THE APPLICATION OF DISCRIMINANT FACTORIAL ANALYSIS FOR THE ESTABLISHING PHENOTYPICAL HOMOGENITY FOR CLONES OBTAINED FROM CABERNET SAUVIGNON GRAPEVINE VARIETY

APLICAREA ANALIZEI FACTORIALE DISCRIMINANTE PENTRU STABILIREA OMOGENITATII FENOTIPICE LA CLONELE SOIULUI CABERNET SAUVIGNON

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Abstract. *The discriminat factorial analysis is a mathematics-statistics multivariation methode, which permits to corelate a big number of quantity variable, such as it can be establish phenotipical homogenity degree of individuals analysed which belong to one group specifics and also the diferences between gropus. In this paper he application discriminat factorial analysis was made to the clones obtained of Cabernet Sauvignon grapevine variety plants: Cabernet Sauvignon - population, Cabernet Sauvignon – 4 Is, Cabernet Sauvignon – 7 Dg and Cabernet Sauvignon – 33 Vl, cultivated in ampelographic colection of Horticultural Faculty of Iaşi.*

Rezumat. *Analiza factorială discriminantă reprezintă o metodă statistico-matematică multivariațională, care permite corelarea unui număr mare de variabile, ce pot fi folosite pentru stabilirea gradului de omogenitate fenotipică a fiecarui individ analizat, putându-se evidenția apartenența sau nu la grupurile luate în studiu. In această lucrare s-a efectuat analiza factorială discriminantă la clonele soiului Cabernet Sauvignon, cultivate în colectia ampelografică a Facultății de Horticultură Iaşi: Cabernet Sauvignon - populatie, Cabernet Sauvignon – 4 Is, Cabernet Sauvignon – 7 Dg şi Cabernet Sauvignon – 33 Vl.*

In ampelography discriminatory analysis helps characterize the phenotypical homogenity of individual varieties (of the population) and establish any similarities that may exist among varieties, from a phenotypical perspective.

Discriminatory linear analysis is a multidimensional statistical-mathematical method, descriptive and predictive which allows for the evidentiation of links between data by means of calculation of the main components. The method is used by techniques aimed at the classification or allocation to priorly known classes of individuals characterized by a large number of nominal or numerical variables.

In the first stage, discriminatory analysis is aimed at separating, from the basic sample, the individuals characterized by p-variables into q-classes defined a priori by a y-nominal qualitative variable. The second stage will

evidence the way in which a new individual, characterized by the same *p*-variables, influences the already identified classes in the basic sample.

Discriminatory analysis calls for two descriptive and decisional approaches: establishing the discriminatory linear function for the individual sample and subsequently the linear combinations of quantitative variables, i.e. establishing the quantitative values that best separate individual classes; determining the class affected by new individual characterized by the same explanatory variables.

MATERIAL AND METHOD

The study comprises application discriminat factorial analysis to the clones obtained of Cabernet Sauvignon grapevine variety plants: Cabernet Sauvignon - population, Cabernet Sauvignon – 4 Is, Cabernet Sauvignon – 7 Dg and Cabernet Sauvignon – 33 VI, characterized by 30 quantitative variables established by means of ampelometric measurements of leaves.

Each clone was represented by 10 stems (individual group) that yielded adult leaves.

Ampelometric measurement (variables) comprised: length of main nervures (N1, N2, N3, N4); angles A, B, C between main nervures; ratios 21a, 31a and 41a of nervure lenghts; angles F and AP defining the shape of the middle lobe of the leaves; angle ABE formed by the middle nervure and extremity of the lower lateral lobe; the distances U and O between the basis of the sinuses and the petiol point; the opening of the lower and upper lateral sinuses SS and SI; the opening of the petiol sinus SP; the length of the leaf limb ALT; limb width AN; outer leaf contour ENS, ENM, ENI and NL; inner leaf contour DS1, DS2 and DS; ratios UN2 and ON3 of lateral sinus basis and the nervures wich support those sinuses; ratio L/A of limb length and width.

Figure 1 explains the ampelometric measurements operated on leaves.

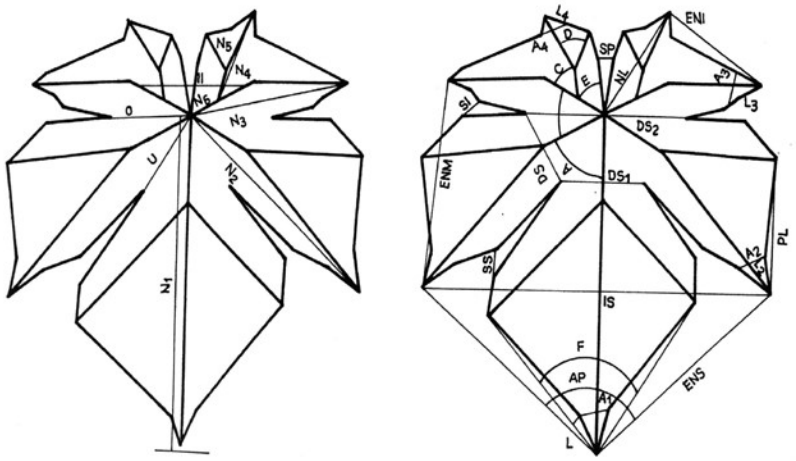

Fig. 1 Ampelometric measurements (variables) in vine leaves

INTERPRETATION OF RESULTS

In the first stage the intergroup or interclass variance-covariance matrix was calculed. For a satisfactory grouping of individuals into classes the matrix values should be high, either negatively or positively. When values approach zero, the variable's capacity of grouping individuals into classes is reduced.

The study has indicated that the highest value of +79645.89 is yielded by the DS1/DS2 correlation referring to the inner leaf contour while the lowest value –33450.12 is yielded by the AN/SP correlation referring to the limb width and the petiol sinus opening.

Next, each variance-covariance matrix was calculated. The closer to zero the values, the more homogeneous (phenotypically stable) the individual group. At this stage we can note first that, in point of group homogeneity, a wide range of character variability indicated less similarity of the individuals, and second, that we have a good indication of which variables may have a decisive contribution to variety discrimination.

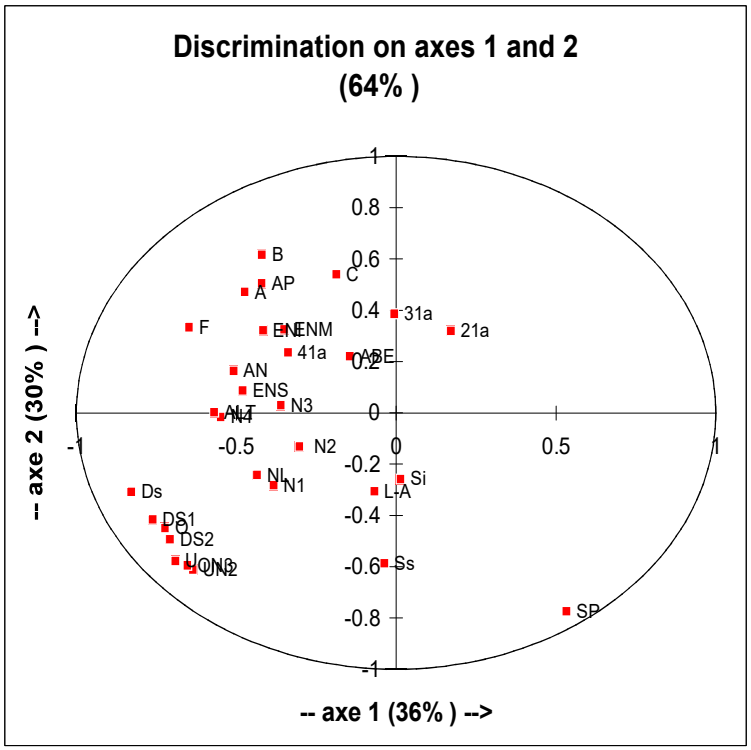

Fig. 2 - Discrimination of ampelographic characteristics versus the first two factors

Finally, the total variance-covariance matrices are calculated, by summing up the interclass and the total intraclass matrices. The resulting limit values were very high, between –44705.12 for the AN/SP correlation and +116120.59 for the DS1/DS2 correlation.

Correlation circle analysis. It resulted thet the first two discriminating factors have a total segregation (discrimintion) capacity of 46% (25.932 for the first and 20.188 for the second). Most of the discriminating function correlations have negative values (see figure 2).

The best correlations with these discriminating factors have been evidenced in the variables DS (-0.827015), DS1 (-0.761423) and DS2 (-0.703581) which determine for inner leaf contour.

The second factor yields the highest correlation values with the variables B (0.615894), C (0.540347), AP (0.504357) which determine the angles formed by the nervures and the middle lobe shape. Important correlations with factor 2, but with negative values, are yielded by the variables: SP (-0.774655), UN2 (-0.612812), ON3 (-0.595173), SS (-0.587155) determined by the sinuses opening and depth.

All these variables are situated toward the extremity of the correlation circle.

The second stage was aimed at determining the classes affected by a posteriori classification. All the 40 individuals grouped into 4 a priori classes, each comprising 10 individuals characterized by the 30 variables, indicate that the initial structure of classes was modified.

The classification error was of only 0.0667, while the class structure was as folows: 10 individuals belong in the group Cabernet Sauvignon - 7 Dg; 9 in the Cabernet Sauvignon - 9 Is clone, 10 in the Cabernet Sauvignon population clone, 11 in the Cabernet Sauvignon - 33 Vl (see table 1).

Table 1

Synthesis of individual reclassification following DFA application

Group	Individues in group 1	Individues in group 2	Individues in group 3	Individues in group 4	Total
Cabernet Sauvignon - 7 Dg (group 1)	10	0	0	0	10
	0.07	0.00	0.00	0.00	0.07
Cabernet Sauvignon - 4 Is (group 2)	0	8	1	0	9
	0.00	0.05	0.01	0.00	0.06
Cabernet Sauvignon - population (group 3)	0	1	7	2	10
	0.00	0.01	0.05	0.01	0.07
Cabernet Sauvignon - 33 Vl (group 4)	0	1	2	8	11
	0.00	0.01	0.02	0.05	0.08
Total	10	10	10	10	40
	0.07	0.07	0.07	0.07	1
Classification error : 0.0667					

The Cabernet Sauvignon - 7 Dg clone (group 1) indicates that all individuals belong in the group, of which only 7 are typical, showing 100% belonging (noted 1), the other 3 belonging to the group in proportion of 0.9183-0.9997.

The Cabernet Sauvignon - 4 Is clone (group 2) shows little homogeneity with only 8 specific individuals, of which only one is typical , while the 2 remaining ones can be grouped alongside the Cabernet Sauvignon - population and Cabernet Sauvignon - 33 Vl clone.

The Cabernet Sauvignon - population (group 3) also shows reduced homogeneity, with 7 individuals conforming to the variety parametres, of which none is typical; proportion variability ranges between 0.6771-0.9989 and 2 individuals may belong in the Cabernet Sauvignon - 4 Is and Cabernet Sauvignon - 33 Vl.

The Cabernet Sauvignon - 33 Vl clone (group 4) has 8 individuals belonging in the group but none is typical, proportion variability ranging between 0.4605 and 0.9950.

CONCLUSIONS

1. The application of DFA to the 4 clones of Cabernet Sauvignon selected with a view to assessing phenotypical homogeneity has indicated high heterogeneity among individuals making up the population (clones). Given the variability of morphological characteristics, their single use to idetify vine clones is insufficient thence the need to investigate the genome expression.

2. The variables allowing for the best discrimination of clones have proved to be: SP, ON3, UN2, U, DS2, O, DS1. These correlate best with factors 1 and 2 and mainly define the opening and depth of lateral sinuses and the petiol sinus.

3. Phenotypical homogeneity analysis has shows the following:
   - high stability varieties: Cabernet Sauvignon - 7 Dg clone;
   - midlle stability varieties: Cabernet Sauvignon - 4 Is and Cabernet Sauvignon - 33 Vl clones;
   - low stability varieties: Cabernet Sauvignon - population. Many individuals making up these populations have shown large fluctuations of ampelographic characteristics, such that, as a result of DFA application, they allowed for their grouping alongside different varieties.

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