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MORPHOMETRIC CHARACTERIZATION OF THE BREAD WHEAT VARIETY "ISKANDARIA" IN THE REGION OF AOUGROUT (ADRAR)

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Abstract

In Algeria, the diversity of wheat is poorly known for this reason an inventory has been made in a region of southern Algeria "Adrar", specifically in the area of Aougrout, located south of the Timimoun region. Therefore, local varieties of bread wheat (*Triticum aestivum*) have been tried for morphological characterization. In this context, only one traditional bread wheat variety was studied using nine quantitative agromorphological traits and eight qualitative traits. The phenotypic diversity was determined by the Shannon-Weaver diversity index (H') at different levels. The estimated H's showed a wide phenotypic variability for the different traits with an average H' of 0.68 for the quantitative traits and 0.34 for the qualitative traits. The results of this work revealed the great phenotypic diversity of the bread wheat variety (Iskandaria) studied and show that this local variety (whose genetic composition remains to be studied more precisely) is mainly grown by traditional farmers, who conserve this genetic resource often on very small plots in oases and inaccessible land.

Key words: Morphometry, bread wheat and Adrar.

Introduction

Biodiversity represents life on earth. This concept refers to the variety of life forms including plants, animals and micro-organisms, the genes they contain and the ecosystems they form (Levêque and Mounolou, 2001). The status of major cereal has been acquired by wheat at the expense of its genetic diversity, especially when local varieties have been replaced on a large scale by a small number of varieties with high production potential (Raymond and Vincent 2006). Bread wheat, although not grown by local people and not specially cultivated before the arrival of colonists (1830), existed in North Africa for a long time as impurities in wheat fields hard (Ducellier, 1930, Laumont and Erroux, 1962). Ducellier (1921) is the first to have drawn the attention of agronomists to "the originality of the saharian wheat" and to the cultural possibilities of a real importance offered by these cereals. In order to make up for the production deficit, numerous measures have been taken, including the introduction of so-called "high yield" varieties. Algerian varieties of wheat have been greatly affected by these introductions leading to the disappearance of 64% of local varieties, more adapted to environmental conditions and therefore more productive (Bouzerzour et al, 2002). It is important to point out that the newly selected varieties,

each consisting of a single genotype, gradually replaced local (traditional) populations, each consisting of a mixture of several genotypes (Feldman and Sears 1981). Our study was launched in the context of highlighting the biological diversity of bread wheat in Algeria, especially in the oases of the south, to know this potential being important to launch future selection program.

This work is only a continuity to the work done during the 2009-2010 the analysis of the diversity of these varieties and the influence of the environment on their performance (Bellatreche and Gaouar 2012), and agro-morphological diversity of some accessions of bread wheat (*Triticum aestivum*) in western Algeria (Bellatreche et al 2017).

Materials and methods

Our study is based on the morphometric identification and characterization of a variety of bread wheat (*Triticum aestivum* L.). The characteristic plant material comes from a field survey during 2015-2016 in the wilaya of Adrar "Aougrout region" (Figure 01). Harvests of 30 spikes from 30 different plants taken at random in the field were collected. These ears were collected from eleven (11) localities belonging to different sites of the study area, in total four hundred and fifty (450) ears of wheat are collected.

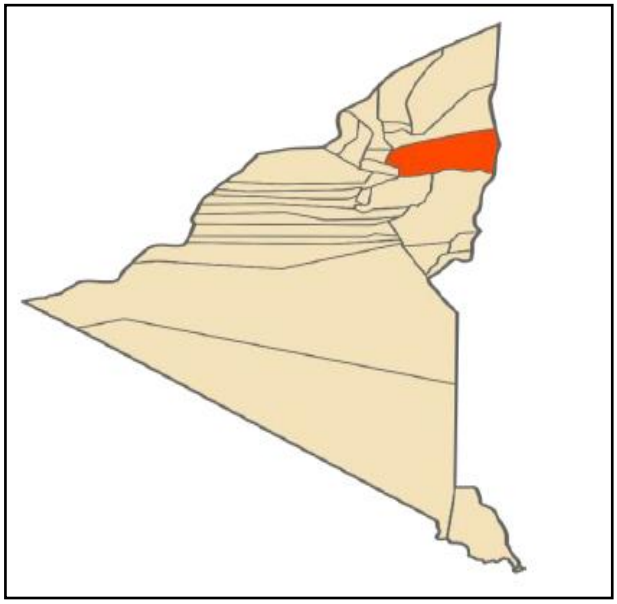

Figure 1. Location of the collection fields of the wheat samples studied (Region of Aougrout, wilaya of Adrar).

To carry out our experiment we used: 11 quantitative agro-morphological traits: plant length (LP), stem height (HT), barb-ear length (LESB), ear width (Width E), ear weight (PE), number of kernels per ear (NGE), weight of kernels per ear (PGE), grain length (LG), grain width (LargG), length of first item (L1A), weight of grain kernels (PMG) , And 8 qualitative traits that are: ear shape (FE), beards presence (PB), width of truncation of lower glume (LTGm), lower glume beak shape (FB), grain shape (FG), grain brush hair length (LP), grain color (CG), ear color (CE).

*The plant material studied (**Figure 2**)*

The material studied is composed of a single variety (Iskandria) of bread wheat, harvested from 13 localities (representing three zones) of the study area. Each locality represents an accession appart.

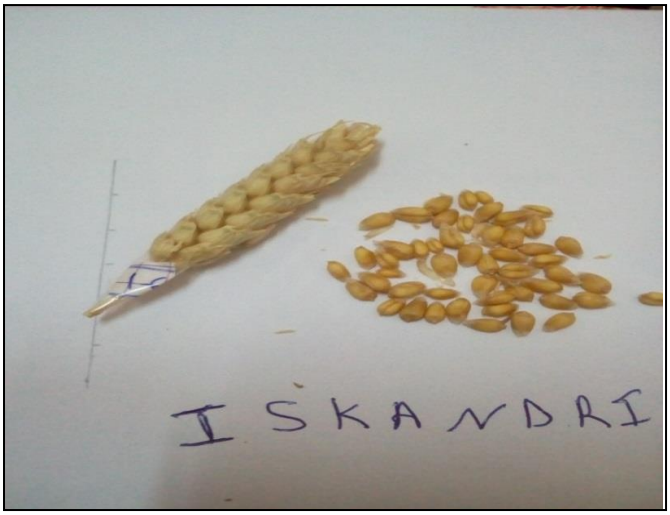

Figure 2: Morphology of the ear and seed of the Iskandaria variety.

Statistical analyzes:

After reporting the collected data to a matrix, several statistical tests were performed by the R software (version R 2.13.1) to calculate the Shannon-Weaver.

Shannon-Weaver Index

Before performing this test, a transformation of the quantitative features into classes was carried out, this transformation was carried out with the "summary" function of the software R that divides the range of values into the desired number of classes (four), and determines the limits of each class. The frequencies of the different phenotypic classes for each trait in each of the three areas (13 accessions, table 1) for collection as well as for the four classes were calculated.

Table 1: List of accessions studied.

Accession	Origin
ISKA OU la	Farmer 1
ISKA OU ISTI	Farmer 2
ISKA OU GJ	Farmer 3
ISKA OU GT	Farmer 4
ISKA OU LA	Farmer 5
ISKA OU GG	Farmer 6
ISKA OU IST	Farmer 7
ISKA OU IS2	Farmer 8
ISKA OU JA	Farmer 9
ISKA OU JJ	Farmer 10
ISKA OU JAA	Farmer 11
ISKA OU JA2	Farmer 12
ISKA OU ISB	Farmer 13

Based on these frequencies, the Shannon-Weaver index (Shannon & Weaver, 1948) was calculated for each trait in order to estimate the phenotypic diversity that exists in these study areas.

The Shannon-Weaver index is calculated using the following formula:

$$H = -\sum_{i=1}^{n} Pi\ Ln\ Pi$$

With

H = Shannon and Weaver Diversity Index

Pi = Frequency of each phenotypic class i of a given character

n = Number of phenotypic classes of each character.

The number of classes is calculated by the "summary" function of the R software (in this case, we have 4 phenotypic classes).
The index (H) is converted to the relative index of phenotypic diversity (H ') by dividing it by its maximum value H max (Ln (n)) in order to obtain positive values between 0 and 1.

$$H' = -\sum_{i=1}^{n} Pi\ Ln\ Pi\ /\ Ln(n)$$

The relative index of diversity (H') reaches its minimum value, which is equal to zero for the monomorphic characters. In addition, the value of this index increases with the degree of polymorphism and reaches a maximum value (1) when all the phenotypic classes have equal frequencies.

Result and discussion

Relative index of diversity of the different characters

The Shannon-Weaver index, calculated on the basis of the frequencies of the different classes of quantitative and qualitative traits, made it possible to highlight the diversity levels of our samples (Table 2 and 3).

Quantitative trais

Table 2. Relative index of diversity of the different quantitative characters of the Iskandria variety (13 accessions).

variété	H' LP	H' HT	H' LESB	H' Larg E	H' PE	H'NGE	H' PGE	H' LG	H' Larg G	La moyenne
ISKA OU La	0,91	0,97	0,78	0,63	0,94	0,98	0,89	0,08	0	0.69
ISKA OU ISTI	0.85	0.8	0.89	0.83	0.94	0.98	0.82	0.25	0	0.71
ISKA OU GJ	0.49	0.55	0.87	0.98	0.78	0.95	0.75	0.22	0	062
ISKA OU GT	0.99	0.97	0.84	0.97	0.98	0.99	0.95	0.23	0	0.77
ISKA OU LA	0.96	1	0.82	0.71	0.78	0.95	0.76	0.17	0	0.68
ISKA OU GG	0.85	0.79	0.81	0.88	0.98	0.96	0.92	0	0	0.69
ISKA OU IST	0.44	0.44	0.96	0.72	0.94	0.96	0.96	0.25	0	0.63
ISKA OU IS2	0.6	0.62	0.82	0.98	0.9	0.88	0.85	0.08	0	0.64
ISKA OU JA	0.75	0.75	0.89	0.92	0.95	0.87	0.98	0	0	0.68
ISKA OU JJ	0.56	0.59	0.93	0.84	0.99	0.86	0.98	0.13	0	0.65
ISKA OUJAA	1	1	0.82	0.71	0.78	0.95	0.76	0.17	0	0.69
ISKA OUJA2	0.92	0.91	0.95	0.93	0.99	0.99	0.95	0.13	0	0.75
ISKA OU ISB	0.83	0.83	0.91	0.85	0.91	0.9	0.95	0	0	0.69
La moyenne	0.78	0.79	0.87	0.84	0.91	0.94	0.89	0.13	0	0.68

The relative index of diversity (mean H') for all the characters of the set of accessions studied is of the order of 0.68 (Table 2) reflecting the great morphological diversity of the ears of this collection. This diversity is close to that obtained by Al Khanjari et al. (2008) in an indigenous population of durum and bread wheat from Oman with an index of 0.66 for the quantitative characteristics of bread wheat.

Regarding the accessions this index varies between 0.62 for the variety ISKA OR GJ to 0.77 for the variety ISKA OR GT. Several factors could explain the difference in the values of this index depending on the localities, in particular, environmental factors such as adaptation to environmental conditions (soil and climate) and human factors essentially the preferences of farmers (type of agriculture) (Belhadj et al., 2015).

For the characters this index varies between 0 for the grain width at 0.94 for the number of grains / ear (Table 2). Null values for a trait are likely due to the fact that the trait is adaptively important or that the trait is controlled by genes that control physiologically or adaptively important traits. The high diversity of the studied collection is mainly due to the presence of several polymorphic characters with a value (H '> 0.50), apart from the length and width of the grains. Regarding the length of the plant we found an index (H '= 0.78), this value is higher than the one found by Sahri et al. 2014 (H '= 0.53) on his study carried out in the valley of Er Rich - Imilchil (Morocco). For the length of the barb-free spike (H '= 0.87) the value found was higher than that found by El Khanjari et al. 2008 (H '= 0.74). Finally, for the number of grains per spike (H '= 0.94) our result is close to that of Al Khanjari et al. (2008) (H '= 0.85). With regard to the rest of the characters (weight of grains per ear (H '= 0.89), length of the stem (H' = 0.79), weight of the ear (H '= 0.91), ear width (H '= 0.84) after consulting several databases we did not find work similar to ours and therefore we are perhaps the only ones (according to our knowledge) to have worked on the diversity index of these traits in bread wheat. Taking into account all traits and all accessions, it was found that the highest diversity index (H '= 1) is that of the length of the plant for ISKA OR JAA accession and that of the height character of the stem for ISKA OR JAA and

ISKA OR LA accessions. This means that the selection approach is not the same for the different farmers in the region and that selection is not made on these traits. For the length of the grain we found an index (H '= 0.13), which is higher than that found by Belhadj et al. (2015).

Qualitative trais

Table 3: Relative index of diversity of the different qualitative characteristics of the Iskandria variety (13 accessions).

Variété	H' FE	H' LTG	H' FB	H' PB	H' LP	H' FG	H' CG	H' CE	La moyenne Total de blé tendre :
ISKA OU La	0	0.61	0.58	0.3	0.63	0.61	0	0	0.34
ISKA OU ISTI	0	0.65	0.42	0.22	0.56	0.78	0	0.49	0.39
ISKA OU GJ	0.15	0.36	0.24	0.13	0.56	0	0	0.46	0.27
ISKA OU GT	0	0.15	0.37	0.22	0	0.35	0	0.62	0.21
ISKA OU LA	0	0.51	0.28	0.36	0.41	0.3	0	0.6	0.31
ISKA OU GG	0	0.15	0.44	0	0.53	0.3	0	0	0.18
ISKA OU IST	0.47	0.48	0.41	0	0.53	0.61	0	0	0.31
ISKA OU IS2	0.2	0.54	0.54	0.3	0.41	0.22	0	0	0.28
ISKA OU JA	0.35	0.43	0.59	0.56	0	0.63	0	0.58	0.39
ISKA OU JJ	0.56	0.6	0.4	0.36	0.49	0.6	0	0	0.38
ISKA OU JA	0.85	0.62	0.78	0.54	0.78	0.68	0	0	0.53
ISKA OU JA2	0	0.59	0	0.3	0.63	0.58	0	0.63	0.34
ISKA OU ISB	0.36	0.4	0.43	0.53	0.63	0.99	0	0.58	0.49
La moyenne Total de blé tendre :	0.23	0.49	0.42	0.29	0.47	0.51	0	0.3	0.34

Regarding the shape of the ear, we found an index (H '= 0.23), which is much lower than that found by Chentoufi et al. (2014) (H '= 0.82) for traditional varieties in the Moroccan Pre-Rif. The shape character of the grain gave us a value H '= 0.51 which is lower than that found by Belhadj et al. (2015) H '= 0.98. For the color of the ear, we find an index (H '= 0.3) which has a value greater than that found by Othmani et al. (2015), (H '= 0.17). Regarding the length of the bristles of the grain brush (H '= 0.47) is a much lower value than that found by Belhadj et al. (2015) H '= 0.80. For the color of the grain we found an index (H '= 0) these results are much lower than those found by Chentoufi et al. (2014) (H '= 0.78) for traditional varieties in the Moroccan Pre-Rif. In this case, we can say that the selection at the level of the study area was very severe on this character which is not the case in the region of the Moroccan Pre-Rif. For the width character of the truncation of the glume, the index H 'is of the order of 0.49. This result is inferior to that found by Belhadj et al. (2015). The shape of the lower glume beak (FB) gave a value of H '= 0.42 which approximates that found by Belhadj et al. (2015).

Conclusion

Through this work, we have contributed to the study of the phenotypic characteristics of the Iskandaria bread wheat varieties (13 accessions) in the region of Aougrout (Adrar). In this region the bread wheat species is grown by traditional means, the know-how of agriculture has allowed the preservation and maintenance of the diversity of wheat in the harsh conditions of the Sahara. This work has shown that

there is a great diversity of traits (both quantitative and qualitative) and the presence of a single variety of bread wheat (iskandria) that adapts to the conditions of the study area. The estimated H's showed a wide phenotypic variability for the different traits with an average H' of 0.68 for the quantitative traits and 0.34 for the qualitative traits. This high diversity is due in part to the traditional typological nature with which this variety is cultivated characterized by low selective pressure. In the near future a more precise survey (a larger region, more varieties and a more efficient questionnaire) is to be considered. A study of genetic variability with molecular markers may allow us to better appreciate the potential of the variety studied and consider ideal crossover plans.

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