Research Article

Studies of Morpho-Physiological and Phenological Aspects for a Collection of Algerian Durum Wheat (*Triticum durum Desf.*)

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ABSTRACT: A collection of 215 genotypes belonging to two varieties of Algeria durum wheat (*Triticum durum*) were examined in this study. The field work was done at the experimental farm Technical Institute for Field Crops (TIFC/ITGC) 2008–2009. The climatic conditions, in this period (temperature and precipitation) were more or less favorable to the different phases of growth of our plants. However, their effect on phenological and morpho-physiological parameters was different for the two varieties studied: Leucomeulon and Reichenbachi. Multivariate analysis revealed the existence of very important intra- and inter-varitale variability. Thus, most of the genotypes of the variety *Reichenbachi* present displayed physiological and morphological aspects allowing a better development of plants, whilst many genotypes of the variety *leucomelon* displayed better performance in terms of production.

KEYWORDS: *Triticum durum*, Phenology, Morphology, Physiology, Adaptation

INTRODUCTION

Today food and industrial plants are mainly use selected and improved strains, providing the highest yields per hectare, those best adapted to specific conditions of climate and farms or the richest in certain constituents, such as sucrose in the sugar beet (*Beta vulgaris* L.) or gluten for Durum wheat (*Triticum durum* L). Recently crop improvement of medicinal plants has also received attention. Such research has aimed to address several criteria: increase growth rate; increase resistance to pests; improve the appearance of the drug drawn from them; but especially for a high content of active ingredients.[1] Consumption of Durum wheat is known to decrease many chronic diseases including diabetes,[2] cardiovascular disease[3] and cancer[4] due to the presence of beneficial phytochemicals including antioxidants[5] and phenolic compounds.[6]

Algeria for decades had stagnant wheat yields, due mainly to climatic conditions and the random choice of variety, the poor control of technical itinerary and the low performance of yields leading to a mismatch between supply and demand. The quantities of cereals produced in Algeria are estimated at 41 million quintals per year. Local production of wheat covers only 50% of the national needs. The annual needs of Algeria in durum wheat are estimated at 60 million quintals.[7] As the low yield potential engenders low grain production, it is imperative to select high-yeilding cultivars, in our study, we chose a part of a collection that includes 215 genotype to study the variability related to phonological and morpho-physiological aspects. The results were processed by multivariate analysis.

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MATERIALS AND METHODS

The plant material consists of accession of Algerian durum wheat genotypes,containing 215 genotypes belonging to the varieties leucomelon and Reichenbach.[8] This collection comes from different regions of Algeria and is stored at the ITGC “El Khroub-Constantine”.

Experimental Protocol

The experiment was performed on a relatively homogeneous plot referred to as “el Koudiet Kamhi”, at the experimental station (ITGC) El-Khroub, south of

Constantine, at an altitude of 640 m. The soil is deep and gravel with a clay loam texture, pH = 7.5.

Measured parameters

Measurements and observations are based on the characters studied during development cycle of the plant.

Phenological parameter

The duration of different phases of the growth cycle of the plant for 242 genotypes is counted from planting. The duration of ear emergence is noted when 50% of items surveyed (tiller, spike etc) of the elementary plot were released.

Morphological and agronomic parameters

The parameters studied are:

- The number of tillers herbaceous (TH).
- The number of tillers, ear (TE).
- The length and width of flag leaf (LonF, Larf).
- The height of the plant (HP (cm)) measured from ground to the top of the ear (non-beard included).
- The length of the ear (LE (cm)) at maturity, measured from the base of the ear to top, beard not included.
- The length of the beard (LB (cm)) measured at maturity from the middle third of the ear.
- Cervical length (CL (cm)) measured at maturity from the last node.

Yield components

- The number of ear per plant (NE/P).
- The number of spikelets per spike (NS/E).
- The number of grains per spike (NG/E) is determined by counting the number of grains.
- The weight of grains per ear in grams (PG).

Physiological parameters

The determination of chlorophyll is made from the flag leaf at a rate of 3 replicates for each genotype.

From the results, multivariate analysis were performed using the software XLSTAT.

The water content was calculated by reducing the fresh weight of the dry weight of flag leaf (FE).

All measurements were made on 11 variables and 3 repetitions for each genotype.

Principal component analysis (PCA)

This descriptive technique allows to synthesize information contained in a large number of variables.

RESULTS

Phenological parameters

Duration of emergence of spikes

This phase spans a period from 135 to 137 days in the variety Leucomelon. Genotypes 1–18, 45–56, 83–89, 103–107, 116–128 registered the shortest period of 135 days, followed by genotypes 108–115, 129–139 hat have duration of 136 days. The remaining genotypes (19–38), (57–70) and (90–102), show a period of 137 days (Figure 1).

Among the variety Reichenbachi, the duration for emergence of spikes is 140 to 142 days. Genotypes 1–14 and 44–57 took 140 days for spike emergence, followed by genotypes 15–43 genotypes whose duration was 141 days. The duration for spike emergence of genotypes (68–76) was 142 days (Figure 2). The emergence of spikes specifies the duration of developmental phases that play an important role in the development of yield components and the avoidance adverse weather accidents. This is a very important feature in the adaptation of the cereal to a given environment.[10]

Morphological and physiological parameters–height of the plant

Plant height varies from 74 to 165.2 cm for the leucomelon varieties. Genotypes 12, 45, 113 and117 form the group of the tallest plants with a maximum height of 165.2 cm for the genotype 44. In contrast genotypes (68, 75 and 76) were shorter plants (Figure 3). The Leucomelon variety recorded values ranging from 71.3 cm to 162.5 cm for the minimum and 76.7 cm to 167.9 cm for the maximum values, with a standard deviation of 1.41 to 10.6.In comparison, for the Reichenbach variety, the height of its plants is between 63.5 for cultivar 12 and 152.5 cm for 29. Genotypes (3, 4, 15, 16.17, 29, 30, 32, 33, 36, 39, 47 and 69) recorded the greatest height, unlike the genotype 13 which was the shortest. The other genotypes showed intermediate heights and very variables (Figure 4). Nachit et al.,[9] Bouzerzour and Oudina,[10] it has previously been shown that height is a desirable trait in semi arid areas where the pay is not a problem. [1, 7] Also in these areas is very significant straw by livestock.

Agronomic parameters – number of spike per plant

The results show a small variation in the number of spikes per plant between the 139 genotypes of the variety Leucomelon. Indeed, the mean values are from 3 to 6 ears per plant.

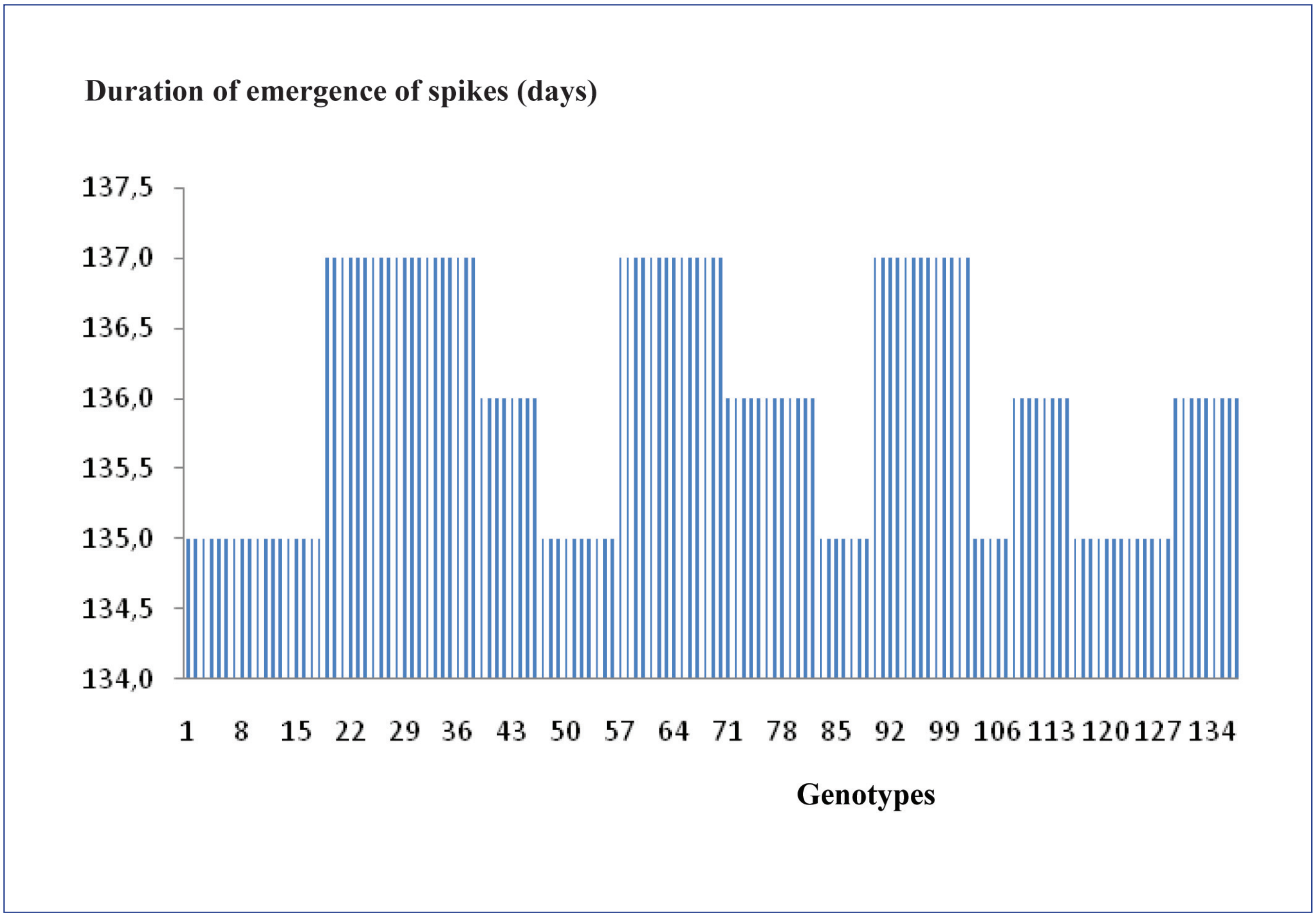

Figure 1: The number of days to heading of 139 genotypes of the variety Leucomelon.

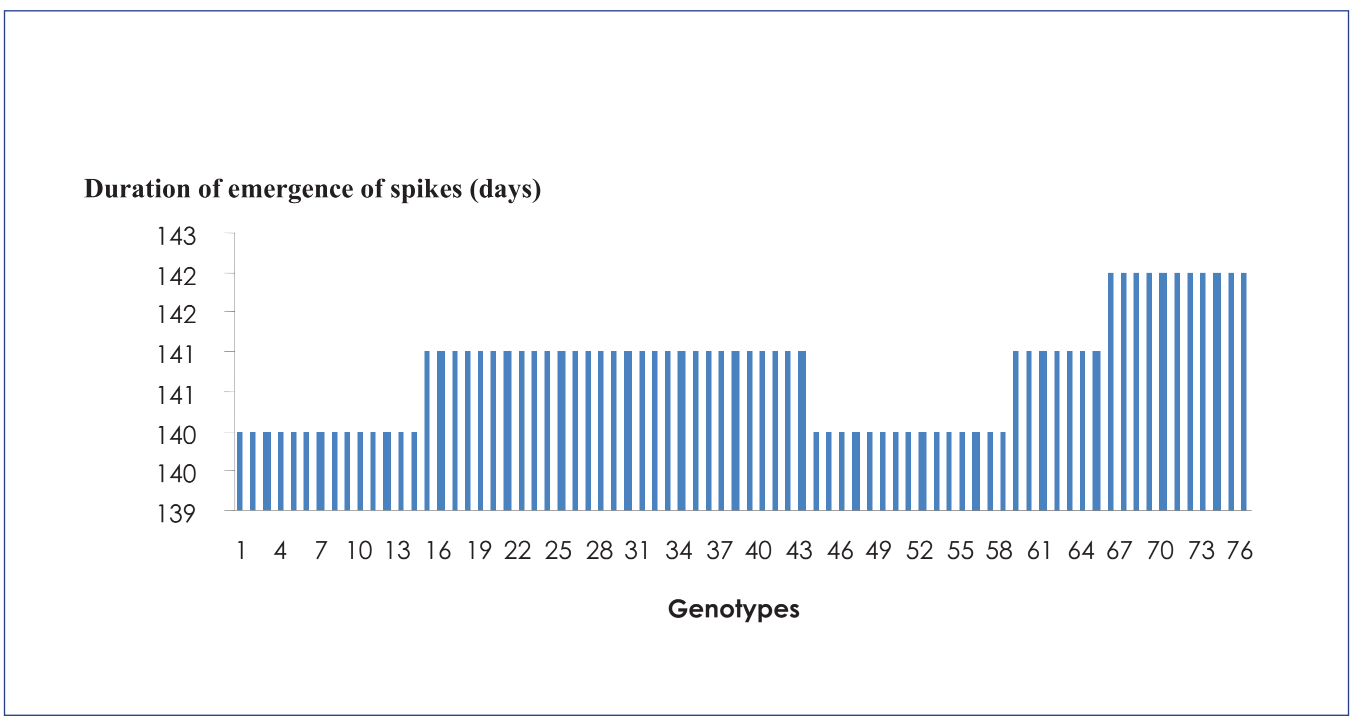

Figure 2: The number of days to heading of 76 genotypes of the variety Reichenbachi.

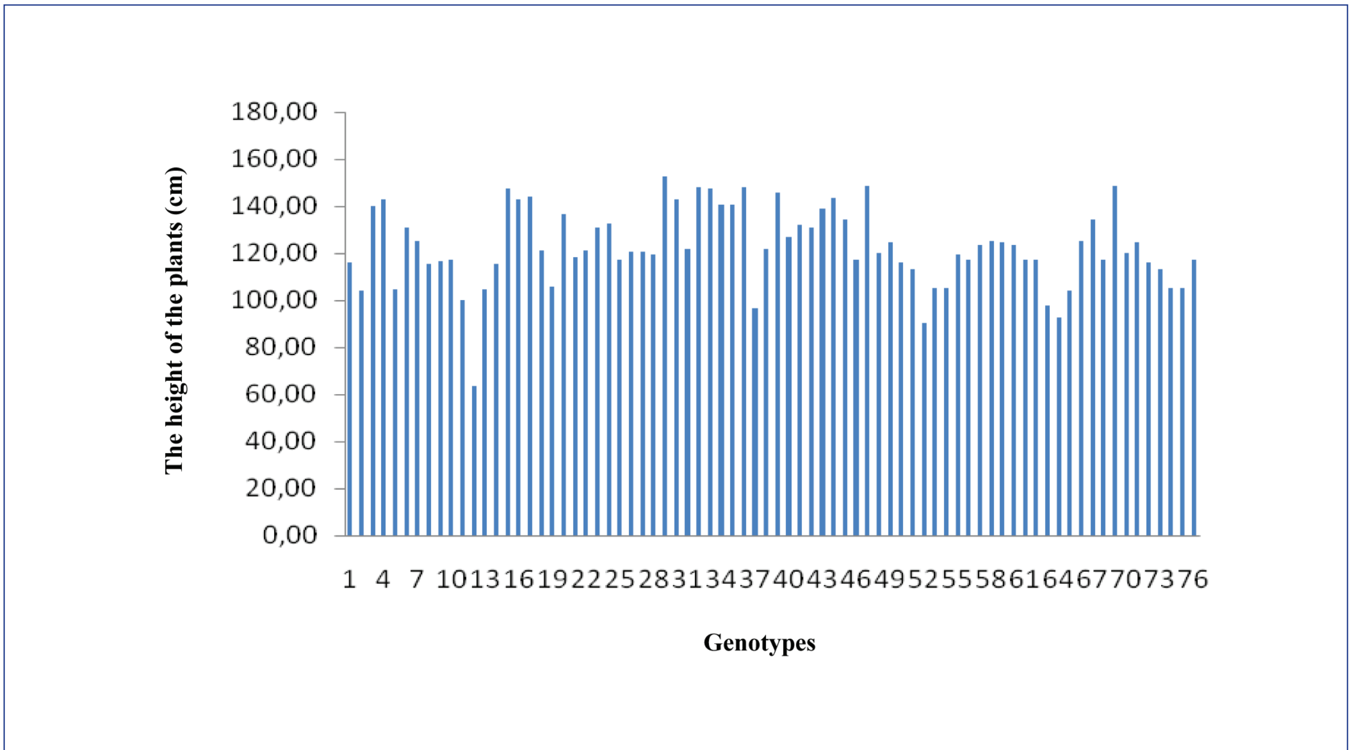

Figure 3: The height of the plants of 76 genotypes of the variety Reichenbachi.

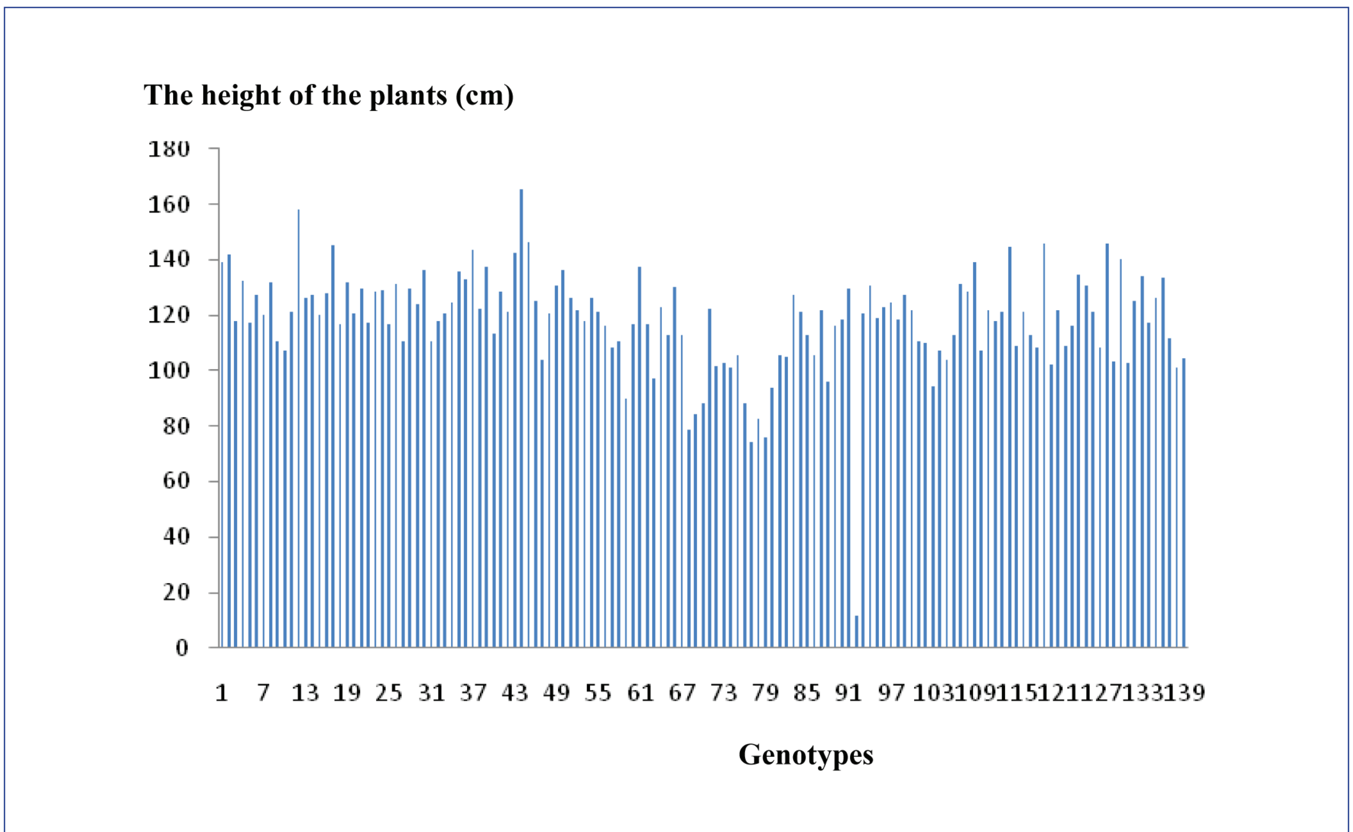

Figure 4: The height of plants of 139 genotypes of the variety Leucomelon.

The 3, 4, 13, 14, 15, 50, 51, 52, 97, 98 genotypes and 99 have 6 spikes, the 25,26,74 and 120 genotypes possess five. However, the genotypes 22, 25, 26, 42, 45, 46, 58, 60, 61, 72, 75, 89, 92, 108 and 109 have only 3 (Figure 5).

Among the variety Reichenbachi, the mean values are from 3 to 6 ears per plant. The number of ears was the highest observed among genotypes 19, 20, 21, 36, 37 and 74 and lowest among genotypes 3, 5, 6 and 39 (Figure 6).

Study of variability

To compare the two varieties, a principal component analysis (PCA) was performed on a data matrix of a population of 215 genotypes of varieties *Leucomelon* and *Reichenbach*. Eleven variables were considered in this study.

The principal component analysis allowed revealing that the axes 1, 2, 3.4, respectively, explain 18.5%, 12.25%, 10.96% and 10.04% of the total information, so the three planes 1–2, 1–3 and 1–4 provide 30.75%, 29.4% and 28.54% respectively.

The correlation matrix of variables

The analysis of correlations between the measured parameters shows the existence of positive and negative links between these parameters, they vary from low to strong binding (Table 1). It appears that the length of ear (SARA) is positively and moderately correlated with the length of the plant (HP) (r = 0.47), and cervical length (CL) is positively correlated with plant height (HP) (r = 0.55).

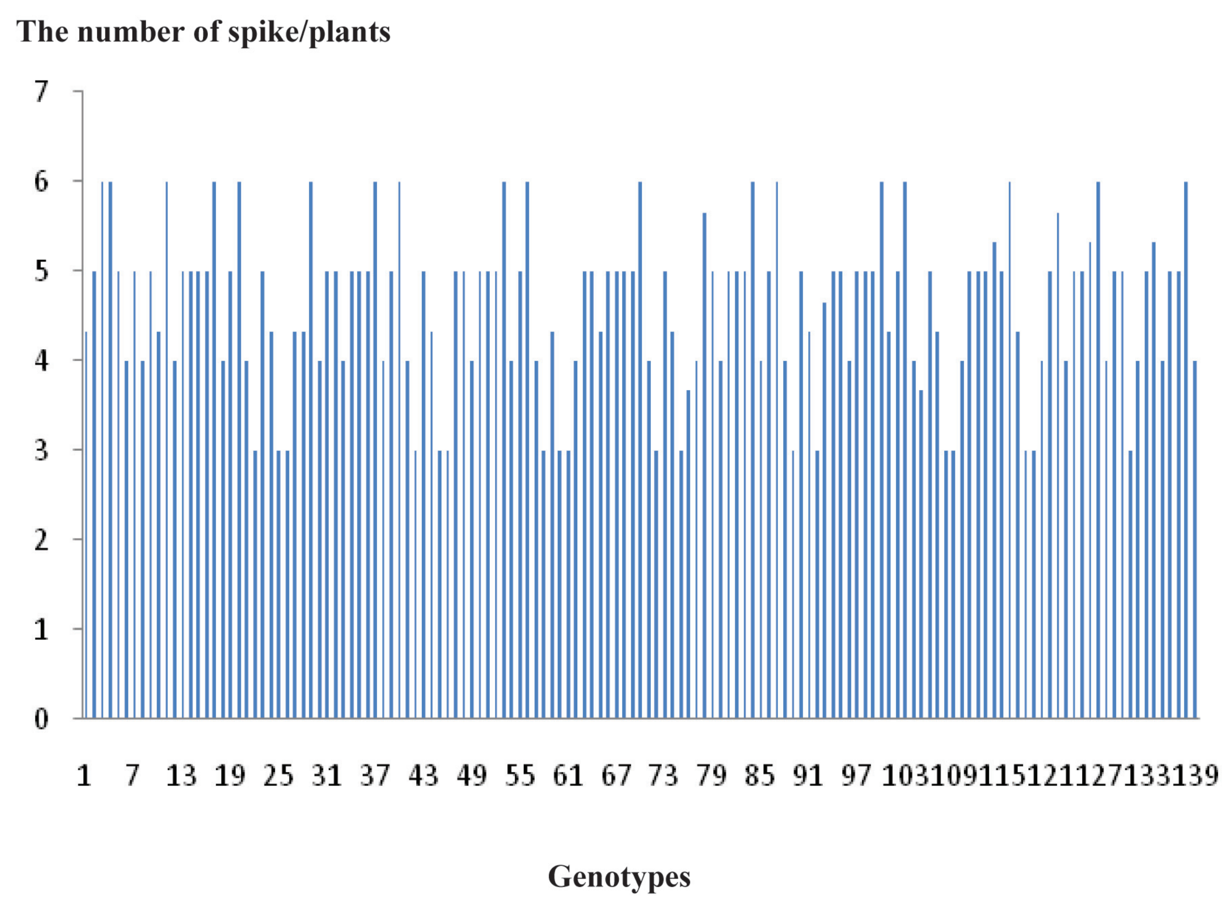

Figure 5: The number of spike/plants of 139 genotypes of the variety Leucomelon.

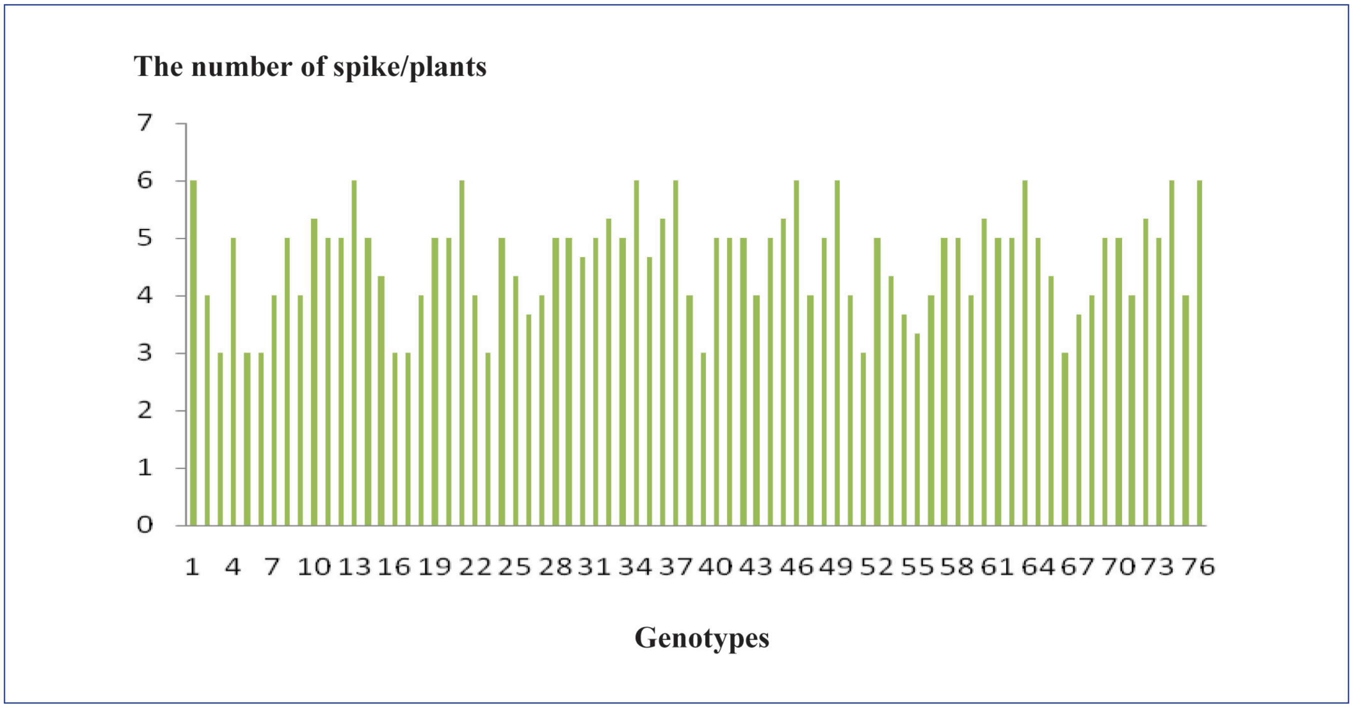

Figure 6: The number of spike/plants of 76 genotypes of the variety Reichenbachi.

DISCUSSION

The principal component analysis allowed us to highlight the formation of eight groups that differ in their phenological and morpho-physiological aspects:

- The first group is formed by genotypes belonging to the variety Leucomeulon and variety Reichenbachi, grouping plants that were most developed (genotypes 9, 13, 20, 23, 26, 41, 43, 47, 48, 49, 54, 67, 117, 133, 137 for variety Leucomeulon; genotypes 4, 5, 19, 20, 33, 34, 39, 42, 43, 44, 45, 49, 50, 51, 53, 58 for the variety Reichenbachi).
- A second group, which consists of fewer genotypes than the previous group, comprised plants that were less developed (genotypes 74, 77, 78, 85 for Leucomeulan variety; genotype 15 for Reichenbachi variety).
- A third group, included 4 genotypes of Leucomelon variety (12, 17, 19, 23) and 5 of Reichenbachi variety (13, 37, 38, 40, 46) was characterized by a higher return .
- A fourth group was composed of some genotypes of the variety Leucomelon (108, 112, 113, 135, 148) and only two genotypes of the variety Reichenbachi (7, 36). This group was characterized by a lower return.

Table 1: Matrix of correlations between variables

	LEP	LB	LC	HP	CHT	LAF	LOF	NE	EP	NG	PG
LEP	1										
LB	0.275	1									
LC	0.277	0.026	1								
HP	**0.474**	0.069	**0,511**	1							
CHT	0.155	–0.069	0,052	0,057	1						
LAF	0	–0.093	0,035	0,027	0,031	1					
LOF	–0.004	0.068	0,096	0,161	0,045	–0,184	1				
NE	0.111	0.1	0,064	0,033	0,062	0,058	0,065	1			
EP	–0.104	–0.072	–0,075	–0,082	0,018	0,004	–0,019	–0,016	1		
NG	0.04	–0.064	–0,072	–0,146	0,027	–0,063	–0,073	0,032	0,011	1	
PG	0.049	0.044	0,013	0,021	–0,016	–0,004	–0,072	–0,018	0,093	0,289	1

- A fifth group consisting of 11 genotypes of the variety Leucomelon (38, 50, 52, 53, 60, 79, 80, 82, 83, 90, 91) and 4 genotypes of the variety Reichenbach (9, 18, 19, 41) was characterized by a width of the flag leaf (LAF).
- A sixth group consists of 10 genotypes of the variety Leucomelon (9, 35, 37, 45, 87, 88, 89, 110, 113, 147) and 4 genotypes of the variety Reichenbachi (5, 35, 38, 82). These plants are characterized by high length of the flag leaf (LOF).
- A seventh group, with 10 genotypes of the variety Leucomelon (25, 30, 42, 61, 62, 72, 86, 97, 104, 111) and 4 genotypes variety Reichenbach (2, 31, 32, 63) had a number of spikelets per spike and a high significant amount of chlorophyll.
- An eighth-group comprising 10 genotypes of the variety Leucomelon (22, 23, 34, 39, 57, 90, 123, 128, 150, 153) and 3 genotypes of the variety Reichenbachi (18, 30, 57) is essentially the opposite of the previous group, with a low the amount of chlorophyll and number of florets per spike.

Cereal production depends on climatic conditions, phenological, morphological and agronomic characters of genotype, and partly of genotype-environment interaction. Indeed, the different nutritional and climatic factors of the environment influence the development and on the potential of plant growth.[12] The results obtained from the parameters considered in this study showed an important variability within this accession of 215 genotypes of two varieties.

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