Pak. J. Agri., Agril. Engg., Vet. Sci., 2022, XXXXX
ISSN: 1023-1072 (Print), ISSN: 2663-7863 (Online)

MORPHOLOGICAL AND AGRONOMIC TRAITS CHARACTERIZATION OF SIX CULTIVARS LOCAL DURUM WHEAT (*Triticum durum* Desf.) IN OUED RIGH REGION (SOUTHEAST ALGERIA)

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ABSTRACT

The study has been carried out at experimental station of National Institute of Agronomic Research of Algeria (INRAA) of Sidi Mehdi Touggourt zone. The plant material consists of six cultivars of *Triticum durum* Dest. The experimental plan has Randomized Complete Bloc Desing (RCBD) with four replication and nineteen biometric characters. The objective of this study is the agro-morphological characterization of six durum wheat cultivars (*Tritcium durum* Desf.) from the Oued Righ region. Nineteen agro-morphological parameters were considered in this study. Moreover, the analysis variance (ANOVA) and the principal component analysis (PCA) highlighted a distinct variation between the studied cultivars, some of which showed good traits such as: precocity yield per plant, thousand grains weight and earing earliness, it's the case of *Fritissi* with 40.8g; 52.38g and 102 days respectively. This inter-cultivar variability observed through morphological characterization requires use of biochemical and molecular markers in order to confirm achieved results.

Keywords: genetic diversity, morphological and agronomic, plant genetic resources, wheat, yield

INTRODUCTION

The interest of wheat cultivars for Algerian agriculture cannot be neglected. These cultivars have been cultivated since 100 years and are adapted to the environmental conditions of arid regions (random water supply, high temperatures and salinity of water and soil) and by their diversity that maintained by the farmers, these cultivars are likely to be the real "model" for Algerian agriculture conditions where the water remains the first limiting factor. Wheat, formerly cultivated in the oases of the Sahara, is becoming increasingly rare. According to resource people, some cultivars have been disappeared (Djermoun, 2009).

Cereals and their derivatives constitute the basic food in many developing countries, particularly in Maghreb countries (Western part of North Africa and the Arab world). Durum wheat (*Triticum turgidum* L. var. Durum), a symbol of Mediterranean diet, is the raw material for many derived products (bread, semolina, pasta, cakes and biscuits) (Troccoli *et al.,* 2000). It is also a privileged resource for animal feed. Its components are extracted mainly as carbon source (starch, glucose and sorbitol) or protein (gluten, emulsifiers and plastics). Wheat grain is an energetic food that contains on average 70% starch, 12% protein, 9% cellulose, free sugars, lipids and minerals at levels below 5%.

Algeria is being recognized as a centre of significant diversity for several cereal species including durum wheat (*Triticum durum* Desf.) and soft wheat (*Triticum aestivum* vulgare L. and *Triticum aestivum spharococcum* L.) (Adamou *et al*., 2005). Unfortunately, this diversity is being threatened by regrettable genetic erosion, especially for Saharan wheat. However, we note a lack of accurate inventories and studies on the state of conservation and management of these local genetic resources (Chekara-Bouziani, 2011).

According to Abdelguerfi and Laouar (2000), from 1967-1968, the massive introduction of so-called high genetic potential foreign cultivars led to great decline in certain cultivars. Even in the oases, the decline of local cultivars is beginning to be felt, some cultivars

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used during the seventies have practically disappeared.

In Algeria, the cereal constitutes the main part of the population's daily food ration and covers an area of 2.7 million hectares and its production reached 3.3 million tonnes in 2014 (FAO, 2015), moreover, it. Durum wheat (*Triticum durum* Desf.) is the first cereal grown in the country and annually occupies more than one million hectares. However, its production is still low, covering only 20-25% of the country's needs, the rest being imported (Chehili *et al*., 2017).

Currently, producing more cereals has become a preoccupation issue for Algeria, whose growing population needs are estimated at more than 111 million quintals by 2020 (Hervieu *et al*., 2006).

Many travellers, such as had reported the presence of wheat in the oasis crops for a long time but their description was imprecise, even erroneous, otherwise, the wheat of the Saharan oases remained for a long time not well known (Benlaghlid *et al.,* 1990).

Several reasons might be advanced to explain this lack of knowledge. Among of them: isolation of the Saharan areas, self-consumption of the wheat produced (the modest production does not agree the constitution of exchangeable surplus) and difficulty of studying Saharan wheat outside their original environment, particularly because of their extreme susceptibility to yellow rust (*Puccinia striiformis* Westend) and failure (Benlaghlid *et al*., 1990).

From the twentieth century, studies were especially devoted to the cultivation of Saharan wheat (Benlaghlid et *al*., 1990 and Chekara-Bouziani, 2011). Ducellier (1920) was the first to attract the attention of agronomists to "the originality of Saharan wheat" and to "the real cultural possibilities" that these cereals offer. It began a considerable work of prospecting and describing the Saharan populations of wheat, which is reflected in the publications of Benlaghlid *et al*. (1990) and Chekara-Bouziani (2011). Up to now, these studies have focused on morphological variability of ears and grains and aim to classify different types encountered. This approach is limited and faces many difficulties such as the heterogeneity of populations, abundance of intermediate forms and imprecision of nomenclature (Benlaghlid *et al*., 1990).

Local names of wheat revealed in the different Saharan regions for different varieties correspond overall either to:

- An estimated characteristic of a phenological stage, such as precocity. In this case, we can quote

***Sebaga*, *Chatter*, *Chouittar* cultivars**

- A rather characteristic aspect of an organ of the plant in question, particularly the ear, for example: Fritas (not bearded) and the quality of their flour, for example: Belmabrouk, El Farh.
- A region, for example: Touatia, Eskandaria, El Menea cultivars.
- Ear colour: The term Hamra (Red), Kahlaya (Black) cultivars.

Indeed, the great variety of soils and climates in the country, and particularly the importance of arid and semi-arid areas, incites us to search for suitable genotypes.

Characterization of genetic resources is a key step in selection (Amallah *et al*., 2016). It enables the safeguarding and rehabilitation of this genetic heritage (Chentoufi *et al*., 2014). These steps also make it possible to estimate the existing of diversity in the material studied and be considered as a starting point for its use in breeding programmes. The ability to identify genetic variation is essential for effective management and use of genetic resources (Khennaoui, 2018).

In this context, we described the extent of the intra-specific agro-morphological variability among collection of durum wheat accessions comprising 6 local cultivars, maintained in the Oued Righ region.

This study was conducted to preserve plant genetic resources from erosion and to valorize our varietal heritage.

MATERIALS AND METHODS

Plant materials

The plant material consists of 6 cultivars of *Triticum durum* Desf. Seeds formerly cultivated of which were collected from farmers in the Oued Righ region. Two cultivars were collected from origin localities: Temacine zone "Khallouf" (Cv1) and "Blidet Amor" (Cv2); three cultivars from Touggourt zone "Arbi" (Cv3), "Hedba" (Cv4) and "Fritissi" (Cv5) and one cultivar from Meggarine zone "Ghamra" (Cv6). Cultivars are named according to the names assigned by the farmers, or their areas of origin, as in the case of the cultivars "Blidet Amor" and "Ghamra".

Experimental site and planting the materials

The study was carried out under irrigated conditions in the experimental station of the National Institute of Agronomic Research of

Algeria (INRAA) located at Sidi Mehdi-Touggourt in the department of Ouargla located at distance of 660 km from the capital of Algiers, during campaigns of 2019; 2020 and 2021. The station is located at longitude 06° 05' 798" East, latitude 33° 04' 325" North and altitude 85 m (Titouh *et al*., 2021). The climate is Saharan; the annual average temperature is 21.97°C. The cumulative annual precipitation for a period of ten years (2004-2013) is 75.13mm. The soils are sandy to sandy-silty. The salinity rate is very high with values between 1.37g/l and 1.43g/l (Allam *et al.*, 2021). Our experimental site is characterized by a soil sandy-silt, with 70 % fine sand. The organic matter is very low, 0.5% and the salinity is 3 mmhos/cm².

The climatic conditions during the experimental years: minimum temperature, maximum temperature, mean temperature and precipitation are respectively as follows: 15.72°C, 29.93°C, 22.68°C and 46.3mm in 2019; 15.9°C, 29.8°C, 22.7°C and 31.6mm in 2020; 20.36°C, 29.8°C, 22.33°C and 97.4mm in 2021

The seed of 6 wheat cultivars and lines was sown in a randomized complete block design with four replications. There were six rows 2.5m long and 20 cm apart and the plot size was 5m². The fertilizer application was performed before sowing, on the plots at the rate of 200 kg ha^{-1}, N.P.K. 15:15:15.

The sowing dates of the cultivars for the 3 years were respectively as follows: 05 November 2018; 12 November 2019; and 25 October 2020.

The irrigation system applied is sprinkling with one irrigation per week, i.e. a water volume of 82.8m^3. The amount of water supplied during the cycle for each year 2019, 2020 and 2021 is respectively estimated at: 910.8m^3; 993.6m^3 and 1076.3m^3.

Agro-morphological data collection

These landraces were characterized by 18 specific morphological traits and earing duration, based on the International Plant Genetic Resources Institute (IBPGR, 1985). The dates of measurements of the various parameters for the 3 years were respectively as follows: 26; 27; 28 and 29 March 2019; 04; 05; 06 and 07 April 2020; 01; 02; 03 and 04 March 2021.

The harvest dates were respectively as follows: 10 and 11 May 2019; 05 and 06 June 2020; 25 and 26 May 2021.

Ten harvest plants of one square meter from middle of each plot were tagged randomly to study different traits and data were recorded for each accession. The following variables were recorded: days to head emergence (DHEM); plant height (PH, cm) measured at maturity from the ground level to the top of the ears; tiller number (TN); internodes number (IN); internode length (IL, cm); leaf number (LN); leaf length (LL, cm); leaf width (LW, cm); spike number per plant (SN); spike length (SL, cm) measured from the base of the ear to the tip; awns lenght (AL, cm); seeds number per spike (Sd/S) determined by counting at the maturity stage; spikelet number per spike (Sp/S); seeds number per spikelet (Sd/Sp); grain length (GL, mm); grain diameter (GD, mm); spine length (SnL, mm); grain yield per plant (YP, g) and thousand grains weight (TGW, g) determined by weighing directly using a precision balance.

Statistical analysis data

The results obtained of different traits of six cultivars have been interpreted by statistical analysis using the XLSTAT program (Addinsoft. XLSTAT. 2016.02.28451). The method used is the Principal Component Analysis (PCA) which is an essentially descriptive statistical method. Its objective is to present, in a graphical form, the maximum amount of information contained in a data Table.

RESULTS AND DISCUSSION

The results recorded represent the average of data from the three years of experimentation (2019, 2020 and 2021).

Phenology (earing duration)

The analysis of the phenology, from sowing to heading, revealed variability between the six wheat cultivars studied varied from 102 to 125 days (Figure 1). The Fritissi cultivar is the earliest with 102 days, while the Boukallouf and Blidet Amor cultivars are the latest with 125 days. In the Saharan areas and under irrigated conditions, we prefer early varieties, in order to avoid high temperatures and water deficits.

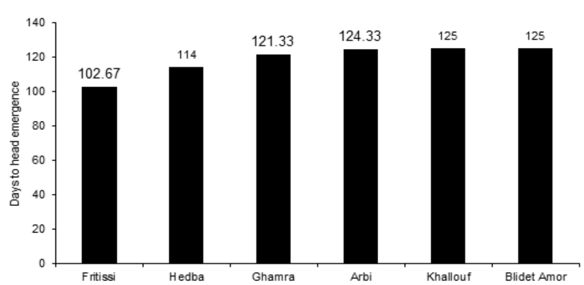

Figure 1. Duration of development cycle (days) of different wheat cultivars

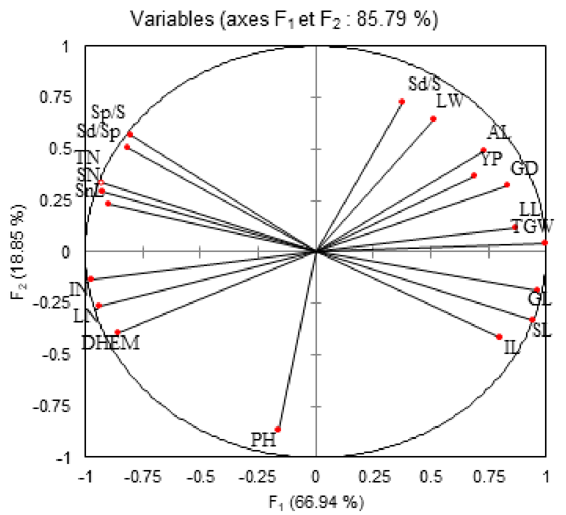

Figure 2. Presentation of parameters according to F_1 and F_2 plan

DHEM: Days to head emergence; PH: plant height; TN: tiller number; IN: internodes number ; IL: internode length; LN: leaf number; LL: leaf length; LW: leaf width; SN: spike number per plant; SL: spike length; AL: awns lenght; Sd/S: seeds number per spike; Sp/S: spikelet number per spike; Sd/Sp: seeds number per spikelet; GL: grain length; GD: grain diameter; SnL: spine length; YP: grain yield per plant; TGW: thousand grains weight.

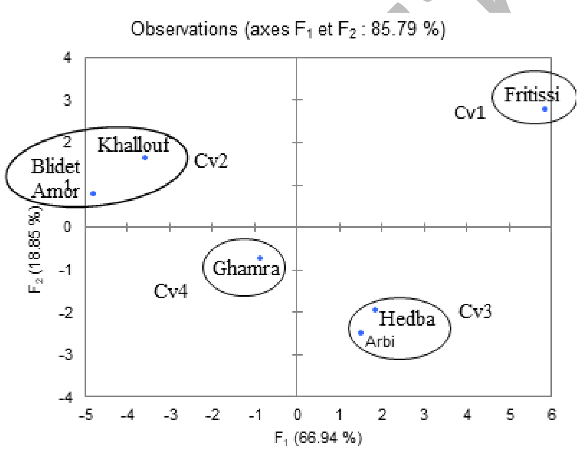

Figure 3. Presentation of cultivars according to F_1 and F_2 plan

According to Djennane (1990), the precocity of a variety is determined by the development of cycle time from sowing to head emergence. According to this author, a variety is considered early if the duration is less than 100 days; semi-early if the duration is between 100 and 120 days; and late if it exceeds 120 days. Based on this classification, cultivars could be classified into two groups:

- 1st semi-early group with the Fritissi and Hedba cultivar. 2nd late group with the other cultivars, Ghamra, Arbi, Khallouf and Blidet Amor.

Ghennai *et al*. (2017) in semi-arid areas evaluated the early varieties at 128 days, medium early varieties at 124-131 days and late varieties at 135-155 days. As a result, it can be understood that the earliness of phenological stages differs from one region to another depending mainly on climatic conditions. Through the results, we note that, there is a shortening of vegetative cycle of wheat cultivars. According to Slimani *et al*. (2014), this could be explained by high temperatures during these phenolic stages characterizing the study region. According to Ben Naceur *et al*. (1999), this early earing characteristic is advantageous for avoiding constraints of drought and high temperatures at the end of the crop cycle.

Agro-morphological traits

ANOVA analysis showed the presence of variability among the durum wheat (*T. durum* Desf.) accessions and between quantitative morphological and agronomical traits analysed. Highly significant variation was found in all quantitative traits, except for LW and YP not significant at the probability P0.05 (Table 1). The most important are, days to head emergence (DHEM) ranged from 102.67 days for Fritissi cultivar to 125 days for Khallouf and Blidet Amor cultivars with a range of 118.72 days.

Plant height (PH) averaged 120.81cm and ranged from 107.63cm for Fritissi to 134.31cm for Arbi. Spike length (SL) averaged 10.49 cm and ranged from 8.95 to 12.88 cm. Spike number per plant (SN) averaged 22.84 spikes and ranged from 16.6 for Hedba to 31.07 for Boukhallouf and Blidet Amor. Seeds number per spike (Sd/S) averaged 60.13 seeds and ranged from 52.47 for Hedba to 68.52 for Fritissi, and thousand grains weight (TGW) averaged 38.21g and ranged from 27.34g for Blidet Amor to 52.38g for Fritissi.

Atoui (2021) in the East of Algeria obtained a maximum PH of 158.67cm and a minimum of 76.83cm. For the SL, the values ranged from 10.33cm to 7.67. The Sd/S varies between 64.67 and 51 grains. Our results are close to those of this author and encouraging, despite the unfavorable environmental conditions (drought, salinity and soil poverty in fertilizing elements). Knezevic *et al*. (2012) have shown that the number of seeds per spike is very important in the variability of yield and depends on the fertility of the spikelet. According to Polat *et al*. (2015), improving yield necessarily requires reasoning about the number of seeds per spike which explains 75% of the variations in yield.

Regarding thousand grains weight (TGW), studied cultivars are classified into four classes according to the range developed by Boufenar-Zaghouane and Zaghouane (2006):

- The cultivar Blidet Amor has a low TGW, less than 30g, or 27. 34g.
- The cultivar Khellouf has an average TGW between 30g and 35g, or 30.42g.
- The cultivars Arbi, Hedba and Ghamra have TGW between 35 and 45g, or respectively 42.5, 41.41 and 35.22g.
- The cultivar *Fritissi* has a very high average TGW, greater than 45g, or 52.38g.

The high amount of variability found in the present study suggests the southeast Algerian durum wheat (*T. durum* Desf.) germplasm has considerable level of variance available to the breeders and it must be considered sufficient for the creation of new favourable gene combinations.

Table 1. ANOVA of quantitative agro-morphological traits of six cultivars local durum wheat (*Triticum durum* Desf.) of Southeast Algeria

	DHEM	PH	TN	SN	IN	IL	LN	LL	LW
Blidet Amor	102.667 b	107.229 c	17.571 c	14.643 c	5.643 d	39.250 a	5.429 d	28.821 a	1.707 a
Fritissi	121.333 a	126.318 ab	27.909 ab	23.091 b	6.364 abc	33.664 b	6.364 abc	23.782 bc	1.445 a
Khallouf	125.000 a	115.567 bc	33.600 a	31.067 a	6.533 ab	32.013 b	6.467 ab	20.367 c	1.427 a
Arbi	124.333 a	132.443 a	20.929 bc	20.357 bc	6.286 bc	42.507 a	6.286 bc	23.443 bc	1.350 a
Ghamra	125.000 a	118.208 bc	36.154 a	32.538 a	6.769 a	30.846 b	6.769 a	21.577 bc	1.446 a
Hedba	114.000 a	120.460 b	18.467 c	16.600 bc	6.000 cd	38.660 a	6.000 c	25.013 b	1.533 a
Pr > F	0,005	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,512
Significant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

	Sp/S	Sd/S	Sd/Sp	SL	AL	SnL	GL	GD	YP	TGW
Blidet Amor	23.500 bc	68.429 a	3.671 a	9.521 b	12.314 a	4.286 bc	7.910 a	3.351 a	40.422 a	52.377 a
Fritissi	24.182 abc	60.545 abc	3.273 ab	9.636 b	5.736 b	5.091 ab	6.384 c	3.131 b	34.001 a	35.218 cd
Khallouf	25.267 ab	62.000 ab	3.107 bc	12.880 a	0.000 c	5.600 a	6.003 d	2.985 b	33.952 a	30.416 de
Arbi	22.929 c	62.429 ab	3.243 b	9.379 b	11.471 a	4.143 c	7.519 b	3.001 b	37.131 a	42.496 b
Ghamra	26.385 a	56.846 bc	2.831 c	12.123 a	0.000 c	5.308 a	5.626 e	2.722 c	29.985 a	27.339 e
Hedba	22.333 c	52.467 c	2.933 bc	8.953 b	11.747 a	4.800 abc	7.482 b	3.003 b	29.722 a	41.413 bc
Pr > F	0,006	0,005	0,001	0,000	0,000	0,004	0,000	0,000	0,463	0,000
Significatif	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

DHEM: days to head emergence; PH: plant height; TN: tiller number; IN: internodes number ; IL: internode length; LN: leaf number; LL: leaf length; LW: leaf width; SN: spike number per plant; SL: spike length; AL: awns lenght; Sd/S: seeds number per spike; Sp/S: spikelet number per spike; Sd/Sp: seeds number per spikelet; GL: grain length; GD: grain diameter; SnL: spine length; YP: grain yield per plant; TGW: thousand grains weight.

Table 2. Correlation matrix

Variables	PH	TN	SN	IN	IL	LN	LL	LW	Sp/S	Sd/S	Sd/Sp	SL	AL	SnL	GL	GD	YP	TGW	DHEM
PH	**1**																		
TN	-0.095	**1**																	
SN	-0.072	0.974	**1**																
IN	0.328	0.884	0.886	**1**															
IL	0.240	-0.869	-0.751	-0.690	**1**														
LN	0.461	0.810	0.790	0.980	-0.668	**1**													
LL	-0.217	-0.759	-0.864	-0.853	0.452	-0.787	**1**												
LW	-0.868	-0.305	-0.373	-0.634	0.029	-0.701	0.636	**1**											
Sp/S	-0.335	0.953	0.889	0.727	-0.911	0.637	-0.551	-0.022	**1**										
Sd/S	-0.453	-0.039	-0.044	-0.383	0.114	-0.475	0.340	0.364	0.121	**1**									
Sd/Sp	-0.300	0.934	0.963	0.733	-0.743	0.610	-0.783	-0.181	0.899	0.128	**1**								
SL	0.109	-0.993	-0.968	-0.872	0.888	-0.803	0.778	0.304	-0.938	0.081	-0.939	**1**							
AL	-0.321	-0.458	-0.486	-0.713	0.409	-0.739	0.691	0.450	-0.284	0.891	-0.326	0.491	**1**						
SnL	-0.142	0.873	0.851	0.775	-0.872	0.734	-0.768	-0.248	0.802	-0.303	0.843	-0.923	-0.636	**1**					
GL	-0.033	-0.966	-0.910	-0.915	0.919	-0.886	0.732	0.371	-0.899	0.229	-0.835	0.973	0.583	-0.913	**1**				
GD	-0.287	-0.662	-0.705	-0.872	0.453	-0.841	0.785	0.489	-0.507	0.631	-0.530	0.642	0.877	-0.602	0.694	**1**			
YP	-0.297	-0.473	-0.377	-0.657	0.644	-0.741	0.396	0.309	-0.388	0.805	-0.218	0.504	0.844	-0.634	0.668	0.683	**1**		
TGW	-0.178	-0.907	-0.888	-0.963	0.812	-0.946	0.839	0.505	-0.778	0.440	-0.774	0.922	0.764	-0.907	0.964	0.828	0,749	**1**	
DHEM	0.598	0.694	0.745	0.923	-0.422	0.934	-0.878	-0.874	0.451	-0.428	0.566	-0.691	-0.685	0.621	-0.737	-0.792	-0,538	-0,844	**1**

DHEM: days to head emergence; PH: plant height; TN: tiller number; IN: internodes number ; IL: internode length; LN: leaf number; LL: leaf length; LW: leaf width; SN: spike number per plant; SL: spike length; AL: awns lenght; Sd/S: seeds number per spike; Sp/S: spikelet number per spike; Sd/Sp: seeds number per spikelet; GL: grain length; GD: grain diameter; SnL: spine length; YP: grain yield per plant; TGW: thousand grains weight.

Principal component analysis

Correlation matrix

Table 2 revealed several correlations between the characterized variables. The most prominent positive associations are: a strong positive association between tiller number (NT), spike number (SN), leaf number (LN), spikelet number per spike (Sp/S), seeds number per spikelet (Sd/Sp) and spine length (SnL); between internode length (IL), spike length (SL), grain length (GL) and thousand grains weight (TGW); between seeds number per spike (Sd/S), awns length (AL) and yield per plant (YP). This result demonstrates the role of plant's growth habit and vigour on ear production in quantity and quality terms. According to Mouhouche and Bourahla (2007) in practice, this phenomenon is very important for wheat cultivation since high straw production also implies high grain production; this is what often searches for by farmers and/or breeders.

The YP had a significant positive correlation with TGW (r= 0. 74). According to Mohammadi *et al*. (2011) GY in durum wheat is mainly influenced by TGW. These results concord with those of (Atoui *et al.*, 2021), however there are contrast with those of Sinha *et al*. (2006) and Gelalcha and Hanchinal (2013) where non-significant relationship was reported between thousand grains weight and yield per plant in irrigated conditions. According to Safarova *et al*. (2019) the number of grains per spike, the weight of 1000 and the number of spikes per plant contribute positively to yield and therefore need to be included in a selection index to improve yield. Otherwise, several authors found significant correlations between yield and its components (Mouhouche and Bourahla, 2007; Banga kalala *et al*., 2012). (Table 2) also shows a negative association of which the most important are between PH and LW; between SL and SnL. Such negative relationships were also found SN with LL, SL, GL and TGW, and between IL with Sp/S and SnL.

Cultivars classification according to Principal Component Analysis (**PCA**)

The principal component analysis was carried out on 18 specific morphological traits and earing duration of wheat cultivars. The results obtained show two axes 1 and 2 (Figure 2) that contribute by 66.71% and 19.03% of total inertia, or a cumulative percentage of 85.74%. Within the 19 characters studied, 12 of them are discriminative: Plant height (PH), tiller number (TN), number of ears per plant (SN), internodes number (IN), leaf number, (LN), spike length (SL), grain length (GL), leaf width (LW), seeds number per spike (Sd/S), awns lenght (AL), spine length (SnL) and thousand grains weight (TGW).

Figure 3 represents projection of the individuals on the plane formed by axes 1 and 2 according to their contribution. Examination of the figure allows distinguishing four groups of cultivars:

Group 1

Represents the cultivar Fritissi, is characterized by high values for parameters of length and width of leaf (LL and LW), seeds number per spike (Sd/S), spike length (SL), awns length (AL), length and diameter of grain (GL and GD), yield per plant (YP) and thousand grains weight (TGW), with, (28.45cm and 1.67cm); 68.52; 12.44cm; 3.67 mm; (7.93mm and 3.36mm); 40.8g and 52.38g, respectively. On the other hand, this cultivar has low values for parameters, days to head emergence (DHEM), plant height (PH), tiller number per plant (TN), spike number per plant (SN), internodes number (IN), leaf number (LN) and spine length (SnL), with, 102.67 days; 107.63cm; 19,07; 16.27; 5.6; 5.4 and 4.27 mm, respectively.

Group 2

Represents the cultivars Khallouf and Blidet Amor, the essential thing which distinguishes these two cultivars is the absence of awns (AL) and the longest vegetative cycle (DHEM) (125 days). Other parameters have high values, such as, tiller number (TN), spike number per plant (SN), spikelet number per spike (Sp/S), spike length (SL), spine length (SnL), with, 33.6 and 35.67; 31.07; 25.27 and 26.13; 12.88cm and 12.15 cm; 5.62mm and 5.33mm, respectively. Additionally, other parameters have low values, such as, internode length (IL), leaf length (LL), grain length (GL), grain diameter (GD) and thousand grains weight (TGW), with, 32.01 and 29.95cm; 20.37 and 22.09cm; 6 and 5.67mm; 2.99 and 2.71 mm; 30.42 and 27.34g, respectively.

Group 3

Represents the cultivars Arbi and Hedba, these cultivars are characterized by high values for parameters of internode length (IL) with 42.91 and 38.66cm. They also show low values for number of spike length (SL), spike number per plant (SN), spikelet number per spike (Sp/S), with, 9.54 and 8.95cm; 22.4 and 22.3; 20.67 and 16.6, respectively.

Group 4

Represents the cultivar Ghamra, this cultivar has no discriminating traits. It has intermediate values for all characters.

CONCLUSION

In conclusion, we can argue that the observed diversity between studied cultivars is a genetic reality which constitutes a potential that should be preserved, improved and exploited rationally. However, the opening of new perspectives, in order to make our investigations more profitable, remains judicious. Such as expanding the collection of other wheat cultivars from other regions not studied yet will allow us to build a larger database. Implementing the molecular techniques to studying local wheat cultivars that present more adaptive capacities and constituting a gene pool for breeding programs.

ACKNOWLEDGEMENT

The authors thank the National Institute of Agronomic Research of Algeria (INRAA) and farmer's for making available the durum wheat plant materials.

CONFLICTS OF INTEREST

Authors have declared that no conflicts of interest exist.

AUTHOR'S CONTRIBUTION

All authors read and approved the final manuscript.

A. Allam: Designed the study and performed the experiments.

A. Tirichine: Sample collection and Data analysis.

H. Madani: Data analysis and review of literature

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(Received: February 17, 2022; Acceped: August 11, 2022)