DIFFERENTIATION OF GRAPE VINE VARIETIES FROM SCDVV IASI GENE BANK BY USING THE MAIN COMPONENT STUDY METHOD

DIFERENŢIEREA SOIURILOR DE VIŢĂ DE VIE DIN BANCA DE GENE A SCDVV IAŞI PRIN UTILIZAREA METODEI DE ANALIZĂ ÎN COMPONENŢI PRINCIPALI

DAMIAN Doina[1], VASILE Ancuţa[1], ZALDEA Gabi[1], SAVIN C.[1], PAŞA Rodica[1]
e-mail: doinadamian@yahoo.com

Abstract. *The variability of morphological features in grape vine and the existence of a large number of varieties makes more difficult their description and acknowledgement. Many researchers specialized in ampelography have developed several easier identification methods based on scientific principles which are improved; a step forward is represented by the introduction of ampelometry as study method, using as basis the morphological characters of the leaf. Therefore, in order to differentiate and classify some grape vine varieties from the ampelographic collection we used the main component study, which is based on the study of co-variation or of correlation between variables, allowing the differentiation and grouping of genotypes according to size and shape of adult leaf. Studies were performed on 18 indigenous or local varieties, selected according to synonymy criterion or affinity to the same group of varieties, as well as on other five known varieties from Iasi vineyard.*
Key words: genotypes, indigenous, statistical methods, correlation

Rezumat. *Variabilitatea caracterelor morfologice la viţa de vie şi existenţa unui număr mare de soiuri, face dificilă descrierea şi recunoaşterea acestora. Mulţi ampelografi au elaborat numeroase metode de identificare, mai uşoare, axate pe principii ştiinţifice care s-au perfecţionat, un pas înainte constituindu-l introducerea ampelometriei ca metodă de studiu, bazată pe caracterele morfologice ale frunzei. În acest sens pentru diferenţierea şi clasificarea unor soiuri de viţă de vie existente în colecţia ampelografică a fost utilizată analiza în componenţi principali, a cărui principiu se bazează pe studiul covarianţei sau al corelaţiilor dintre variabile, permiţînd diferenţierea şi gruparea genotipurilor mai ales după mărimea şi forma frunzei adulte. Cercetările s-au efectuat asupra unui număr de 18 soiuri autohtone sau locale, alese după criteriul sinonimiilor sau apartenenţei la acelaşi sortogrup, precum şi a altor cinci soiuri cunoscute cultivate în podgoria Iaşi.*
Cuvinte cheie: genotipuri, autohtone, ampelometrie, corelaţii

INTRODUCTION

Viticulture has a long history, ranging between 2000 and 7000 years. Through colonization, migrations, development of some economic routes etc., the varieties of grapevines have spread all over the world, some of them lasting until

[1] Research and Development Station for Viticulture and Vinification Iasi, Romania

nowadays and others, less adapted, have disappeared. The large number of vitis genotypes existing today, with very strong phenotypic variability, renders difficult their description and recognition.

Currently, over 18,500 names and 23,000 synonyms (Erika Maul, 2003) are registered in the international catalogue of vitis species. The differentiation and description of varieties of grapevines are essential for obtaining reliable results in research, improvement and propagation of vitis, while the effective management of germplasm conservation is aimed at preventing the loss of local, valuable genetic resources which are adjusted to the ecosystem conditions. Over time, famous ampelography experts have tried several identification methods based on scientific principles, which have improved from the pre-philloxeric period until today. One of the most advanced methods for the recognition and identification of grapevine species is that of ampelography descriptors developed by UPOV (1984), OIV (1983) and IPGRI (2004) currently Biodiversity, by means of which uniform working rules were set with the ultimate goal of standardizing the description of vitis species. The list of OIV descriptors completed with the 18 ampelographic descriptors complements the methodology of describing and differentiating the species at the same time reconsidering the ampelometric method. This method, based on the progress of informatics (Erika Dettweiller, 1987), allowed the development of new mathematical models for ampelography investigation, one of which is the principal components statistical analysis (PCA) (Liliana Rotaru, 1999, 2002). For identifying and cataloging local, native or less known grapevine species which are included in the ampelographic collection of SCDVV Iasi, we used the principal components analysis, which is the subject of this paper.

MATERIAL AND METHOD

The studied genotypes can be found in the gene bank of the entity, which comprises about 430 varieties of *Vinifera* species, created in our country or introduced from other countries. The study used 18 less known Romanian genotypes selected according to the following criteria:

- synonymy, the Romanian White variety is synonymous with the White grapevine variety of Akermanski and the White of Belgorod, Francusa variety is synonymous with Creaţă variety, Om rău variety synonym with Verde variety, Coarnă roşie variety is synonym to Ţâţa caprei neagră variety, Iordan variety synonymous to Gordan variety, Ferdinands Lesseps variety is synonymous with Ananas variety, Bătută neagră variety synonymous to Romanian Black variety;
- belonging to the same group of varieties (Ceauş alb and Ceauş roz). Moreover, we used in this study a less known indigenous variety, Coarnă vânătă and five varieties cultivated in Iasi vineyard (Chardonnay, Băbească neagră, Muscat Ottonel, Sauvignon and Aligoté).

To differentiate the studied varieties we applied the principal components analysis with 30 variables derived from the calculation of ampelometric parameters in adult leaf, which were determined by a number of 68 measurements: length of main vein (N1, N2, N3, N4); the distance between the side sinuses and the petiole (U, O); the opening of side sinuses (SS, SI) and of petiole sinus(SP); length (ALT) and width (AN) of the lamina; outside contour of the leaf (ENS, ENM, ENI, NL); inside contour of

the leaf (DS1, DS2, DS); angles between main veins (A, B, C); angles defining the shape of the median lobe (F, AP); angle between the median vein and the end of the lower side lobe (ABE); the ratios between the length of veins (21a, 31a, 41a); the ratio between the basis of side sinuses and sinus supporting veins (UN2, ON3); the ratio between the length and width of the lamina (L-A).

The data were statistically processed by means of the Microsoft XL-STAT 2010 program.

RESULTS AND DISCUSSIONS

The principal components analysis includes information from ampelometric matrices in graphical form (correlation circle and the plane determined by principal components), thus the closer to each other two individuals or two variables are on these graphs, the more similar they are. The use of this method involves the following stages:

Calculation of correlation matrix based on Pearson correlation coefficient, whose values range from -1 to +1 and expresses the degree of linear correlation between two variables. The closer the variables are to this value, the stronger is the correlation between them.

By analyzing the correlation matrix of studied varieties it was noticed that NL(15) and U(11) variables had the most significant positive correlation, which suggest deep lateral sinuses. The C variable, which represents the angles between main veins, had the lowest signification (2). The depth of lateral sinuses (U, O, DS1, DS2 and DS) had significant correlations between 9 (DS1) and 11 (U). The number of significant correlations was higher in the case of AN variable (12), which expresses the width of the lamina and of 10 for ALT (length of lamina). The outer contour of the lamina (ENS, ENM, ENI and NL) had significant positive correlations ranging between 9 (ENS and ENI) and 15 (NL). The shape of the median lamina had a small number of significant positive correlations 6 (AP) and 7 (F), and the angles between the veins were positively correlated with two variables (A) and three (B, C and ABE), and 11 variables (B) and nine (C) were negatively correlated. The correlations representing the ratios between the lengths of main veins, had significant positive correlations of four (21a), eight (41) and 10 (31a) and the variables U, N2 and On3 and were correlated significantly with 10 and respectively 14 of the variables. The L-A variable, which represents the ratio between the length and width of the lamina had the most numerous negative correlations.

Determination of variables' values and own vectors (based on the correlation matrix) within the space created by the main components; it was observed that among the varieties studied the percentage of inertia of the first two main components is of 64,765, nearly 65%, and respectively 37% and 28% on the first two axes, and their values decrease from component 1 (axis 1) to the 22-nd component, with the value of 0. By analyzing the first two principal components it was seen that for the principal component 1 most variables have positive vectors from 0,283 (UO) to 0,032 (SI), and negative vectors are observed for five variables (A, B, C, ABE and L-A), which in the correlations circle will be found

in quadrants 3 and 4. In the case of principal component 2 (axis 2) the positive vectors are determined by 14 variables (N1, N2, N3, N4, S4, NAM, ALT, ENS, ENM, ENI, NL, Si, B and C), which will be located in the quadrant 1of the circle of correlations. The negative vectors of axis 2 are determined by the variables: U, A, DS1, DS2, DS, SS, F, AP, Abe, 21a, 31a, 41a, UN2, ON3 and LA, which will be found in quadrants 2 and 3 of the correlations circle;

Making correlations between variables and principal components.

The results obtained in determining these correlations in the studied varieties show that the highest correlation coefficient values of factor 1, on axis 1, were those defining the shape of leaves (depth of the sinuses): U (0.937), O (0.935), DS2 (0.919) and DS1 (0.833).The lowest correlation coefficient was that of factor SI (0.106).

On axis 2, principal component 2, the correlation coefficient had higher values for the variables that define the sizes of lamina: N1 (0.948), ALT (0.922), ENM (0.914), N2 (0.858), AN (0.753), ENI (0.697) and ENS (0.670) and the lowest correlations were found in variables that correspond to axis 1, that is U (-0.171) and O (0.176). These results are also seen in the correlation circle (figure 1) resulting from statistical and mathematical processing. It is noticed that the variables SP, SS and SI, which define the opening of sinuses are opposite to those which represent the angles between the veins (ABC), the ratio of lamina length and width (LA) and the sum total of the angles between the center vein and the upper lobe basis, so one may say that these ones contribute more to leaf shape and to a lesser extent to its size.

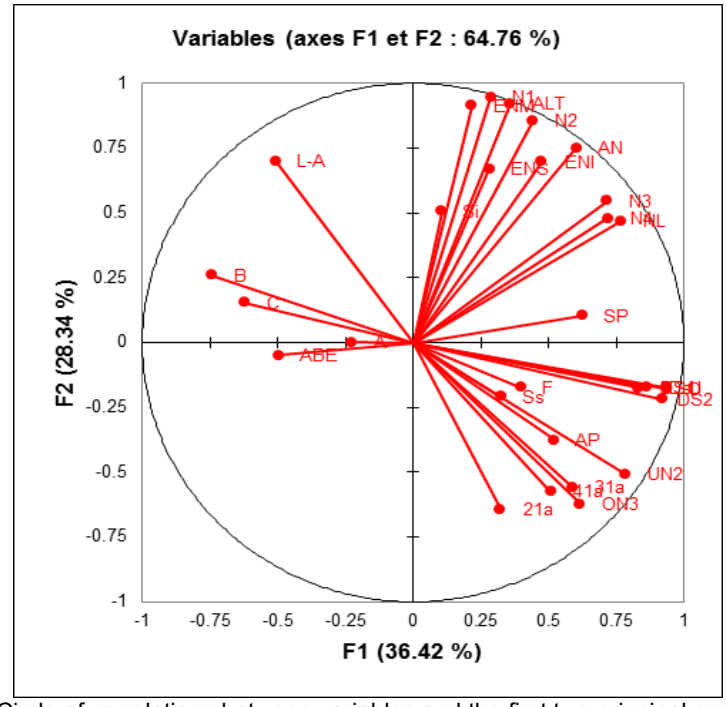

Fig. 1 - Circle of correlations between variables and the first two principal components

Higher correlations were recorded in the case of variables defining the length of the lamina (ALT) with those showing the length of veins N1, N2, the outer contour of the leaf (ENM, ENS) and between the lamina width variable (AN) and the veins length N3, N4, the distance between limit N3 and N4 (ENI).

The correlations between variables and main components are key elements that provide information about the size and shape of the leaf, the ampelographic traits which help differentiate grapevine species.

Distribution of varieties on the principal axes, is important in terms of their contribution to the definition of principal components (figure 2).

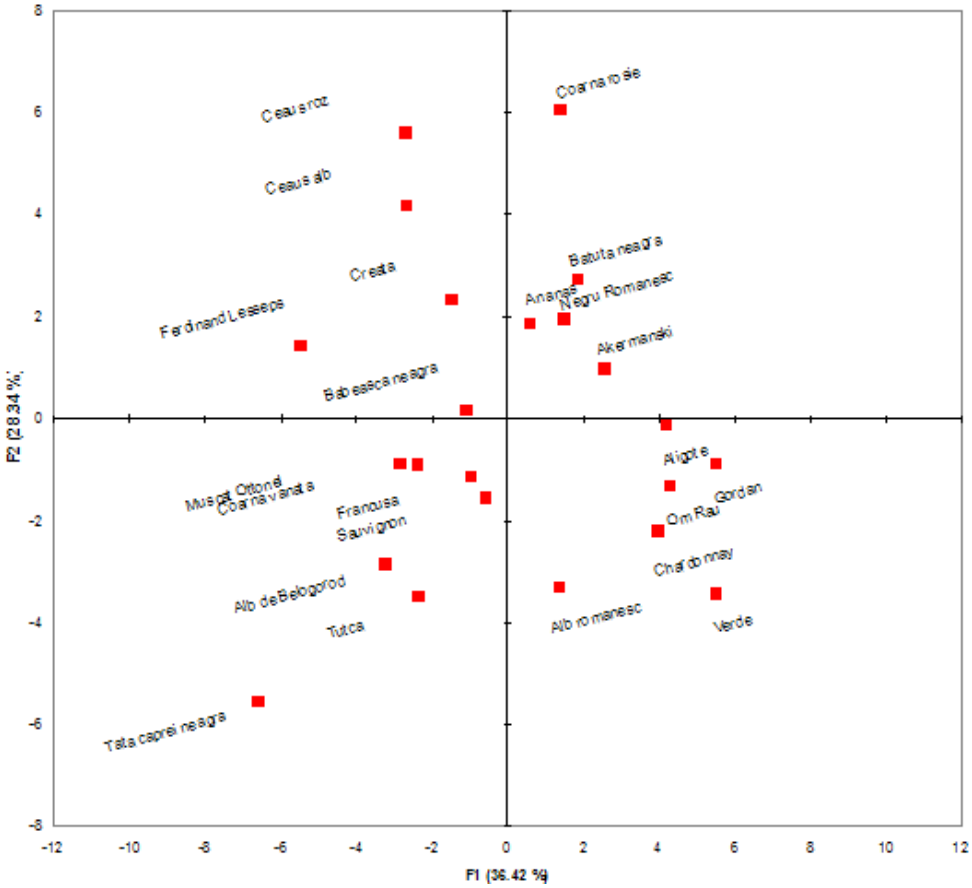

Fig. 2 - Coordinates of varieties in the plane determined by the first two principal components

Analyzing results we were able to see that the greatest contribution to the definition of the main component 1, was that of varieties Verde (5.4940), Gordan (5.4874), followed by Om rău (4.2927) Aligoté (4.1820) and Chardonnay (3.9518), their position being dispersed in quadrant 4 and at the opposite side we may find Ţâţa caprei neagră variety (-6.6307), Ferdinand de Lesseps variety (-5.4874 the smallest contribution to factor1 definition was of Ananas variety (0.5575). For the definition of component 2, the varieties Coarnă roşie (6.0763),

Ceauş roz (5.6225) and Ceauş alb (4.1935) were mainly noticed, the last two belonging to the same group, with leaves of similar size and shape, and a negative contribution was seen in the case of Ţuţca varieties (-3.4710) and Alb românesc (-3.2854), their position being dispersed in one direction or another one, their leaf sizes also differ: round with 3-5 lobes for the former and cuneiform, medium to large in the latter's case.

The results obtained after variety differentiation by applying principal components analysis, highlight the following varieties: Bătută neagră, Ananas, Negru românesc, as a homogeneous group, with large pentagonal leaf, Ţâţa caprei neagră variety has round leaf, 3-5 lobes and Coarnă roşie with mature round, large leaf, 5-7 lobes.

CONCLUSIONS

1. Using principal components analysis in ampelometry opens new perspectives in grapevine variety differentiation, complementing the methods of ampelographic descriptors.

2. For the PCA, 68 ampelometric measurements were made on 30 mature leaves for each variety; this is the main ampelographic instrument for the differentiation of vitis genotypes.

3. The application of this method produced the following antagonistic groups: varieties Verde (5,4940), Gordan (5,4847), Om rău (4,2927) and Aligoté (4,1820) versus Ţîţa caprei neagră (-6,6307), Ferdinand de Lesseps (-5,4874) and Ananas (0,5575), separated by factor 1 (axis 1); varieties Coarnă roşie (6,0763), Ceauş roz (5,6225), Ceauş alb (4,1935) versus Alb românesc (-3,2854), determined by factor 2 (axis 2). This antagonistic separation of varieties showed that those groups have very few common traits.

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