ABSTRACT

The thesis entitled „***The study of phenotypic characters of indigenous varieties of vines using mathematical methods based on ampelometry***" was held during the three-year study (2013-2016), is drafted into 10 chapters and is divided into two distinct parts.

The first part, current state of knowledge, consists of three chapters which lists bibliographic data.

Chapter 1. Heritage conservation importance of vineyard. Due to the valuable forms of nature, there were obtained varieties based on all sorts of spontaneous plants listed in culture and which are propagated vegetatively. The long evolution that is found in these plants has led to these valuable forms. However, varieties may appear due to mutations, environmental influences causing vegetative jumps. Mutations are frequently found on vines, forming new varieties.

Varieties that resembles the morphological characteristics (phenotype) represents *ecotypes varieties.*

Based on historical evidence we have, the age of the vine culture in our country dates back to the Iron Age (c. V-I BC). The archaeological discoveries, especially in central Transylvania, revealed Dacian iron spades as specific tools in viticulture. The significance of vine culture is told by historian and geographer Strabo, who says that King Burebista ordered that all vineyards in Dacia to be destroyed in order to stop the invasion of migratory peoples. From this period we encounter the Romanian lexicon the words: *grape, vine, tendril,* words that are of Dacian origin.

The morphological and biological homogeneity of the vine varieties is linked to the length of its during cultivation and the propagation method practiced. The most unitary varieties are the ones ameliorated and the ones propagated vegetatively. But even the homogeneity of new varieties propagated vegetatively is relative because they undergo morphological mutations, mosaics, chimeras grafting, physiological mutations or by human intervention, through artificial mutations.

Chapter 2. Modern methods used for the description and recognition of varieties of vine. In the study of varieties of vines, botanical description occupies an important place both for recognition, description as well as for characters determination which helps establish their classification.

Over the centuries, the taxonomy of the vine has long been studied by many scientists, each proposing their own system of classification, enriching in this way the framework of concerns, enabling thus the transition from simple morphological descriptions, biological properties and technical and cultural characteristics, to matters of molecular biology.

In ampelography are used three types of taxonomy: numerical taxonomy, biochemical taxonomy and genetic taxonomy.

In addition to descriptive ampelographic schemes, the methods based on examining the leaf morphological characters acquires great importance, the leaf as the main body and expression of those characters by measurements and numerical values, which together constitute *ampelometry*.

Research results in the ampelography established genetic training centers and membership genus *Vitis varieties* from certain environmental groups. Also, it could highlight the influence of ecosystem conditions on variability of the morphological, agrobiological and technological characters.

Chapter 3. Material, objectives and research methods. This chapter presented the research objectives, the biological material used and research methods.

In this thesis we proposed to establish the degree of similarity / dissimilarity between varieties belonging to these phenotypic sortogroups. So we studied three sortogroups:

- Coarnă neagră sortogroup and the new creations Coarnă neagră selecționată, Azur, Milcov, Gelu, Ozana and Mara;
- Coarnă albă sortogroup and the new creations Miorița and Muscat Timpuriu de București;
- Băbească neagră sortogroup and the new creations Băbească gri, Codană, Arcaș, Balada, Cristina and Mamaia.

To do this, starting from ampelometric method, we used modern statistical and mathematical methods to determine the phenotypic similarity and dissimilarity between varieties belonging to the sortogroups studied, being introduced into the international scientific research the new romanian creations, less known, but very valuable.

Research will focus on the following objectives:

1. characterization of new romanian varieties using ampelographic descriptors so that their presentation be made by a modern and uniform method so it can be included in the database of the OIV's, for being accepted in the flow of international scientific field;

2. application of multidimensional statistical methods (principal component analysis, cluster analysis, discriminant analysis) in order to rank vine varieties from the sortogroups studied using the data data obtained from the ampelometric measurements.

3. the use of new mathematical methods (fractal analysis) to study the leaf architecture as the main ampelographic organ by determining the fractal dimension of the leaves and the sectarian degree of leaves, thus enabling a more accurate and precise differentiation of varieties within each sortogrup.

The last part of this chapter is the largest and presents research methods: ampelometric method, using ampelographic descriptors (morphological, agrobiological and technological character encoding), principal components analysis, cluster analysis, discriminant factor analysis, fractal analysis and sectarian degree of leaves.

Chapter 4. Results on the application of ampelometric method and analysis of variance. In this chapter ampelometric method was applied on the sortogroups studied. After that, on the base of encoded characters we defined the leaf shape. For the beginning, we calculated the average values for the principal ampelometric characters and these values were then coded. Based on these encodings, using leaf shape diagram designed by Galet, we defined the shape of the leaf for each variety of vines in the study: Coarnă neagră – cuneiform; Coarnă neagră selecționată – tronconic; Azur – orbicular-reniforme; Mara - orbicular; Ozana – orbicular-reniforme; Milcov - cuneiform; Gelu - tronconic; Coarnă albă – orbicular; Muscat Timpuriu de București – orbicular-reniforme; Miorița - orbicular-reniforme; Băbească neagră – tronconic; Băbească gri – tronconic; Codană – tronconic; Arcaș – tronconic; Balada – orbicular-reniforme; Cristina - orbicular-reniforme; Mamaia - orbicular-reniforme.

Chapter 5. Results on the application of ampelometric descriptors method. In this chapter there are presented morphological, agrobiological and technological characters encodings for the varieties from the sortogroups studied. Sheets thus completed for each variety, permit their introduction into the database O.I.V.'s, the presentation being consistent and allows the exchange of information internationally.

Chapter 6. Results on the application of principal component analysis. This chapter presents the results achieved by the principal components analysis at the sortogroups studied.

At Coarnă neagră sortogroup, the percentage of inertia of the first two principal components was 84,31%, 63,83% at the first principal component (axis 1) and 20,48% at the second principal component (axis 2). This way is waived multidimensional space of the 30 variables analyzed initially on the two-dimensional, created by the first two principal components, preserving the 84,31% of inertia (variance) from the total of individuals.

This shows the position of Coarnă neagră and Coarnă neagră selecționată varieties, which had almost the same contribution to defining the principal constituents, which indicates high similarity of the architecture leaves to these two varieties.

At Coarnă albă sortogroup, the percentage of inertia of the first two principal components was 100%, 73,49% in the first principal component (axis 1) and the second component 26,51%.

At Băbească neagră sortogroup, percentage of inertia of the first two principal components, for varieties analyzed was 86,40%, 52,14% at the first principal component (axis 1) and 34,26% at the second main component (axis 2). This way is waived multidimensional space of the 30 variables analyzed initially on the two-dimensional, created by the first two principal components, preserving the 86,40% of inertia (variance) from the total of individuals.

Chapter 7. Results on the application of cluster analysis. This chapter presents the results obtained from applying the Cluster analysis.

In order to establish phenotypic similarities at Coarnă neagră sortogroup, we used cluster analysis, which acknowledges the existence of politeness groups (similar varieties groups), measure the similarity of the elements of the group and the difference between groups. Based on this analysis were established: the levels of linkage / relationship varieties analyzed, the values of chaining index, histogram hierarchy of varieties analyzed and varieties similarity dendrogram.

Analyzing the varieties similarity dendrogram, it has been found that there are two major politeness groups of descendants of Coarnă neagră variety. We found the same result at Coarnă albă sortogroup.

Given the values of chaining index, it can be observed that the group of Miorița and Muscat Timpuriu de București is more homogeneous, being closest in terms of leaf architecture, while the leaf of Coarnă albă variety is a little different from its two offspring.

For Băbească neagră sortogroup, dendrogram analysis finds that there are two major politeness groups of descendants of Băbească neagră variety, the first group being composed by several subgroups.

Given the values of chaining index, it can be observed that the closest to the Băbească neagră variety in terms of architecture leaf are Balada and Codană varieties, while the other hand we have Cristina and Arcaș varieties, with values of the index of dissimilarity much higher.

Chapter 8. Results on the application of discriminant factor analysis. This chapter presents the results obtained from the application of discriminant factor analysis.

In this analysis, the first step was to represent the variance-covariance matrix between groups. For a good division into classes is intended that values should be as high, either negatively or positively. When a variable value is close to zero, its ability to achieve the division into classes is quite low.

It was represented then the intraclass matrix for each variety within each sortogroup. It was then realized the total variance-covariance matrix, then Mahalanobis distances were analyzed. On the base of Mahalanobis distances we determined which are the extremes cloud of individuals and whether the hypothesis variance-covariance matrices as intraclase be equal to each other.

Another step was to realize the reclassification of individuals taken into study, specifying membership groups already established, while being entered the coordinated discriminating on 6 axes.

In terms of total individuals, we found a homogeneity of 51,43%, with 36 individuals typical to each variety of the 70 in the study in Coarnă neagră sortogroup. For Coarnă albă sortogroup, we found a homogeneity of 66,67%, with 20 individuals typically to each variety of the 30 under study in this sortogrup. For Băbească neagră sortogroup we

found a homogeneity of 54,29%, with 38 individuals typical to each variety of the 70 in the study.

Chapter 9. Results on the application of fractal analysis and sectarian level of leaf. Analysis of data obtained revealed the following:

- Average values of fractal dimension leaf vine varieties studied in Coarnă neagră sortogroup, varied from 0,9788 at Mara variety to 1,1570 at Ozana variety;

- Average values of the fractal dimension of the leaves of vine varieties under study considered part of Coarnă albă sortogroup, varied from 1,0292 at Coarnă albă variety to 1,1726 at Muscat Timpuriu de București variety;

- Average values of fractal dimension leaf vine varieties studied at Băbească neagră sortogroup, varied from 1,0036 (Băbească neagră variety) to 1,1595 (Cristina variety).

Ampelometric average values of ratio d1 / N2 which show the sectarian degree of leaves varied as follows:

- at Coarnă neagră sortogroup, ampelometric values varied from 0,4293 at Ozana variety to 0,7218 at Mara variety;

- at Coarnă albă sortogroup, ampelometric values varied from 0,5087 at Coarnă albă variety to 0,6655 at Mioriţa variety;

- at Băbească neagră sortogroup, ampelometric values varied from 0,3856 (Cristina variety) to 0,7178 (Arcaș variety).

The results obtained in the two analyses described above were then processed and interpreted statistically using analysis of variance / ANOVA test. At the Coarnă neagră sortogroup, due to the arithmetic average value of Mara variety compared to other varieties, yields a P value of 0, far less than the critical value of P 0,05, the difference between the values of P and P critic indicating that there are significant differences between the leaves of these seven varieties, both in terms of fractal analysis and the sectarian degree of leaves. At Coarnă albă sortogroup, differences in fractal analysis are lower than in the sectarian degree of leaves and at Băbească neagră sortogroup, P value was between the other two sortogroups values (0,000129) and here there are very significant differences, both in terms of fractal analysis and the sectarian degree of leaves.

At the end of the thesis are presented the general conclusions, bibliography, list of tables and list of figures.