1995	104.7	246

Table 3. Level and stages of fat body diminution at *E. integriceps* (multigeneration average).

Stages	Fat body level		Diminution	
	limits	average	limits	average
Diapause beginning	33.03-37.58	35.69	0	0
End of dia-pause	21.97-27.64	25.43	24.57-36.33	27.39
End of ovi-position	8.12-10.39	8.78	66.50-78.69	74.43

Table 4. Mortality registered at the *Eurygaster integriceps* populations, during diapause in different generations, from Romanian area

E. integriceps natural popula-tion	Mortality (%)	
	Limits in coun-ties	Total area (mean)
2000-2001	4.6-35.7	8.7
1995-1996	3.7-36.4	10.2
2001-2002	5.1-32.3	12.7
1985-1988	3.8-41.2	14.8
1999-2000	4.8-97.6	24.5
1973-1974	11.6-85.0	39.5
1988-1989	17.5-68.4	48.2

Table 5. Fat body value at *Eurygaster integriceps* populations, established on female groups, distributed in weight classes, at the beginning of diapause (multigeneration average).

Weight (mg)	% from the total of population	Fat body (%)

	limits	average	limits	average
below 0.110	3.7-7.7	5.6	26.2-26.6	26.4
0.111-0.118	7.6-23.1	13.3	26.5-28.8	28.7
0.119-0.126	15.9-24.7	19.7	32.8-33.5	33.6
0.127-0.134	32.5-34.8	33.7	34.9-36.4	35.4
over 0.145	22.4-30.8	28.6	35.7-39.8	38.7

Table 6. Fat body value at *Eurygaster integriceps* populations, established on male groups, distributed in weight classes, at the beginning of diapause (multigeneration average).

Weight (mg)	% from the total of population		Fat body (%)	
	limits	aver-age	limits	aver-age
below 0.105	7.0-19.7	12.3	25.3-26.7	26.2
0.106-0.113	16.8-19.9	17.3	27.2-28.5	27.7
0.114-0.121	20.3-29.5	23.7	29.4-33.8	31.5
0.122-0.129	19.2-32.7	28.5	31.2-35.5	32.6
over 0.130	15.5-23.9	19.4	31.4-36.6	33.8

Table 7. Mortality (%) registered at *Eurygaster integriceps* female populations, depending on the fat body (multigeneration average).

Fat body (%)	Mortality (%)			
	During August-October		During November-March	
	limits	average	limits	average
26.4	17-22	20.4	59-64	61.3
28.7	13-15	12.9	43-54	47.6
33.6	9-17	12.5	41-52	46.2
35.4	4-11	6.6	29-34	33.6
38.7	4-7	5.8	26-35	30.9

Table 8. Mortality (%) registered at *Eurygaster integriceps* male populations, depending on the fat body (multigeneration average).

Fat body (%)	Mortality (%)			
	During August-October		During November-March	
	limits	average	limits	average
26.2	22-31	22.6	62-71	67.1
27.7	11-24	20.4	53-62	57.4
31.5	12-19	14.3	39-47	44.0
32.6	9-18	12.7	30-44	37.6
33.8	5-14	9.1	24-45	32.3

Table 9. Sterility and prolificacy registered at the *Eurygaster integriceps* populations, depending on the fat body (multigeneration average).

Fat body (%)	Females sterility (%)		Mean prolificacy (egg/female)		
	limits	aver-age	limits	aver-age	maxi-mum
26.4	100	100	0	0	0
28.7	60-72	63.5	4.1-6.6	5.4	42

33.6	54-63	57.3	16.2-22.8	19.5	78
35.4	35-44	39.1	26.4-33.1	30.3	135
38.7	25-32	29.8	38.9-51.7	45.8	194

Table 10. Multiplication index at the *Eurygaster integriceps* populations, depending on the fat body (multigeneration average).

Fat body (%)	Multiplication index (egg/female)	
	limits	average
26.4	0	0
28.7	0.37–2.47	1.54
33.6	4.54–9.62	6.95
35.4	28.57–40.18	35.22
38.7	49.38–64.83	56.47