

## TRIVALE, THE NEW WINTER WHEAT VARIETY ADAPTED TO THE LUVIC SOIL CONDITIONS

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### Abstract

Improving wheat for increased adaptability to luvic soil conditions in the south of the country has made significant progress lately. The sufficiently wide genetic dowry available has shown that even in the conditions of white luvic soil in the south of the territory, varieties with tolerance to aluminum ions can be obtained. The Trivale variety obtained under these conditions proved new plant characteristics, including those required by the new intensification conditions. And in this case, some gains of morphological characters were found. Their study could be useful in the constant progress of wheat improvement. From the data obtained in the two years of experimentation it was found that the length of the straw was 69-76 cm, with the thickness at the base of 3.4-3.5 mm. The length of the spike was on average 8.7-9.0 cm, and its weight was between 2.1 g and 2.4 g. The spikelets in a spike were 18.4-18.8 in number. In the spikelet, the outer glume measured 8.7 mm, the lower palea 9.7-10.0 mm, and the awns measured an average of 5.8-6.4 cm. 41.2-42.7 grains were formed in a spike, with mean weighing of 1.7-1.8 g. The grains were 6.5-7.0 mm long, 3.1-3.2 mm thick, and the mass of one thousand grains was 39-43 g. Positive correlations were generally obtained between the morphological characters. The data obtained demonstrate a progress in improving the morphological characteristics of the Trivale variety, due to the gain of a tolerance to the concentration of aluminum ions into the soil.

Keywords: ears, grains, variability, Trivale variety, wheat.

### 1. INTRODUCTION

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., common wheat, bread wheat) is one of the most important crop plants (Bonjean & Angus, 2001; Cagliari & Bradham, 2001). The name *Triticum* expresses the adaptation of the words *threshing* and *bruising* which means third, and *aestivum*, in summer, indicates the maturation of plants this season. The wheat that is threshed is also called *spelta*. By crossing with *Aegilops tauschii*, cold resistance was added to wheat, which is very important for cultivation in temperate climates (Sayre et al., 1997) and more. The researched variety also contains the modern RHtB1b gene, which induces the relatively short stem/ straw (Curtis et al., 2002), very important for more sustained fertilization and mechanized harvesting, elements necessary for their cultivation in intensive conditions (Slafer & Satorre, 1999; Săulescu et al., 2007). For resistance to aluminum ions, repeated crosses were performed with the *Atlas* variety from the international collection (CIMMIT control), recognized as the most tolerant to these conditions (Li et al., 2014). In general, the wheat has a terminal spike, a

distich, 4-18 cm long, with sessile spikelets, caught solitary on the rachis, zig-zagged (Tester & Langridge, 2010). The spike is 10-25 mm long, being compressed laterally, it has two awns and flowers each. The glume is the tip like a short, blunt tooth, but also a slightly smaller edge. Each flower has a palea and a lemma. Depending on the variety, the lemma extends in the form of an awn, or as a hood. When the glume and the lemma adhere to the grain, it becomes so dressed. The caryopsis bean has an ellipsoidal shape (Shewry, 2009), with a central channel on one side. The grain is 4-12-14 mm long and 1.5-4.5 mm thick. The mass of one thousand grains (MTG) is between a minimum of 15 g and a maximum of 60-70 g. The plant generally forms stems with heights between 50 (60) and 140 (150) cm. Lower values are manifested in dwarf varieties. The researches aimed to observe the variation of some new characters (Ionescu et al., 2021) of wheat plants from the Trivale variety. The stem (straw) was measured as the total length, the length of the last three internodes below the spike and the thickness of the basal internode. The length, weight and number of spikes of ear were determined. For the spikelets, determinations were made for the length of the outer glume, the lower palea (lemma) and the awns. For the grains, determinations were made for the number, weight (both in the ear), the length, thickness and mass of a one thousand grains (MTG).

## 2. MATERIALS AND METHODS

In the last two years (2020 and 2021) the Trivale variety has been cultivated using the technology recommended by the resort. The experiments were set up according to the block method, with variants of 25 m<sup>2</sup> each in 4 repetitions. At full maturity, 25 plants (stems) from each repetition were randomly selected (zig-zag), which meant a total of 100. These stems were cut from the ground and brought to the laboratory. The following 100 stems were measured and determined: straw length, length of the last three straw segments, basal internode diameter, spike length and weight, number of spikelets in spike, length of glume, palea and awn, number of grains in an ear and their weight, the length and thickness of the grain and the mass of a thousand grains (MTG). These morphological characteristics of the wheat plants obtained were then analyzed by the method of histograms. Both class intervals and absolute values were used in their expression. Each histogram was established according to the specific string of values obtained. After establishing the respective intervals, the modal values (with the highest frequencies), the limits of the variability intervals of the studied characters and the specificity of each character resulted. The correlations were established between the analyzed characters, with the help of which their tendencies within the studied ecotypes could be observed. Excel was used to express values. The significance of the correlation coefficients was obtained by comparing with the  $r_{\max}$  values for the levels of 5%, 1% and 0.1% of the transgression probabilities. The statistical calculation was also performed, which was based on the analysis of variance (anova test), namely on the variation strings. Statistical indices were obtained using the formulas:  $\bar{a} = \sum x/n$ , where  $\bar{a}$  = average of the determinations, and  $x$  = the determined values,  $S^2$  (variance) =  $1/(n-1) [\sum x^2 - (\sum x)^2/n]$ ,  $S$  (standard error) =  $\sqrt{S^2}$ ,  $S\%$  (coefficient of variation) =  $S/\bar{a} \cdot 100$ .

## 3. RESULTS AND DISCUSSIONS

Variability in wheat straw size. The wheat straw is segmented by several internodes (5-7) with longer lengths towards the ear. The length of the straw is between 40-50 (60) cm for intensive varieties and up to 130-150 cm for extensive varieties. At harvest maturity, the straw has a vertical position, being suitable for mechanized harvesting. The measurements showed that the straw of the

*Trivale* variety was between 55 and 90 cm. The differences between the two years were due to the more favorable climate in the last year (figure 1). The highest frequency was 70 cm (26-27%) in the first year and 75 cm (28%) in the second year. The diameter (thickness) of the straw at the base was generally between 2.5 and 5 mm (figure 2).

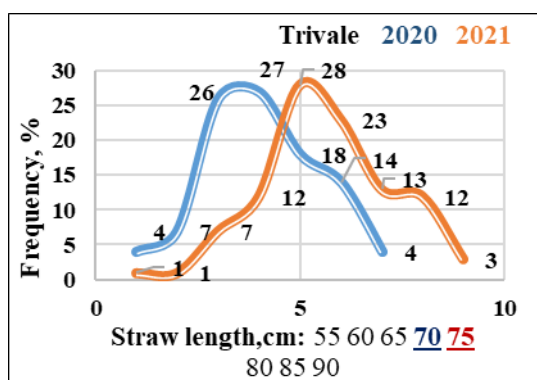


Fig. 1. Frequencies of straw length

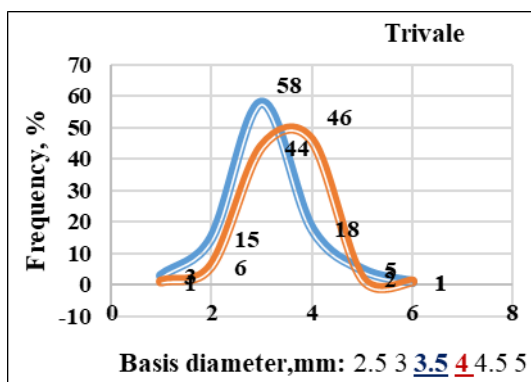


Fig. 2. Frequencies of basis diameter of straw

They dominated the segments with 3.5 mm in the first year (58%) and those with 4.0 mm in the second year (46%). These data show that the straws formed had medium to high heights, thick enough to give them increased strength.

**Variability of wheat ears.** The appearance and size of the ear were characteristic in the two years analyzed. Thus, the length of the spike generally ranged from 7 to over 11 cm. The lengths of 9 cm (39%) in the first year and those of 10 cm (38%) in the second year dominated (figure 3). The data obtained show that the spike formed had relatively long lengths. The weight of the ears was between 1.0 g and over 3.5 g at the level of the two years (figure 4). They dominated the ears whose weights were 2 g in the first year (40%) and those with 2.5 g in the second year (33%). The formation of ears whose biomass has reached 3.5 g is indeed a new feature of this variety.

The number of spikelets in a spike ranged from 13 to 23 (figure 5). They dominated the ears with 19 spikelets in both years (55% in 2020 and 32% in 2021). The appearance of *Trivale* plants during the flowering period is characteristic (figure 6).

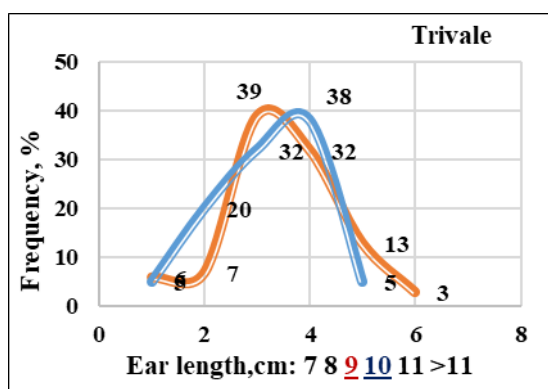


Fig. 3. Frequencies of ear length

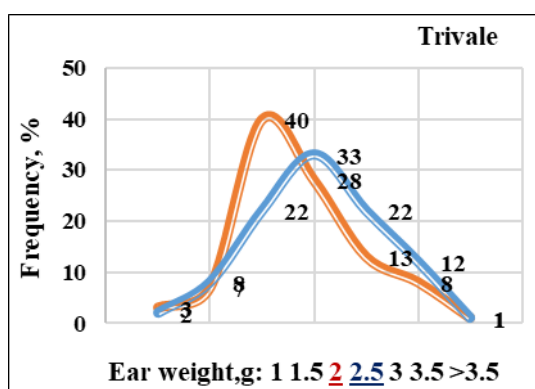


Fig. 4. Frequencies of ear weight

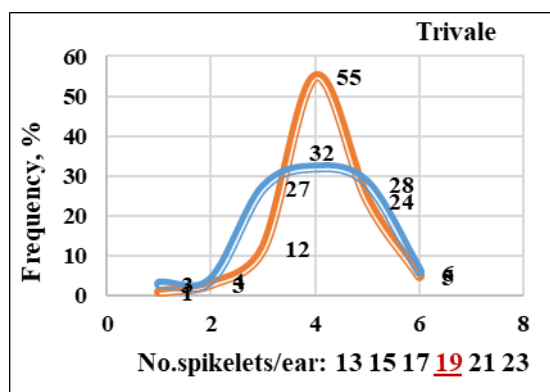


Fig. 5. Frequencies of no.spikelets/ear



Fig. 6. Trivale variety after flowering period

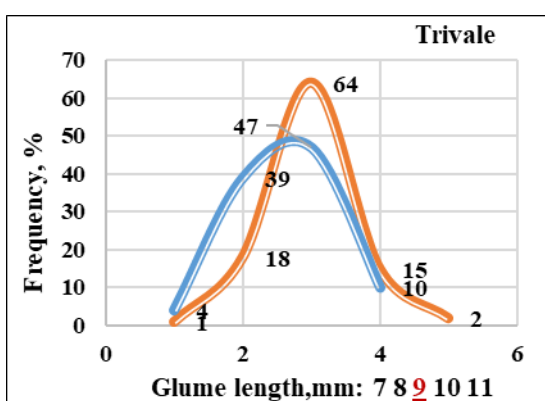


Fig. 7. Frequencies of external glume length

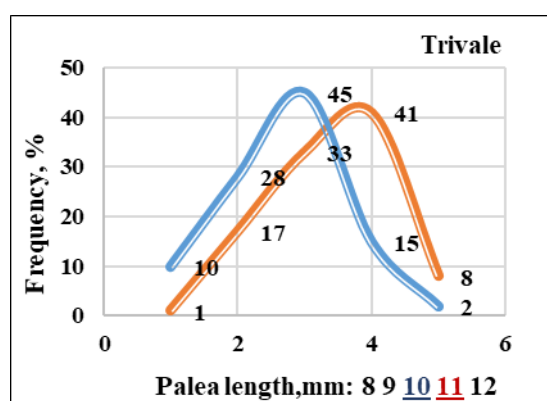


Fig. 8. Frequencies of basis palea length

The spikelets are protected by two glumes. Measurements were made on the outer glume. Flowers are usually formed in the spikelet. These flowers are protected by two paleas. The lower one, also called *lemma*, was measured, because it has an awn, a filiform formation, characteristic of each variety. Thus, the external glume had lengths between 7 and 11 mm. In the two years, 9 mm glume dominated similarly (64% in the first year and 47% in the second year), (figure 7).

The lower palea (*lemma*) had differentiations in length in the two years. Thus, in the first year the palea had dominant lengths of 11 mm (at the level of 41%), and in the second year the lengths of 10 mm (45% modal value) dominated (figure 8). The data obtained show that external glume generally have shorter lengths than the lower palea.

The awn of this variety is considered medium in length. The determinations were performed on the awn located in the upper third of the ear. The length of these awns was between 4 and 10 cm (figure 9). The dominant lengths were 8 cm (30%) in the first year and 6 cm (42%). The appearance of the awn of the Trivale variety on the ears at the end of the grain filling period is specific - figure 10.



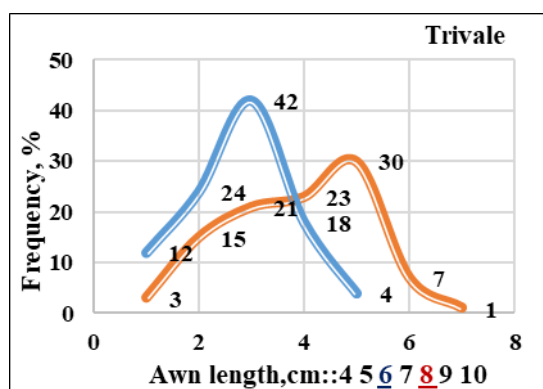


Fig. 9. Frequencies of awn length



Fig. 10. Awn's aspect from mature ears

**Wheat grain variability.** Research has shown that each variety has characteristic aspects related to the grains, depending on the degree of intensification of the production that represents it. In the case of the number of berries in an ear of the *Trivale* variety, the values were between 20 and 80 at the level of the two years. In the first year, the ears were more frequent with 50 grains (35%) (figure 11).

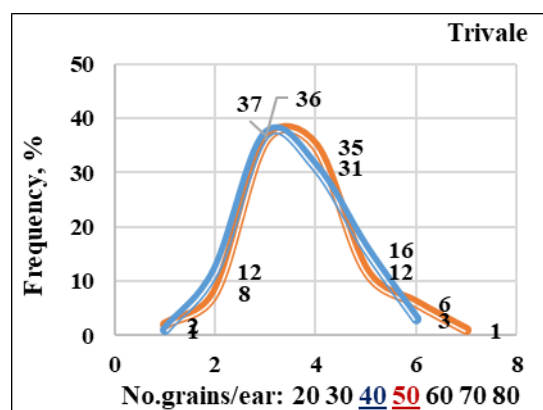


Fig. 11. Frequencies of no. grains/ear

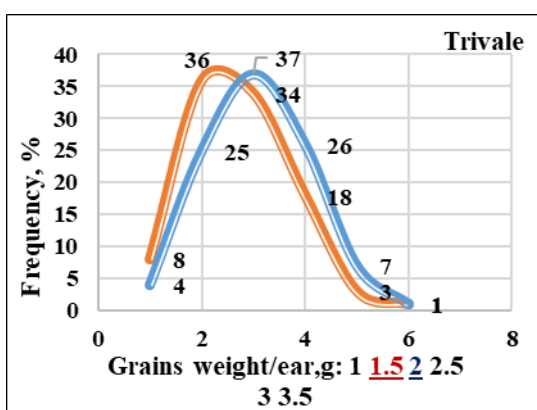


Fig. 12. Frequencies of grains weight/ear

In the second year they dominated the ears with 40 grains/ ear (36-37%). The weight of the grains formed in a spike had corresponding values between 1 g and 3.5 g. The highest frequency was obtained at weights of 1.5 g (36%) in the first year and 2 g (37%) (figure 12). The graphs show, on the one hand, the large number of grains that form in an ear, as well as their relatively high weight, which is sufficient to justify high levels of production per unit area.

The size of the grains also had some characteristics. Thus, the grain length was in the range of 5.5-8 mm, with a maximum of 7 mm (36% and 48%, respectively) in both years (figure 13).

The grain thickness was between 2.4 and 4.0 mm, with similar modal values of 3.2 mm (44% in the first year and 50% in the second year) (figure 14).

The mass of a thousand grains (TGW) has shown some differences. The extreme values of this character were between 25 and 55 g. The modal value was 40 g (36%) in the first year to 45 g (45%) in the second year (figure 15). The morphological characteristics of *Trivale* berries are shown in figure 16.

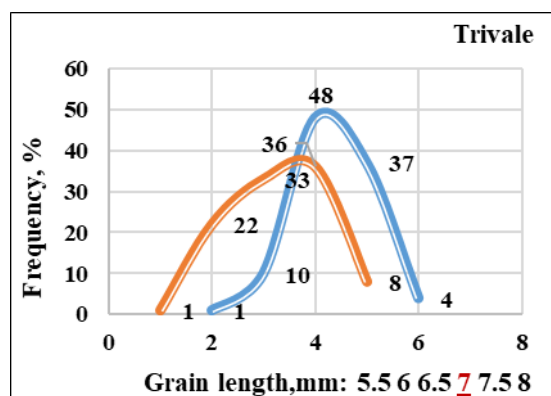


Fig. 13. Frequencies of grain length

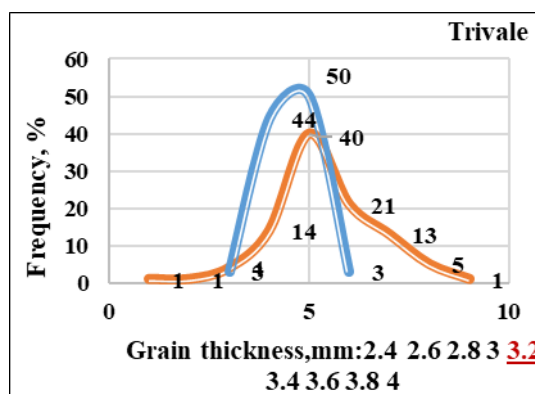


Fig. 14. Frequencies of grain thickness

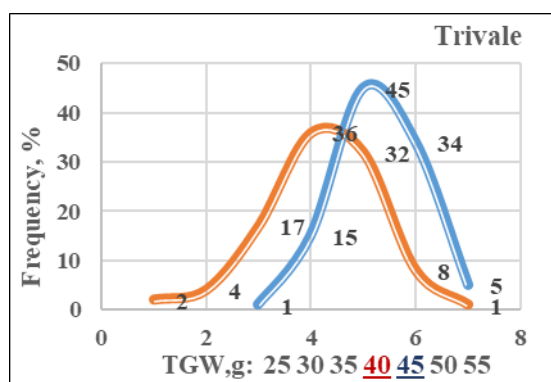


Fig. 15. Frequencies of a thousand grains weight



Fig. 16. The grains aspect of Trivale variety

Correlations between the main morphological characteristics of wheat plants. If we analyze the whole set of correlations between all the characters analyzed in the two years, we find specific situations. Thus, the correlation coefficients had values, both positive and negative. This is the case with the correlations between the height and the weight of the ear, between the height of the plant and the number of grains in an ear and of the grain size, the length was mostly correlated with the other characters, while the thickness of the grain was mostly insignificant, either positive or negative. The mass of a thousand grains correlated very significantly positively with the size of the plants only in the first year, as well as with the size and weight of the grains in an ear. Positive correlations with statistical assurance were found between the number of grains in the ear with the length of the grain and the number of spikelets in an ear (table 1). Most correlations were positive and statistically assured in a similar way during the two years of culture. One explanation would be that this variety has a more obvious adaptation to the ecology of soil.

Statistical analysis of the variability of morphological characters in wheat. The results obtained in the morphological analysis of some characters for the *Trivale* winter wheat variety, showed specific aspects. Thus, the straw length measured on average 68.7 cm in the first year and 76.1 cm in the second year. The length of the internode 3 under the ear oscillated between 14.8 cm and 13.2 in the two years. The subapical internode was 17.5-20.6 cm, and the apical internode measured between 24.7 cm and 34.1 cm. The diameter of the straw at the base was 3.35 mm (2020) and 3.51 mm (2021). The length of the ears was 9.02 cm and 8.66 cm in the two years. The weight of the spikes was in the same comparison of 2.13 g compared to 2.39 g. The number of spikelets was

approximately the same, namely 18.8 and 18.4 (table 2). The weight of the ear had greater variability in both years.

Between the two years, the length of the glume was similar, of 8.67-8.65 mm, that of the lemma was 10.02 mm compared to 9.74 mm, and the awns measured 6.41 cm to 5.77 cm.

**Table 1. Correlations between morphological characters of wheat plants, Trivale variety**

Characters	Straw 3 <sup>rd</sup>	Straw 2 <sup>nd</sup>	Straw 1 <sup>st</sup>	Ø base	Ear length	Ear weight	No. spikelet	Glume mm	Palea mm	Awn cm	No. grains /ear	Grains weight, g	Grain length mm	Grain thick mm	TGW g
<b>2020</b>															
High,cm	.384	.432	.511	.274	.130	.400	.069	.091	.352	-.084	.391	.423	.233	.041	.204
Straw 3 <sup>rd</sup>	1	.197	.236	.016	-.237	-.010	-.154	.026	.282	-.271	-.053	.045	-.054	-.042	.139
Straw 2 <sup>nd</sup>		1	.115	.159	-.116	.152	-.044	-.033	.017	-.091	.101	.162	.182	-.107	.144
Straw 1 <sup>st</sup>			1	.432	.241	.411	-.003	.136	.120	.169	.135	.427	.020	.195	.155
Ø base				1	.407	.587	.372	.240	.116	.250	.545	.575	.318	.249	.319
Ear l.,cm					1	.666	.643	.313	.035	.629	.748	.621	.274	.226	.114
Ear W.,g						1	.409	.407	.249	.496	.912	.973	.512	.430	.533
No. spikelets							1	-.007	-.066	.231	.440	.381	.250	.058	.095
Glume,mm								1	.273	.400	.437	.381	.350	.151	.102
Palea,mm									1	.022	.261	.281	.418	.092	.142
Awn,cm										1	.548	.448	.192	.071	.078
No. grains											1	.871	.428	.202	.181
Grains W.,g												1	.519	.484	.617
Grain L.													1	.291	.356
Grain W.														1	.700
<b>2021</b>															
High,cm	.544	.750	.586	.026	-.113	-.024	.097	-.120	-.004	-.031	-.028	.031	-.170	.051	.153
Straw 3 <sup>rd</sup>	1	.458	.070	-.080	-.209	-.147	-.156	-.161	.014	-.058	-.205	-.100	.037	-.017	.191
Straw 2 <sup>nd</sup>		1	.547	-.038	-.095	.026	-.180	-.160	.003	-.101	.053	.107	-.158	.077	.204
Straw 1 <sup>st</sup>			1	-.055	.045	-.037	-.153	-.060	-.034	-.103	.009	.003	-.189	.006	-.024
Ø base				1	.239	.404	.470	.109	.257	.159	.360	.790	.231	.055	.216
Ear l.,cm					1	.030	.564	.468	.418	.307	.560	.504	.311	-.022	.126
Ear W.,g						1	.724	.444	.579	.493	.939	.990	.338	.209	.558
No. spikelets							1	.335	.420	.451	.713	.671	.230	.114	.240
Glume,mm								1	.649	.386	.384	.407	.339	-.120	.266
Palea,mm									1	.488	.484	.559	.386	.045	.446
Awn,cm										1	.388	.445	.379	.052	.356
No. grains											1	.941	.237	.151	.279
Grains W.,g												1	.305	.239	.575
Grain L.													1	.082	.325
Grain W.														1	.305
LSD 5 % = .190    LSD 1 % = .250    LSD 0.1% = .320															

**Table 2. Statistical indices of Trivale variety straw and ear**

Indices*	Straw, inter-nodes					Ears		
	Length	Basal	Sub-apical	Apical	Ø basis	Length	Weight	No. spikelets
	<b>2020</b>							
Mean	<b>68,65</b>	<b>14,78</b>	<b>17,45</b>	<b>24,71</b>	<b>3,35</b>	<b>9,02</b>	<b>2,13</b>	<b>18,77</b>
s <sup>2</sup>	45,54	12,25	5,01	11,92	0,154	1,187	0,3965	3,00
s	6,74	3,5	2,23	3,45	0,392	1,089	0,6296	1,73
CV %	<b>9,8</b>	<b>23,7</b>	<b>12,8</b>	<b>14,0</b>	<b>11,7</b>	<b>12,1</b>	<b>29,6</b>	<b>9,2</b>
<b>2021</b>								
Mean	<b>76,14</b>	<b>13,16</b>	<b>20,62</b>	<b>34,12</b>	<b>3,51</b>	<b>8,66</b>	<b>2,39</b>	<b>18,44</b>
s <sup>2</sup>	64,6	2,7	6,3	20,9	0,14	1,04	0,3	4,3
s	8,04	1,6	2,5	4,5	0,3	1,02	0,6	2,09
CV %	<b>10,5</b>	<b>12,7</b>	<b>12,2</b>	<b>13,4</b>	<b>10,7</b>	<b>11,9</b>	<b>26,4</b>	<b>11,3</b>

\*) s<sup>2</sup>, variance, s, standard deviation, CV, coefficient of variation

In the same order, the number of grains formed in a spike was 42.7 to 41.2. The weight of the grains in a spike was 1.66 g to 1.84 g. The grains dimensions had an average length of 7.00/ 3.22 mm compared to 6.46/ 3.06 mm thickness.

The mass of one thousand grains was 38.6 g in the first year compared to 43.4 g in the second year (table 3). Greater variability was found in the number of grains in an ear and in the weight of the grains in both years.

**Table 3. Statistical indices of spikelet membranes and grains, *Trivale* variety**

Indices*	Spikelet membranes			Grains				
	Glume	Palea	Awn	No./ear	Weight	Length	Thickness	TGW
2020								
Mean	<b>8,67</b>	<b>10,02</b>	<b>6,41</b>	<b>42,73</b>	<b>1,66</b>	<b>7,00</b>	<b>3,22</b>	<b>38,6</b>
s <sup>2</sup>	0,377	0,700	1,710	105,18	0,2578	0,112	0,068	32,686
s	0,614	0,836	1,307	10,25	0,5077	0,334	0,260	5,717
CV %	<b>7,1</b>	<b>8,3</b>	<b>20,4</b>	<b>24,0</b>	<b>30,6</b>	<b>4,8</b>	<b>8,1</b>	<b>14,9</b>
2021								
Mean	<b>8,65</b>	<b>9,74</b>	<b>5,77</b>	<b>41,22</b>	<b>1,84</b>	<b>6,46</b>	<b>3,06</b>	<b>43,4</b>
s <sup>2</sup>	0,5	0,8	1,02	89,6	0,2	0,1	0,009	15,9
s	0,7	0,9	1,01	9,4	0,48	0,41	0,09	3,9
CV %	<b>8,3</b>	<b>9,4</b>	<b>17,7</b>	<b>22,9</b>	<b>27,1</b>	<b>6,5</b>	<b>3,2</b>	<b>9,1</b>

\*) s<sup>2</sup>, variance, s, standard deviation, CV, coefficient of variation

#### 4. CONCLUSIONS

The morphological characteristics of the winter wheat, studied in comparison in the two years, had specific aspects. The *Trivale* variety has benefited from some new genetic improvements throughout the breeding season in the resort. It has a clear tolerance for soil acidity induced by aluminum ions, but also high production capacity, and other different tolerances, very important for the increased adaptability to the ecology of the resort.

By comparison between the two years of cultivation, namely a drier and a more favorable one, the stem/ straw had an average length of 70-75 cm. The values obtained show the existence of a semi-short waist, a condition increasingly induced in the improvement of winter wheat to maximize production.

The spike had lengths of 9-10 cm, and weighed 2 g. The number of spikelets was 19. Spikelet pieces: glume, palea and awn measured 9 mm, 10-11 mm and 6-8 cm, respectively.

The number of grains in a spike was 40-50, weighing 1.5- 2 g, the grain was 7 mm long and 3.2 mm thick. The mass of a thousand grains stood at 40-45 g. Through these results, the *Trivale* variety showed improved traits in all aspects.

Simple correlations were established between all the studied characters, with some small differences. Thus, both the characteristics of the straw and those between the elements of productivity, mostly similar correlations were obtained in the two years.

The *Trivale* variety showed an obvious improvement in morphological characteristics, based on an increased adaptability to the environment where it was created.

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