

Comparative Analysis of Some Wheat Genotypes Based on Plant Height Parameter

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Abstract. The height of the plants is an important morphological parameter, in relation to the production of biomass, the randomnet of grains, carbon fixation, technological agronomic aspects. The study analyzed and characterized 25 wheat genotypes based on the parameter of plants (LH). The field experiments were located within ARDS Lovrin, agricultural year 2023 - 2024. The height of the plants varied between $pH = 80.00 \pm 1.43$ cm (genotypes L_5040, L_5041, L_5045), and $pH = 105 \pm 1.43$ cm (genotype L_5042). The data series presented a normal distribution, with $r = 0.980$. The mean calculated value was $= 90.32 \pm 1.43$ cm. Compared to the mean value, ten genotypes presented values superior to the average, and ten genotypes presented below average values, under statistical safety conditions. With values higher than the average, 100 cm, and higher, were: L_5042 ($\Delta PH = 14.68$ cm, ***), L_5048 ($\Delta PH = 12.68$ cm, ***) and L_5035 ($\Delta PH = 9.68$ cm, ***). Cluster analysis has grouped the genotypes based on similarity (Coph.Corr. = 0.757). In the series of recorded values, some wheat genotypes presented equal height, three genotypes at the value $pH = 80$ cm, four genotypes at $pH = 85.00$ cm, four genotypes at pH level = 90.00 cm, and five genotypes presented the value $pH = 95.00$ cm. In Quartila Q1 (Lower Quartile), five genotypes (L_5040, L_5045, L_5037, and L_5039) were framed, and in Quartila Q4 (Upper Quartile) four genotypes (L_5026, L_5048, and L_5042) were included. The other genotypes were grouped in the median domain (Q2, and Q3).

Keywords: cluster, comparative analysis, plant height, quartiles, statistical analysis, variability, wheat

INTRODUCTION

In the morphological description and the characterization of wheat plants, the height of plants is a defined genetic character (Würschum et al., 2015; Liu et al., 2022), of high importance in the relationship of plants with environmental factors and productivity of crops (Li et al., 2022; Liu et al., 2022).

In the natural forms of wheat, genotypes with variable heights were identified, and in the programs of greasy improvement were created wheat genotypes with different heights (low, medium, high), for certain environmental conditions, agricultural systems and technologies, the destination of crops (Wang et al., 2022; Temizgul et al., 2025).

In the interaction of wheat plants with environmental conditions, the height of plants varies in relation to water and nutrients, with vegetation factors as a whole, with different stress factors, and through culture technologies this parameter can be controlled with different bioregulatory substances (Miao et al., 2024; Yang et al., 2024).

Genotypes of wheat with low height may have an advantage in culture for areas with limiting climatic conditions, in relation to water and nutritional resources, as well as from the perspective of falling resistance (Cann et al., 2020; Nyaupane et al., 2024).

Genotypes with large waist provide a high biomass production, have a high potential for efficiency, but require more water and nutrient resources (Alotaibi et al., 2025; Gao et al., 2025). At the same time, in the case of these genotypes the phenomenon of plants can record higher frequency (Niu et al., 2021; Kong et al., 2024). The genetic and morphological variability has been analyzed in different genotypes of wheat in relation with the specific growth conditions, and as a genotype - medium interaction (Bendjama and Ramdani, 2022).

Between the height of wheat plants, productivity and efficiency elements were identified certain interdependence relationships, under different climate, soil, culture technology (Zhang et al., 2024; Shaheen et al., 2025).

Crops with high height may have agronomic and environmental advantages from the perspective of high biomass yields, high productivity with favorable effects in carbon fixation (Thompson et al., 2019; Blandino et al., 2020). Secondary biomass from wheat crop (plant residues, straw) can be incorporated into the soil, with beneficial effects on the soil, or can be used in other economic sectors.

The study comparatively analyzed a collection of 25 wheat genotypes based on the height of plants, and classified the genotypes based on the respective parameter.

MATERIAL AND METHODS

Twenty -five wheat genotypes were analyzed and characterized in this study, in terms of plant height. The comparative culture was located within the ARDS Lovrin, the agricultural year 2023 - 2024. The climatic data

that characterized the experimental period are presented in Table 1. During the entire agricultural year, the rainfall regime recorded a deficit of -104.0 mm. During the period October - July (the growing season of wheat), the rainfall regime recorded a deficit of -133.3 mm compared to the multiannual mean. In the case of the thermal regime, a positive deviation of 3.7 °C was recorded compared to the multiannual mean.

Table 1. Climatic data during the experimental period

Climatic parameters	Period												2023-2024
	2023				2024								
	IX	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	
	Rainfall regime (mm)												Amount
Monthly amount	79.0	23.2	63.8	49.4	38.0	7.4	35.0	23.0	15.4	24.4	33.8	25.0	417.4
Multiannual mean	42.4	40.5	48.0	39.7	32.7	29.6	32.3	42.7	57.3	68.1	55.8	32.3	521.4
Deviation	36.6	-17.3	15.8	9.7	5.3	-22.2	2.7	-19.7	-41.9	-43.7	-22.0	-7.3	-104.0
	Thermal regime (°C)												Mean
Monthly mean	21.3	15.3	6.7	3.4	1.6	7.9	9.6	13.8	18.1	23.6	26.8	26.9	14.6
Multiannual mean	16.8	11.1	5.5	1.1	-1.1	0.9	5.3	10.7	16.3	19.8	22.2	21.7	10.9
Deviation	4.5	4.2	1.2	2.3	2.7	7.0	4.3	3.1	1.8	3.8	4.6	5.2	3.7

The wheat genotypes were noted in this study from L_5026 to L_5050. For the uniformity of the experimental conditions, the comparative culture was located on a plan, with chernoziom soil, and the field peas was the preliminary culture. The classic system of works was used for the preparation of the land. Fertilization with complexes (1/1/1, 180 kg ha⁻¹, application in autumn) and urea (118 kg ha⁻¹, application in spring) was made evenly. The sowing was made in the second decade of October. The sunrise was registered since the first decade of November. Culture technology has ensured plant protection.

At the physiological maturity, the plant samples from each genotype were taken and the parameter height plants (pH, cm). The determination was done in the laboratory, by measuring the table on the graded ruler (precision ± 0.1 mm). The registered data were analyzed with the PAST software (Hammer et al., 2001) and the calculation module in Excel.

RESULTS AND DISCUSSIONS

From the aspect of the height of the plants, the genotypes of wheat have behaved differentiated, in relation to the biological potential. Values of the height of the plants between pH = 80.00 ± 1.43 cm (L_5041, L_5045, three genotypes), and pH = 105 ± 1.43 cm (L_5042) have been recorded. The series of values for the morphological character The height of the plants (pH, cm) presented normal distribution, $r = 0.980$, figure 1.

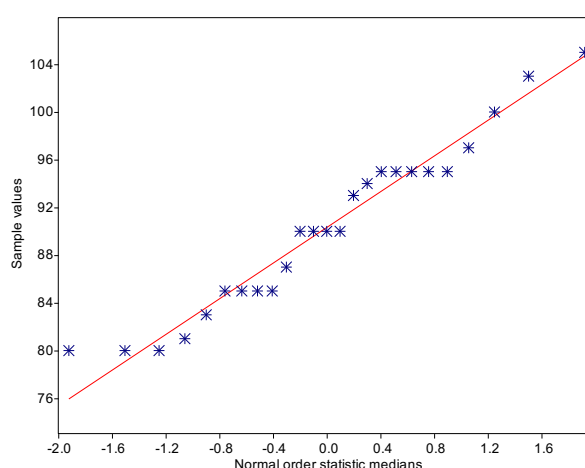


Figure 1. Data series distribution, PH parameter of wheat genotypes

Plant height is an important parameter for wheat cultivation, in relation to biomass production, grain yield (Xi et al., 2024), but also in relation to the risk of plant collapse under certain technological conditions and environmental factors (Khobra et al., 2019).

A comparative analysis of wheat genotypes was performed to evaluate the positioning of each genotype relative to the average value at the experiment level. The calculated average value was $= 90.32 \pm 1.43$ cm.

Compared to the average value, ten genotypes presented values above the average, and ten genotypes presented values below the average, within statistical safety conditions, table 2, figure 2.

Table 2. Difference values and significance for the plant height (PH) parameter in the collection of wheat genotypes studied

Genotype	Given mean	Sample mean	95% conf. interval	Difference	95% conf. interval	t	p (same mean)	Significance
L_5026	97			6.68	(3.7256 9.6344)	-4.6666	<0.001	***
L_5027	95			4.68	(1.7256 7.6344)	-3.2694	0.003	**
L_5028	95			4.68	(1.7256 7.6344)	-3.2694	0.003	**
L_5029	90			-0.32	(-2.6344 3.2744)	0.2236	0.825	ns
L_5030	90			-0.32	(-2.6344 3.2744)	0.2236	0.825	ns
L_5031	94			3.68	(0.72562 6.6344)	-2.5708	0.017	*
L_5032	95			4.68	(1.7256 7.6344)	-3.2694	0.003	**
L_5033	95			4.68	(1.7256 7.6344)	-3.2694	0.003	**
L_5034	87			-3.32	(0.36562 6.2744)	2.3193	0.029	o
L_5035	100			9.68	(6.7256 12.634)	-6.7623	<0.001	***
L_5036	93			2.68	(-0.27438 5.6344)	-1.8722	0.073	ns
L_5037	81			-9.32	(6.3656 12.274)	6.5109	<0.001	ooo
L_5038	85	90.32	(87.366 93.274)	-5.32	(2.3656 8.2744)	3.7165	0.001	oo
L_5039	85			-5.32	(2.3656 8.2744)	3.7165	0.001	oo
L_5040	80			-10.32	(7.3656 13.274)	7.2094	<0.001	ooo
L_5041	80			-10.32	(7.3656 13.274)	7.2094	<0.001	ooo
L_5042	105			14.68	(11.726 17.634)	-10.2550	<0.001	***
L_5043	90			0.32	(-2.6344 3.2744)	0.2236	0.825	ns
L_5044	95			4.68	(1.7256 7.6344)	-3.2694	0.003	**
L_5045	80			-10.32	(7.3656 13.274)	7.2094	<0.001	ooo
L_5046	85			-5.32	(2.3656 8.2744)	3.7165	0.001	oo
L_5047	85			-5.32	(2.3656 8.2744)	3.7165	0.001	oo
L_5048	103			12.68	(9.7256 15.634)	-8.8581	<0.001	***
L_5049	85			-5.32	(2.3656 8.2744)	3.7165	0.001	oo
L_5050	90			0.32	(-2.6344 3.2744)	0.2236	0.825	ns

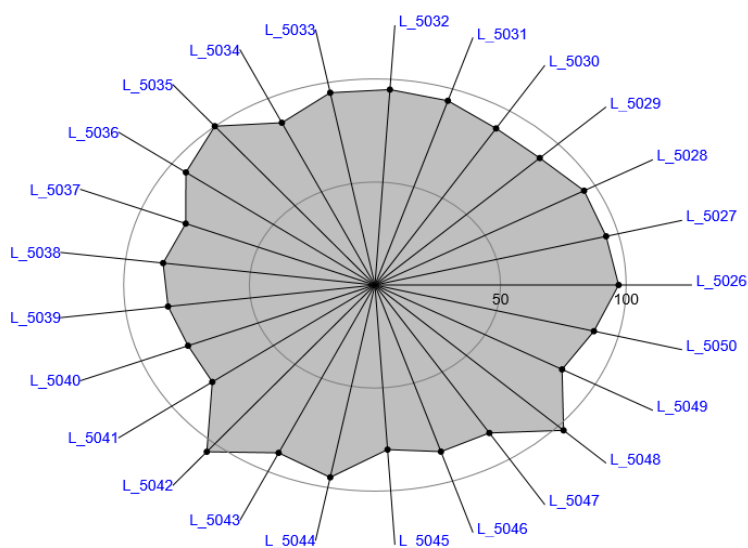


Figure 2. Graphical distribution of wheat genotypes in relation to the PH parameter

With plant height values above average, in conditions of statistical certainty of growth (ΔPH), several genotypes were positioned. The first three genotypes, with values of 100 cm, and higher, were: L_5042 ($\Delta PH = 14.68$ cm, ***), L_5048 ($\Delta PH = 12.68$ cm, ***) and L_5035 ($\Delta PH = 9.68$ cm, ***). According to the data in

table 2, figure 2, another seven genotypes presented values above average, with statistical certainty of differences. With the lowest values, below the average of the experiment, three genotypes were positioned equally, L_5040, L_5041 and L_5045 ($\Delta PH = -10.32$ cm), followed by L_5037 ($\Delta PH = -9.32$ cm). The results in table 2 showed six more wheat genotypes, which recorded values below the average of plant height, with statistically assured differences. The graphic distribution of the differences of the PH parameter in the analyzed wheat genotypes is presented in figure 3.

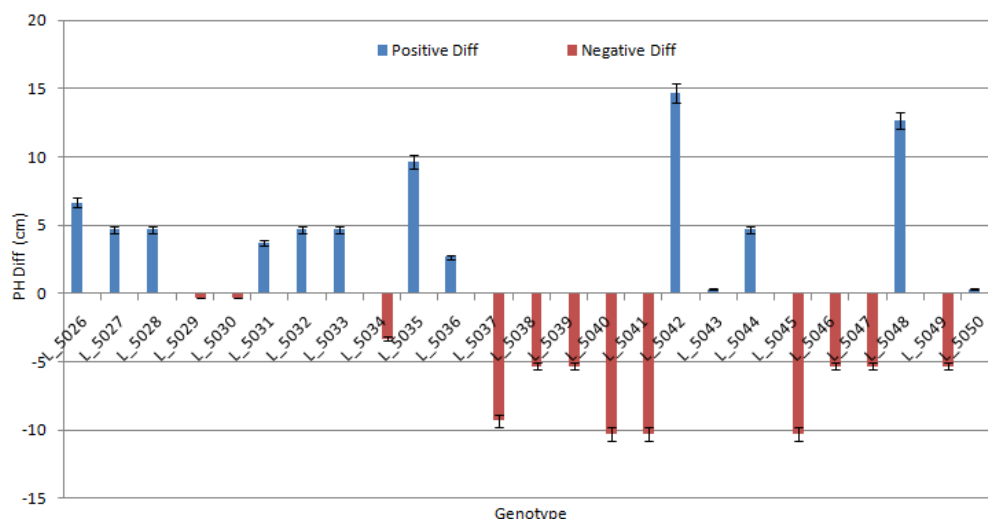


Figure 3. Graphical distribution of the differences in the PH parameter in relation to the mean value in the studied wheat genotypes

The cluster analysis generated a dendrogram grouping wheat genotypes based on similarity, in relation to the values recorded for the plant height parameter (Coph.corr. = 0.757). The wheat genotypes cultivated in the study were grouped into two distinct clusters, with several subclusters, in direct relation to the recorded values, figure 4.

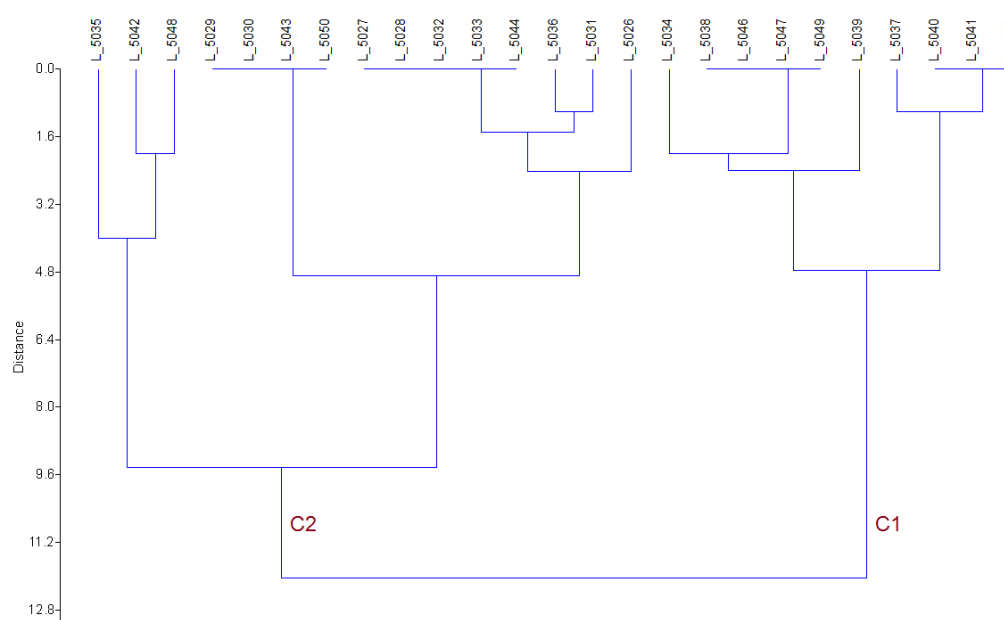


Figure 4. Cluster dendrogram of wheat genotypes, based on Euclidean distances

Ten genotypes were grouped in cluster C1, with low values of the plant height parameter. Fifteen genotypes were grouped in cluster C2, with values close to the average and above the average. High levels of similarity were recorded in both cluster C1 and cluster C2. The values of the plant height (PH) parameter need to

be analyzed in accordance with other morphological, agronomic and yield parameters of the wheat genotypes in the laboratory collection, for a characterization as a genetic source in the improvement process of each genotype. Also, a technological characterization of each genotype is useful.

According to Descriptive Statistics, from the analysis of the data series, the quartile thresholds were 25 percentile = 85, and 75 percentile = 95. Considering that four wheat genotypes presented the value PH = 85.00 cm, and five genotypes presented the value PH = 95.00 cm, in the quartile Q1 (Lower Quartile), five genotypes were classified (L_5040, L_5041, L_5045, L_5037, and L_5039), and in the quartile Q4 (Upper quartile) four genotypes were classified (L_5026, L_5035, L_5048, and L_5042). In the median zone (Q2, and Q3) 16 genotypes were included (L_5038, L_5046, L_5047, L_5049, L_5034, L_5029, L_5030, L_5043, L_5050, L_5036, L_5031, L_5027, L_5032, L_5033, and L_5044). The distribution of genotypes in relation to the 95% confidence interval is presented in figure 5.

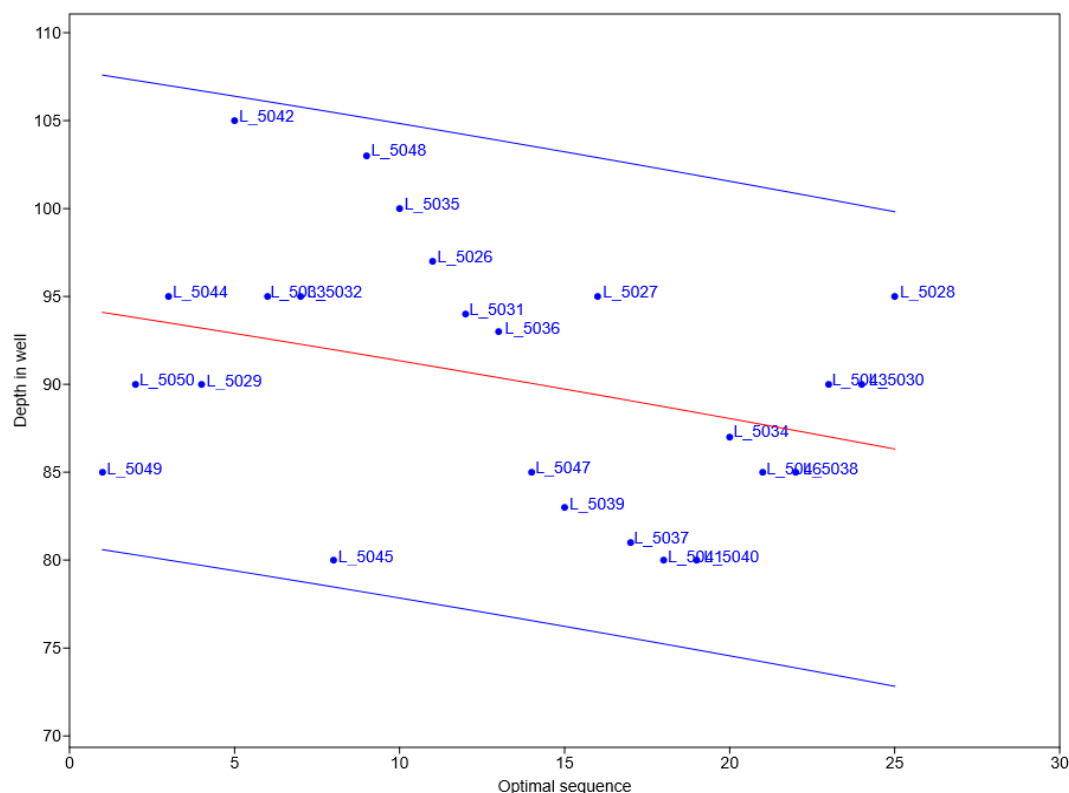


Figure 5. Distribution of wheat genotypes in the confidence interval, based on PH values

Wheat has been extensively studied from agronomic, ecological, yield perspectives, for the optimization of agricultural technologies (Boldea and Sala, 2010; Farouk et al., 2024). Comparative studies have been carried out in different collections of wheat genotypes to characterize physiological indices, morphological and biometric parameters, biomass production and yield (Dhyani et al., 2013; Constantinescu et al., 2018). This study characterized and classified the 25 wheat genotypes in comparative culture based on plant height, with importance for both breeding programs and agricultural practice.

CONCLUSIONS

Wheat genotypes recorded differentiated values for the plant height parameter, as an expression of specific genetic potential, with values ranging between PH = 80.00±1.43 cm (L_5040, L_5041, L_5045, three genotypes equally), and PH = 105±1.43 cm (genotype L_5042).

In relation to the calculated mean value ($\bar{PH} = 90.32 \pm 1.43$ cm), ten genotypes presented values above the mean, and ten genotypes presented values below the mean, under conditions of statistical safety of the differences.

Several wheat genotypes recorded equal height, three genotypes at PH = 80 cm, four genotypes at PH = 85.00 cm, four genotypes at PH = 90.00 cm, and five genotypes at PH = 95.00 cm. In the Q1 quartile (Lower Quartile), five genotypes (L_5040, L_5041, L_5045, L_5037, and L_5039) were included, and in the Q4 quartile (Upper Quartile) four genotypes (L_5026, L_5035, L_5048, and L_5042) were included.

The recorded information is important for the wheat breeding program, in order to select genotypes with low height, for better resistance to lodging. Also, the information is useful for agricultural practice, in order to assess the risk of lodging for genotypes with high values for plant height, and to adapt technologies by using bioregulatory substances, as appropriate.

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