

## VARIATION OF ACTUAL MORPHOLOGICAL CHARACTERS OF WINTER WHEAT

Nicolae Ionescu<sup>1\*</sup>

<sup>1</sup>Agricultural Research and Development Station Pitești,  
Șos.Pitești-Slatina, km. 5, 117030, Pitești, România

### Abstract

Various studies on morphological, biochemical and molecular characters could be used to improve new wheat varieties. Broad genetic dowry and wheat crop conditions usually lead to the characteristic expression of plant morphology. In the case of winter wheat, the Cameleon variety, some new directions have been found, which has recently been improved, with specific characters. Thus, the straw had an average length of 58 cm, of which the basal internode (the third of top) had a length of 12 cm and a thickness of 3.2 mm, usually full marrow. The sub-apical internode measured 20 cm, and the apical internode 21 cm. The spike (ear) had a length of 8.1 cm, a weight of 2.1 g and contained 16 spikelets. The spikelet had an external glume of 8.9 mm, a lower lemma of 9.7 mm, and a 7 cm awn. A medium spike contained 49 grains, weighting 1.62 g. The grains (caryopsis type) had a length of 6.8 mm, a thickness of 2.99 mm, and a thousand grains weight of 33 g. Significant positive correlations were obtained between the morphological characters of the spike. The grains, by size, correlated less with the other characters, except the mass of thousand grains. The new cultivated variety has shown a good adaptability to a new and efficient agriculture.

Keywords: ears, grains, straws, variability, wheat.

### 1. INTRODUCTION

Having a long history, the wheat [*Triticum aestivum* (L.) Thell ssp. *vulgare* (Will.) MK], (pro syn. *Triticum hybernum* L., *T. macha* Dekap. & Menab., *T. sativum* Lam., *T. sphaerococcum* Percival, *T. vulgare* Will., bread wheat, common wheat, soft wheat) are one of the most important crop (Hopf and Zohary, 2000; Bonjean and William, 2001). *Triticum* derives from *threshing*, *trier*, and *aestivum* from the summer. Threshing wheat is called *spelta*. This with the genes of *Aegilops tauschii* gives bread wheat its resistance to cold, required under temperate climates (Brenchley et al., 2012; Li et al., 2014). As a surface wheat occupies the first place, being met in a multitude of conditions. The purpose of his cultivation is the production of grains used for bread. The content of grains in nutrients (Sabelli and Larkins, 2009) is diverse and balanced, with a particular importance in human nutrition. Over time, the plant has evolved in different characters (Tester and Langridge, 2010). Thus, wheat is considered to be one of the most cereal diverse genetically (Bray and West, 2005), which has autumn and spring types, with grained (dressed) and an-grained caryopsis. The present variety has the hexaploid genome,  $2n = 6x = (6 \times 7) = 42$ , with six sets of chromosomes of the A<sup>u</sup>A<sup>u</sup>BBDD form. The diploid form,  $2n = 2x = 14$ , has 2x7 chromosomes, one from each parent, and by tetraploid evolution ( $2n = 4x = 28$  chromosomes) and hexaploids. The variability of this variety is *erythrosperrum* Körn., with white ear, no awns, glabrous glumes and red grain (Caligari

and Brandham, 2001). It also contains the modern gene *Rht*, introduced by Borlaug (1960s) from *Norin 10* of Japanese origin, which determines short stems suitable for rich fertilization and mechanized harvesting, both of which are necessary for the new, very productive varieties. The inflorescence of the plant is a terminal ear, distich, 4-18 cm long, with sessile spikelets, caught solitary on the zigzag rachis. The spikelets is 10-15 mm long, being laterally compressed with two glumes and several flowers. Glume have a tip like a short tooth, but also a 3-5 cm awn. Each flower has palaea and lemma. Depending on variety, the lemma expands in the form of awn, or as a hood. When the palaea and lemma stick to the grain, it gets dressed. The grain (caryopsis) is ellipsoidal, with a central channel on one side. The grain has 4-12 mm long and 1.5-4.0 mm thick. The mass of one thousand grains is between 15 g and 60 g (Black and Halmer, 2006). The plant generally forms stalks with heights between 50 (60) and 140 (150) cm. The research carried out to observe the variation of wheatgrass characters included: i) the strain by the total length of the straw, the length and thickness of the basal internode (third top), the length of the sub-apical internode and the length of the apical internode, ii) the length and weight of ear, iii) the number of spikelets/ear, length of external glume, length of lemma and length of awns, iv) the number of grains/ear, his weight, thousand grains weight (TGW) and grains dimensions (length and thick).

## 2. MATERIALS AND METHODS

Variants have been cultivated over the last two years with the *Cameleon* variety. The experience was set up according to the block method, with variants of 25 m<sup>2</sup> in 4 replicates. The technology used was the one recommended by the resort. At the full maturity, 25 plants (stems) from each replicates (total 100) were randomly chosen, cut and brought into the laboratory. The 100 strains were measured and determined: the total length of the straw, the length and thickness of the base internode, the length of the sub-apical internode, the length of the apical internode, the length and weight of the ear, the number of spikelets in the ear, the length of the glume, lemma and awn, the number of grains in an ear and their weight, the mass of a thousand grains, and the size of the grains: the length and thickness.

The morphological characters obtained were analyzed by the histograms (frequency polygons) method. In their expression were used the class ranges established according to the specific value range obtained. The study revealed several aspects, namely: i) the modal values (with the highest frequencies, ii) the limits of the variability ranges of the studied characters, iii) the specificity of each character of the wheat ecotype in the analyzed area. Between the analyzed characters correlations were established, with the help of which their tendencies within the studied eco-type were observed. The Excel program was used to express the values. The significance of correlation coefficients was obtained by comparing with  $r_{\max}$  values (Erna Weber, 1961) for the 5%, 1% and 0.1% levels of transgression probabilities.

In the statistical calculation of all the obtained values variance analysis (Anova test) was used on the variation rows. Statistical parameters were calculated using the formulas:

$\bar{a} = \sum x \cdot n^{-1}$ , where  $\bar{a}$  = the average of the determinations, and  $x$  = the determined values,

$s^2$  (variance) =  $1 \cdot (n-1)^{-1} [\sum x^2 - (\sum x)^2 \cdot n^{-1}]$ ,

$s$  (standard error) =  $\sqrt{s^2}$ ,

$s\%$  (variation coefficient) =  $s \cdot \bar{a}^{-1} \cdot 100$ .

## 3. RESULTS AND DISCUSSIONS

Variability of the wheat straw dimensions. The straw or wheat stem consists of several internodes (usually 5-7) with increasing lengths to the ear. Generally the straw has lengths between 50 (60) cm

and 150 cm. At harvest maturity, the stems are upright, with relatively low size. The measurements showed that the straw in this autumn wheat variety was between 46 and 70 cm. The high frequency had straws of 56-60 cm (43%), followed by 61-65 cm (24%). Smaller and larger lengths together had 5% of the stems (figure 1). Due to these dimensions of the wheat straw, the Cameleon variety is considered an evolved and intensive one (figure 2).

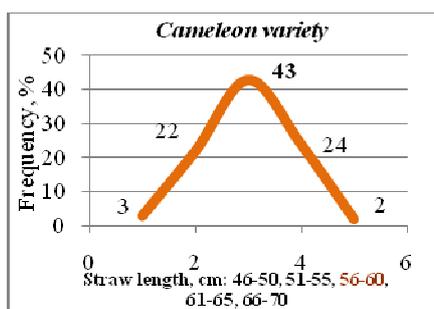


Figure 1. Frequencies of straw length



Figure 2. Winter wheat, Cameleon variety

The lower internode (the third at the top) had lengths between 7 and 15 cm. Higher frequency was 12.1-13 cm (38%), followed by 11.1-12 cm (24%). The shorter and longer lengths were 7%, the others being intermediate (figure 3). The diameter of this basal internode was between 2.0 and 4.0 mm (figure 4). Segments were dominated by 2.9-3.1 mm (35%) and 3.2-3.4 mm (34%). Smaller and bigger thicknesses were together 5%, the others being intermediate. The sub-apical internodes had longer lengths of 17 to 26 cm (figure 5). Larger frequencies had 19.1-20 cm intervals (34%) and 20.1-21 cm (33%). These were followed by internodes of 18.1-19 cm (16%), while the others were between 1% (>26 cm) and 8% (22.1-23 cm).

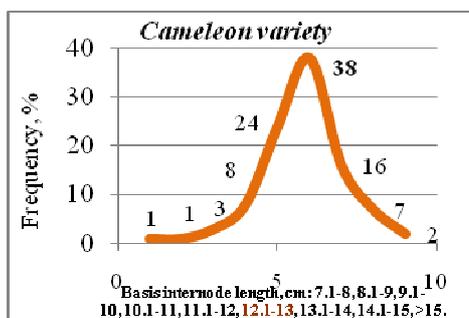


Figure 3. Frequencies of basis internode length

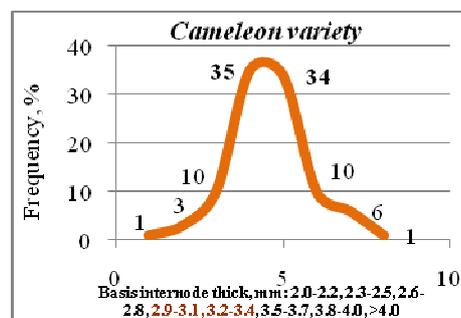


Figure 4. Frequencies of basis internode thick

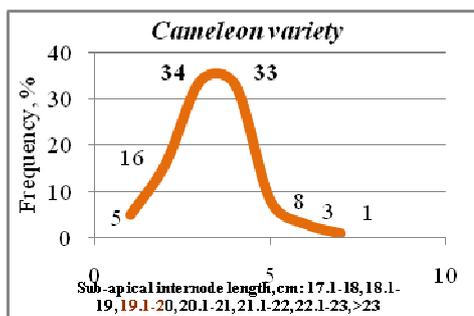


Figure 5. Frequencies of sub-apical internode length

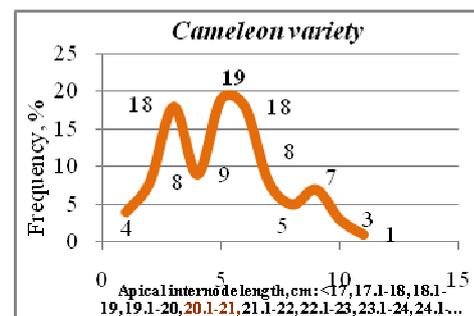


Figure 6. Frequencies of apical internode length

The internode under the spike (apical) is usually the longest. In the case of this variety there were found dimensions close to those of the sub-apical internode. Thus, it ranges between 17 and 26 cm. The highest frequencies were 20.1-21 cm (19%), 19.1-20 cm (18%) and 21.2-22 cm (18%) (figure 6). Values below 10% were obtained at all other intervals. Internodes with smaller lengths (under 17 cm) accounted for 4%, and the highest (over 26 cm) were only 1%. The graph shows that the length of the internode under the ear exhibited fluctuating variability.

Variability of wheat ears/ spikes. The appearance and dimensions of this wheat variety are characteristic. Thus, its length was between 6 and 10.4 cm. The lengths of 8-8.4 cm (22%) and 7.5-7.9 (21%) were dominated (figure 7). Spikes of 8.5-8.9 cm and 9-9.4 cm had frequencies of 15%. And in case of the spike length of these variety there is a fluctuation of variability. The spikes weight was less than 1 g and 3.4 g (figure 8). Spikes with higher frequencies were with 1.81-2.2 g (30%) and 2.21-2.6 g (35%). It's followed ears weighting 1.41-1.8 g (18%) and those with 2.61-3 g (11%). Ears lighter and heavier accounted for a total of 6%. The number of spikes in a spike oscillated between 11 and 19 (figure 9 and 10). There were dominated those with 17 spikelets (23%), then with 15 (21%) and then 16 spikelets (20%). And for this character there is a fluctuating variability. The glumes (two for every spikes) were between 7.5 and 10.5 mm in length (figure 11). The glume with high frequencies were those with 9-9.4 mm (37%), followed by 8-8.4 mm (23%) and 8.5-8.9 mm (21%). The shortest and longest glume accounted for 2% of the total. The awned palaea (called *lemma*) had lengths between 8.5 and 11.4 mm (figure 12).

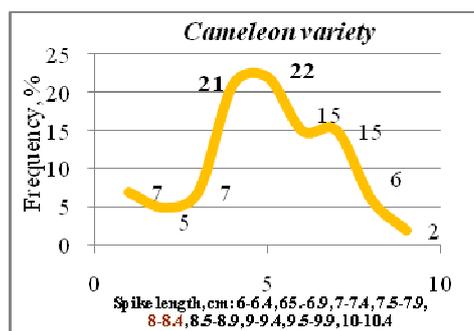


Figure 7. Frequencies of spike length

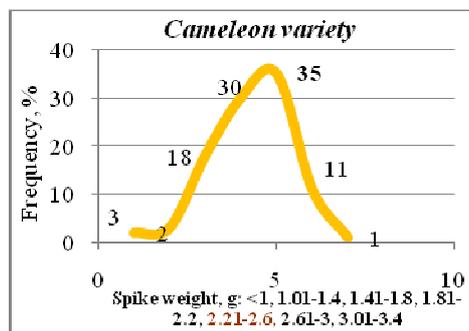


Figure 8. Frequencies of spike weight

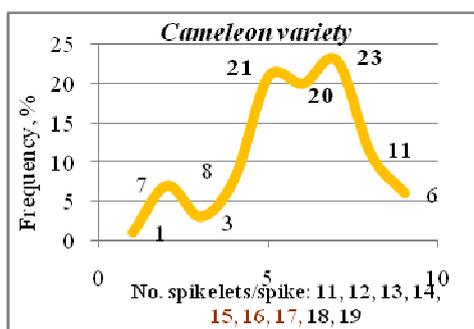


Figure 9. Frequencies of no. spikelets/spike



Figure 10. Internods and spikelets in spike

Big frequencies were 9.5-9.9 mm (29%) and 10-10.4 mm (28%), followed by 9-9.4 mm (23%). The other dimensions were below 10% frequencies. The awns that are formed in spikelets, namely the *lemma*, have the shape and the specific length. The awns dimensions were between 5 and 8.4 mm (figure 13). Larger frequencies were obtained at lengths of 6.5-6.9 cm (26%), 7.5-7.9 cm (25%) and

7-7.4 cm (23%). They were followed by the 6-6.4 cm (13%), while others were smaller, showing the specificity of this variety to this character (figure 14).

**Variability of wheat grains.** From the research it was found that the main elements contributing to the formation of better yields are the number of grains in spikes and their absolute mass (Eira& Caldas, 2000; Hunt et al., 2007). In the case of the Cameleon variety, the number of grains in a spike ranged from 25 to 70. The higher frequency had 50-54 grains (22 %) and 45-49 grains (19%). Spikes with smaller number- under 25 grains accounted for 1% of the total, and those with more than 70 grains/ spike constituted 2%, the others were intermediate (figure 15). The weight of the grains formed in a spike ranged between 0.51 g and 2.50 g. The highest frequency was obtained at weights of 1.31-1.70 g (39%), followed by grains whose weighted 1.71-2.10 g (33%) and those with 0.91-1.30 g (14%). We can see that the grains whose weighted 2.11-2.50 g constituted 10% of the total (figure 16).

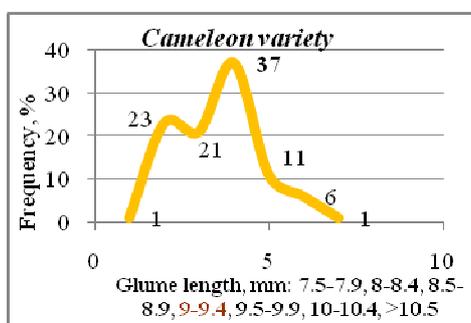


Figure 11. Frequencies of glume length

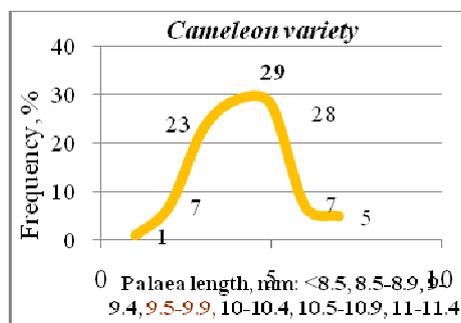


Figure 12. Frequencies of palaea length

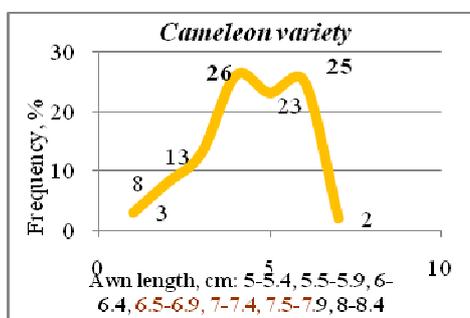


Figure 13. Frequencies of awn length



Figure 14. Spikelet: glume, palaea, awns and grains

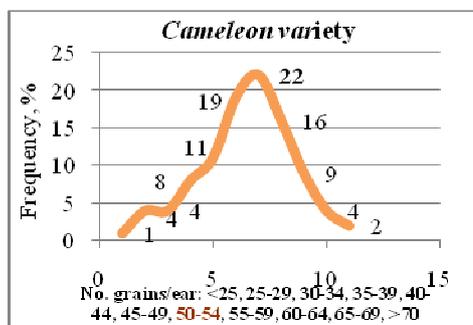


Figure 15. Frequencies of no. grains/ear

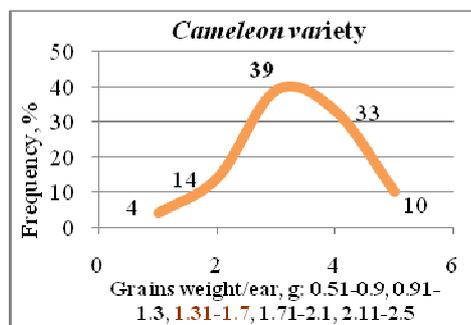


Figure 16. Frequencies of grains weight/ear

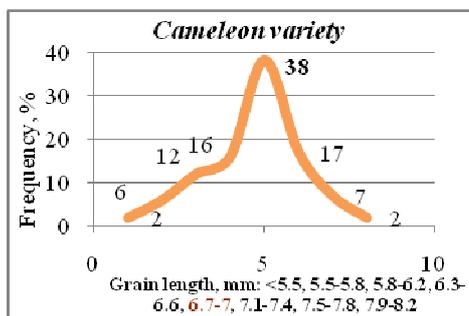


Figure 17. Frequencies of grain length

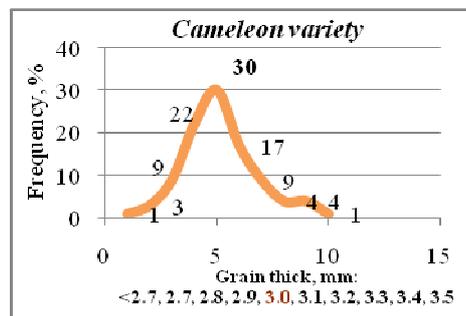


Figure 18. Frequencies of grain thick

The grain sizes also had some characteristics. Thus, the grain length ranged between 5.5 and 8.2 mm, with the modal value at 6.7-7 mm (38%). The extreme grain lengths were 4% together (figure 17). The grain thickness ranged between 2.7 and 3.5 mm, with the modal value at 3.0 mm (30%), followed by the 2.9 mm (22%) and by 3.1 mm (17%) (figure 18). The weight of one thousand grains showed slight differences, thus the values of group 32.1-36 g (36%) and 28.1-32 g (35%). The oscillation of this character was between 20.1 and 44 g (figure 19). This data shows that the analyzed wheat variety generally formed grains in the media of variety for absolute weight (figure 20).

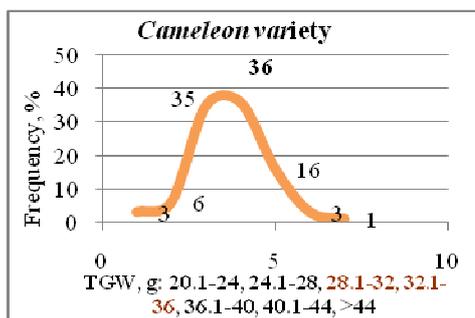


Figure 19. Frequencies of thousand grains weight



Figure 20. Cameleon grains aspect

Correlations between the main characters. If we analyze the entire set of correlations between all the analyzed characters, we find positive and negative situations. Very obvious positive correlations have been observed between the characteristics of the spikes: length, number of spikelets, number of grains, grain weight and floral pieces- glumes and lemmas. Positive insignificant correlations were observed between the length of the straw and the other characters of the plant. The absolute grain mass correlated positively with the weight of the grains in the spike and the grain size- length and thick (table 1).

Statistical analysis of the morphological character variability in wheat. The results obtained in the morphological analysis of some characters in winter wheat showed specific aspects. Thus, the length of the straw measured 57.8 cm. Variability demonstrated low coefficients (6.9%). The basal internode measured 12.4 cm with a variation of 10.7%, and its thickness was 3.17 mm (11.3%). The sub-apical internodes have a mean length of 20 cm (7.8% variability) and the apical internode measured 20.7 cm (11.7% variability). From these data, it appears that this variety has a medium to small port, and this size has occurred by reducing the length of the apical internode (under the spike). The length of spike was 8.1 cm, with low variability (11.7%). The spike weight was 2.12 g,

but with high variability (20.1%). The number of spikes/spike was 15.8 (11.6% variability) (table 2).

**Table 1. Correlations between differing characters of winter wheat plants**

Character	Straw length, cm	Up internode length	Ear length, cm	No. spikelets/ ear	No. grains/ ear	Grains weight/ ear, g	Glume length, mm	Palea length, mm	Awn length, cm	Grain length, mm	Grain width, mm	TGW, g
Straw length,cm	1	.186	.100	.030	.061	.039	.030	.173	-.014	.063	.007	-.007
Up int. length, cm		1	-.178	-.234 <sup>0</sup>	-.137	-.049	-.071	-.203 <sup>0</sup>	.237*	.035	.108	.198*
Ear length, cm			1	.860***	.747***	.596***	.397***	.421***	.071	.076	-.028	-.156
No. spikelets/ ear				1	.777***	.677***	.377***	.376***	.080	.082	.059	-.047
No.grains/ ear					1	.847***	.292**	.434***	.196*	-.020	-.014	-.116
Grains weight/ear,g						1	.229*	.293**	.103	.091	.198*	.417***
Glume length, mm							1	.421***	-.123	.082	.139	-.066
Palea length, mm								1	.039	.001	-.082	-.185
Awn length, cm									1	-.004	-.148	-.128
Grain length, mm										1	.030	.206*
Grain width, mm											1	.423***
TGW, g												1

LSD 5 % = 0.19      LSD 1 % = 0.25      LSD 0.1 % = 0.32

**Table 2. Statistical indices of winter wheat straws and spikes**

Indices	Straw length cm	Basis internode, cm		Sub-apical internode, cm	Apical internode, cm	Spike/ ear		No. spikelets./ear
		Length, cm	Width, mm			Length, cm	Weight, g	
<i>Cameleon variety</i>								
Media, ā	<b>57.78</b>	<b>12.41</b>	<b>3.167</b>	<b>19.95</b>	<b>20.65</b>	<b>8.133</b>	<b>2.123</b>	<b>15.84</b>
Variance, s <sup>2</sup>	15.97	1.752	0.127	2.390	5.787	0.899	0.181	3.388
Standard error, s	3.006	1.324	0.357	1.546	2.406	0.948	0.426	1.841
Var. coeff, s%	<b>6.92</b>	<b>10.67</b>	<b>11.27</b>	<b>7.75</b>	<b>11.65</b>	<b>11.65</b>	<b>20.07</b>	<b>11.62</b>

**Table 3. Statistical indices of winter wheat spikelets and grains**

Indices	Glume length, mm	Palea length, mm	Awn length, cm	No. grains/ ear	Grains weight/ear, g	TGW, g	Grains mm	
							Length	Width
<i>Cameleonvariety</i>								
Media, ā	<b>8.934</b>	<b>9.743</b>	<b>6.936</b>	<b>49.27</b>	<b>1.6167</b>	<b>32.916</b>	<b>6.819</b>	<b>2.985</b>
Variance, s <sup>2</sup>	0.365	0.282	0.490	106.9	0.113	18.75	0.449	0.205
Standard error, s	0.604	0.531	0.700	10.34	0.336	4.330	0.670	0.452
Var. coeff, s%	<b>6.76</b>	<b>5.45</b>	<b>10.09</b>	<b>20.99</b>	<b>20.80</b>	<b>13.15</b>	<b>9.83</b>	<b>15.16</b>

The length of glumes was 8.9 mm (6.8% CV), palaea 9.7 mm (5.5 % CV), and awn 6.9 cm (10.1% CV). The number of grains formed in a spike was 49.3 with a high variability (21%). The grain weight of a spike was 1.62 g, with high variability (20.8%). The grains had an average size of 6.82/2.99 mm. Variability of grain sizes was average (9.8%) for both length and thickness (15.2%). The thousandgrains weight (TGW) was 33 g with 13.2% variability (table 3).

#### 4. CONCLUSIONS

Morphological characters of winter wheat variety studied were specific. Thus, the straw had average lengths of 58 cm. At the plant's height, the basal internode contributed 12 cm, the sub-apical internode with 20 cm and the apical with 21 cm. These dimensions describe a low Cameleon variety suitable for intensive agriculture. The size was reduced by shortening the apical internode at the sub-apical level. The thickness of the basal internode was 3.2 mm, full of the marrow, which also showed good resistance in the wheat crop. Spike 8.1 cm long weighing 2.12 g, is characterized as a medium long and heavy weight. The number of spikelets close to 16 shows a density of 0.5 spikelets per 1 cm of spike length. The spike pieces: glume about 9 mm, 10 mm lemma and 7 cm awn, describe characters to the studied variety. The number of grains in one spike was about 50,

weighing 1.62 g, means a specific variety for a high-capacity production. TGW was about 33 g, considered to be like an average of wheat varieties. Grains measured 6.82 mm in length and 3 mm in thickness describe also average characters.

Between all the studied characters were established simple correlations with some differentiations. Among the characters of the spike, the correlations were very significant, which demonstrates the great productive possibilities of this variety. The characters of the straw (inter-nodes) correlated insignificantly, sometimes negatively with the spike and the grains, and is explained by the genetic improvement obtained in reducing the size of this variety.

The studied statistical indicators have demonstrated a small-sized wheat variety with medium spikes, sufficiently compact, with many grains, but with a medium of TGW. Spikes like these, with 50 grains, weighing 1.62 g, describes a new, productive winter wheat variety.

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