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Application of ampelographic parameters to differentiate native *Vitis vinifera* L. cultivars

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Abstract**—** *This study was conducted in three vegetation successive periods (2015, 2016) to determine ampelographic characteristics of the 39 grapevine accessions prospected in the Northwestern of Morocco by ampelographic criteria using OIV descriptors. The data were processed by multivariate statistical procedures. The integration of the obtained data with ampelographic data would be very important for the accurate identification of the Moroccan cultivars and can become a significant tool for the certification of quality grapevine produced in specific region.*

Keywords**— Ampelography, Vitis vinifera, Morocco, OIV descriptors.**

I. INTRODUCTION

The viticulture domain has always received a significant interest and grapes are extensively used worldwide for fruit and wine production. [1] Estimated the existence of about 14,000 cultivars, with numerous synonyms and occasional use of the same or similar names for genetically different cultivars. In the last decades it has become imperative to handle the large germplasm of grapevine as well, and to properly identify the different cultivars. Traditionally, morphological and agronomical characteristics have been the main criteria for differentiating grapevine cultivars. Ampelography is the first step in grapevine selection, in establishing the relationship within and among grape cultivars and in solving different classification problems [2]. In grapevine collections an average of 5–10% of cultivars are misnamed, and even in commercial viticulture misnaming and confusions related to synonyms and homonyms do exist [3].The morphological descriptors may be easy to examine and therefore they are useful for the laboratory and field research work [4]. The morphometric characterization of *Vitis* varieties is carried out by the measurement of parameters in leaves, grapes and separated grapes. The measurement eliminates subjective evaluation of data. Systems to directly digitize phylometric parameters from leaves have been developed [5], [6].

Grapevine varieties have been characterized for identification purposes by ampelographic characters [7], [8], [9]. Study of plant morphology, mainly leaves, buds, and grape morphology (also called ampelography) it is the last means of detecting vine cultivars [10]. This method is still used for identification [11], [12], [13], particularly during the collection of data plants in situ.

In Morocco, the grapevine as well as the olive tree, the fig tree and the cereals are cultures well adapted to the natural climatic conditions of our country located at the end of the western Mediterranean. Before, the native grape varieties occupied areas whose extent or relative importance could not be assessed, mainly mountain vineyards [14]. However, during the last century, several factors have led to a progressive extinction for many local grape varieties and consequently to their genetic erosion. Currently, these varieties have become rare, little known, not inventoried, unexplored and threatened with extinction. Little study in Maghreb was carried to describe the cultivars of grapevine [14], [15], [16], [17].

As the identification of grapevine varieties by the use of classical ampelographic methods (morphological and morphometric characters) are sometimes afflicted by mis interpretations due to environmental influence [18], the integration of our data with ampelographic data would be of great importance to unambiguously identify the existing Moroccan cultivars and could also be used for legal protection of cultivars.

Our goal in this study was to complete the characterization of Moroccan grapevine prospected in north-west region using the ampelographic descriptors to confirm the existing synonymies and possible relationships among the plant materials in order to preserve the maximum amount of genetic variability for breeding and commercial purposes.

II. MATERIAL AND METHODS

The plant materials consisted of samples from the prospection sites located at the north-west of the country, all of them were classified as minor or endangered

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varieties. The total number of accessions studied was 39 and 10 grapes for each tree (Table 1). Ampelographic characters were described using OIV descriptors [19]. Sampling was done at the time of fruiting. In each site surveyed and with the help of the farmers we collected for each variety named and recognized samples of fruits.
Principal Component Analysis (A.C.P) was done using SPSS Version 10 software.

Table 1. List of varieties studied

Feryal Khal1	Aferyal Byad1	Maticha Mferqa	Fekas khal
Feryal khal2	Aferyal Byad2	Maticha Mjemaa	Fekas Byad
Taferyalt kahla3	Taferyalt Byad3	Mouska	Fekas
Taferyalt Kahla4	Taferyalt Byad4	Mouska Bayda	Ineb Byad1
Taferyalt Kahla5	DiBI 1	Mouska hamra1	Ineb Byad2
Taferyalt Kahla6	Dibi 2	Mouska hamra2	Bezoul awda 1
Taferyalt kahla7	Echabel(Dibi)	Boukhanzir1	Bezoul awda 2
Taferyalt kahla8	Dibani 1	Boukanzir2	Rjiyil Dib 1
Sbiyae Bnat	Dibani 2	Boukhanzir3	Rjiyil Dib2
Ineb Nhal	Sanso	Zbarjel	

III. RESULTAT AND DISCUSSION

Average quantitative parameters of grapes

For each tree, we measured the following variables: weight, length, width, peduncle length and number of wings for each grape (Table.1). The results obtained show important variations between the grapes of the different sampled varieties. For example, the Dibi 1 tree showed the highest average weight with 872g per grape. On the other hand, the Maticha mferqa tree has on the contrary mounted grape with the lowest average weight with 71g. Also, the highest average grape length was observed in the Dibani 1 (30 cm) tree while the lowest average value was observed in the Taferyalt kahla 3 (6.5 cm) tree. Regarding the average width of the grapes, we noticed that the greatest average width of the grape was observed in the Ineb nhal tree (16 cm), while the lowest average value was observed in the Fakkas tree (4 cm). The average Length/Width ratio shows more or less homogeneous values in most grapes, the highest Length/Width ratio was observed in the Fekas tree (2.75), while the lowest Length/Width ratio was found in the Boukhanzir tree 3 (1.2). The average number of wings ranges from 29 in the Bezoul aouda tree 2 to 4 in the Taferyalt kahla 3 tree (Table 1).

Table.1. quantitative parameters of grapes

Variety	Total weight (grape)	Length (cm)	Width (cm)	long/width	Peduncle length	Number of wings
Feryal Khal1	435	28	17	1.64	3.5	18
Feryal khal2	129	17	10	1.70	3	16
Taferyalt kahla3	21	6.5	4.5	1.44	1.5	4
Taferyalt Kahla4	43	10.5	8	1.31	1.8	11
Taferyalt Kahla5	151	18	11	1.63	3.4	13
Taferyalt Kahla6	283	19	11.5	1.65	2	20
Taferyalt kahla7	333	21	11	1.90	2	21
Taferyalt kahla8	296	20	12	1.66	2	15
Aferyal Byad1	551	27	14	1.92	3.5	20
Aferyal Byad2	463	23.5	14	1.67	3.5	26
Taferyalt Byad3	74	17	11.5	1.47	4	12
taferyalt Byad4	17	8	5.5	1.45	4	5
DiBI 1	872	25	17	1.47	3.2	24
Dibi 2	400	30	17	1.76	4	27
Echabel(Dibi)	348	24.5	13.5	1.81	5.5	17
Dibani 1	359	30	14	2.14	4.5	23
Dibani 2	139	15	11	1.36	2	16
Maticha Mferqa	71	15.5	8.5	1.82	2.7	14
Maticha Mjemaa	138	14.5	9	1.61	3.4	19

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Mouska	358	19	12	1.58	2.5	16
Mouska Bayda	184	18.5	11	1.68	2.6	11
Mouska hamra1	20	15	7	2.14	2.2	16
Mouska hamra2	142	18.5	9	2.05	2.5	15
Ineb Nhal	263	26	15.5	1.67	2.8	24
Fekas khal	445	26	16	1.62	4.5	20
Fekas Byad	222	14.5	7.5	1.93	3.2	23
Fekas	10	11	4	2.75	2	10
Ineb Byad1	367	25	17	1.47	3.2	16
Ineb Byad2	157	20	8.5	2.35	2.3	14
Bezoul awda 1	43	14	5.5	2.54	1.5	14
Bezoul awda 2	239	15	8.5	1.76	3.2	29
Boukhanzir1	352	21	8.5	2.47	3.4	20
Boukanzir2	145	19	11	1.72	3.7	18
Boukhanzir3	163	13.5	11.2	1.20	2.2	9
Sbiyae Bnat	93	10	6.5	1.53	3.5	10
Rjiyil Dib 1	277	20	12.5	1.6	2.2	16
Rjiyil Dib2	311	18.5	10	1.85	3.4	18
Zbarjel	90	11.5	6	1.91	2.5	12
Sanso	251.28	19.44	11.01	1.76	3.047	17.605

Principal component analysis

We used the means of the quantitative parameters of the grapes to perform a principal component analysis. Table 2 shows the percentages of the variance associated with each axis.

Table 2: Variances associated with the axes of the ACP of the characters of the grape

Total variance explained			
component	Total	% de la variance	% cumulative
1	4.829	40.242	40.242
2	1.944	16.198	56.440
3	1.653	13.775	70.214
4	1.033	8.605	78.820

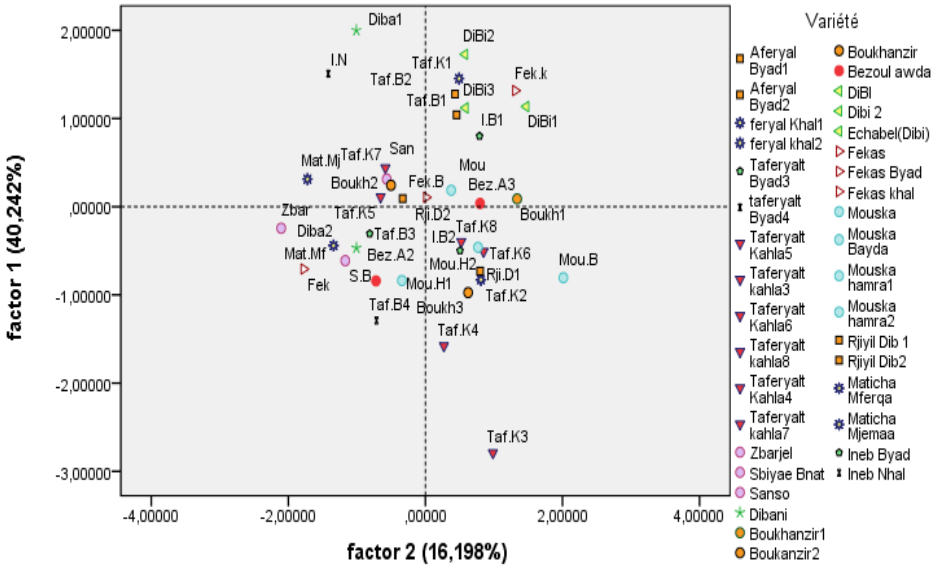

Fig 1. Projection in the plane (1,2) of the principal component analysis

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From the result obtained in Figure 1 we see a compact structure of all trees, no structuring is visible. To better see the structure we eliminated the 12 trees of the "variety" Taferyalt and redo the analysis with only the other varieties. Figure 2 shows the result obtained.

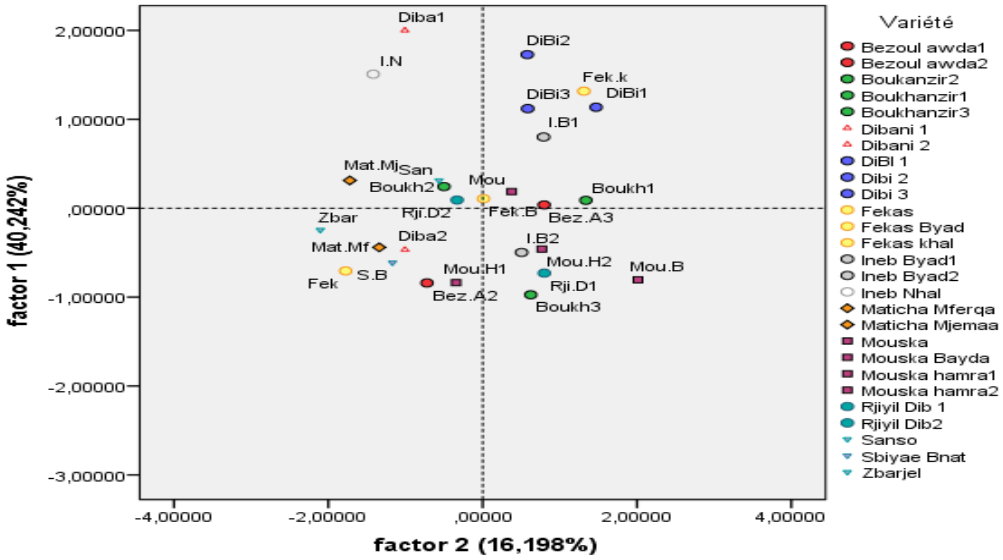

Fig. 2: Projection in the plan (1,2) of the principal component analysis (without Taferyalt cultivar)

In axis 1, the representation shows that the weight variables, the length, the width of the bays are well correlated in the positive direction. Grape parameters: weight, length, width, number of wings and length of peduncle are moderately correlated with axis 1. In the negative sense, the length-on-cluster variable is well correlated with the axis 1. From the analysis of Figure 2, we notice a variability resulting from the remarkable dispersion of the feet studied at the plane formed by the two axes (1 and 2). Axis 1 encompassing 40.24%, of the total information, is defined positively and mainly by the lengths, the widths, the weights and by the numbers of the wings. Therefore, axis 1 opposes the three feet of the variety Dibi, Fekas khal, and Ineb byad 1 in the positive side. As for axis 2, which represent 16.19% of information. It is negatively defined by the sugar content encompassing the feet Maticha mjamaa and mfera, Dibani, Rjiyil Dib (Figure 2). In axis 1, the representation shows that the weight variables, the length, the width of the bays are well correlated in the positive direction.

Therefore, none of these characters distinguish varieties between them, at least from data obtained from our sampling. Indeed, from the results of the factorial analysis (A.C.P) of the quantitative and semi-quantitative parameters of the grapes and berries we note an absence of a net structuring of the feet of the different varieties. And this, despite the discriminating power of the parameters used between different feet without reference to the variety. It is then thought that there is a problem in this study which resides in the number of insufficient feet sampled and the lack of repetitions within the same variety. The only variety that has a large number of feet is the variety Taferyalt with 12 feet. On the other hand, we must not forget the problem of synonymy and homonymy that prevents a good characterization of varieties. For this, molecular characterization is essential for good discrimination of varieties.

IV. CONCLUSION

Morocco is a very rich country in terms of homonymous grape varieties which results from the old tradition of grape cultivation in north-west of country, which began in romain period. We are of the opinion that it is crucial to preserve this genetic potential by describing a reasonable nomenclature and determining the relationships among these varieties through DNA-based markers.

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