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Original scientific article

IDENTIFICATION AND EXAMINATION OF CERTAIN CYTOGENETIC CHARACTERISTICS OF SOME AUTOCHTHONOUS VARIETIES OF GRAPEVINE IN REPUBLIC OF NORTH MACEDONIA

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In R.N. Macedonia has a large number of autochthonous or domestic varieties (cultivars) of grapevine that are grown as individual vines or in small, limited plantations. Until the beginning of the 20th century and before the phylloxera attack in our country, native varieties were much more represented. Autochthonous varieties existed and were cultivated for a long time in several vineyards and were characterized by stable and significant properties. These varieties are adapted to the environmental conditions where they are grown and are carriers of stable genes that can be used in further selection and hybridization to obtain new grape varieties. Therefore, it is very important for a country (region) to have autochthonous varieties in its assortment.In this paper, we considered four autochthonous grape varieties - two table varieties (Konchanka and white winter) and two wine varieties (Ohrid white, Ohrid black). We tried, according to the ampelographic description and certain characteristics of the reproductive system, to determine their origin. According to the phenotypic characteristics that refer to the centers

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of origin of the varieties, the studied varieties - Konchanka and White winter belong to the Eastern varieties convarietas orientalis, subconvarietas antasiatica, and the studied varieties Ohrid white and Ohrid black variety belong to the Black Sea - Balkan varieties convarietas. pontica, subconvarietas balcanica. Among the examined varieties, the properties from the second group of descriptors are described in detail according to the proposals of O.I.V. According to some codes (characteristics) there is a big difference between varieties. Also, for a more detailed differentiation of the varieties, cytological properties were examined - pollen germination and vitality, number of chromosomes in mitosis and meiosis, ploidy level, percentage of fertilization (fecundation), self-fertilization (autogamy) and cross-fertilization (xenogamy). The statistical processing of the ampelography data is according to a cluster program (SPSS) that works on the binary similarity or dissimilarity as measures used to group the data and further form a clear dendogram display.

Keywords: autochthonous varieties, ampelographical description, chromosomes, cytological properties

INTRODUCTION

For the identification of grape varieties, a large amount of data is studied and many properties are described, which contributes to a more accurate determination of their origin. In the eighties and nineties of the last century, the identification of the varieties mostly made based on ampelographic and ampelometrical data, afterwards examining the origins, history of breeding, collection and long years testing and so on (BOŽINOVIĆ 2010). Towards the end of the last century, molecular analysis and sophisticated DNA identification were introduced to investigate the origin and to make a description of the variety (ARADHYA *et al.*, 2003). But still, the ampelographic description has a very significant role in determining the dilemma of whether the variety is certainly the one described, whether the variety is a parent, whether it is a clone or a completely different variety (GALLARDO *et al.*, 2009).

In North Macedonia, there are many discovered and undiscovered autochthonous (domesticated) and native grape varieties. In our research, in the period from 2003 to 2019, as the goal of a large number of subsequent projects, the identification, testing, collection and distribution of grape varieties were intensified. Some of the cultivars have been included in the national cultivar list as recommended grape varieties for wine production, table cultivars, seedless cultivars and vine rootstocks (WOLF *et al*, 1999). In the history of our areas (in the Balkans and beyond) there was a lot of movement of people, trade, migrations, wars, diseases, etc.

That is why there were also changes in the representation of different species and varieties of different plants (different genetic pool). Such is the case with the vine. There is diversity in the assortments of grapevines in different countries. Many of the varieties have long been cultivated in one country, some were introduced from another country or there are some varieties that are represented in many countries in the region, but with different names - synonyms and homonyms (ARADHYA *et al.*, 2003; CIPRIANI *et al.*, 2010).Therefore, when preparing the national list of grapevine varieties in a country, the genetic pool of the grapevine should be examined and the varieties that can be identified as autochthonous, regional or introduced should be identified as precisely as possible.

For this purpose is the application of the above identification methods. In North Macedonia, there are many varieties of grapes that have been cultivated for a long time, and their exact origin is not known. It is not known whether the varieties originated in our country or originated in some near or far country and were domesticated here. Also, some varieties are brought into our country from outside, which are considered as foreign introduced varieties (LAIDIG *et al*, 2009; MAGHRADZE *et al.*, 2009; *MENEGHETTI et al.*, 2009).

Therefore, this paper describes four old grape varieties that are found as single vines or limited small plantations in certain regions of the Republic of North Macedonia (BOŽINOVIĆ 2010). For a large part of the varieties, it is not known whether they originate from Macedonia or were accepted from another country, planted a long time ago and already domesticated (AVRAMOV 1991). In the neighboring countries of the Balkan region, there are varieties that are similar to our indigenous varieties, because they belong to the same ecological-geographical group. Sometimes the same varieties with different names are found or clones of existing varieties obtained by clonal selection are found. By applying identification methods, the origin of the variety can be determined with great accuracy (BLAICH *et al*, 2007; CALÒ *et al.,* 2008). But this process was influenced by many factors such as - the long period of growing the variety without precise information about its origin, ignorance and mistakes when taking the material for testing, also the loss of the only - source material for growing, etc.

The main goal of the examination in this paper is a comprehensive ampelographic analysis and description of the given varieties (especially the cytological characteristics of the reproductive system) as the most relevant and accurate data on their origin and affiliation.

MATERIAL AND METHODS

Plant material

In this paper we were examined four autochthonous varieties grapevine in R.N. Macedonia;

- Konchanka - black table variety, with belonging to eastern varieties (convarietas orientalis, subconvarietas antasiatica), in our country found in Gevgelija-Valandovo vineyard region.

- White winter - white table variety, with belonging to eastern varieties (convarietas orientalis, subconvarietas antasiatica), here is already represented in larger mixed plantations and grapevines where the individual is used as pollinators. It is has been present in Gevgelija-Valandovo, Strumica, Tikvesh, Veles vineyard region and more.

- Ohrid white variety - white wine variety with belonging to Black Sea - Balkan varieties (convarietas pontica, subconvarietas balcanica), in our country found in Ohrid vineyard region.

- Ohrid black varieties - black wine variety with belonging to Black Sea - Balkan varieties (convarietas pontica, subconvarietas balcanica), in our country found in Ohrid vineyard region.

The examinations were performed in several successive years from 2003 to 2019, in Ohrid, Gevgelija-Valandovo and Skopje vineyard region.

Methods of determination

The examinations have an analytical approach and begin with a detailed analysis of a specific group of properties (ampelographic properties) and end with a general part (determination of origin, affiliation or autochthonousness).

The examinations are based on mutual comparisons among the varieties and determining the differences among certain phenotypic characteristics, in particular ampelographic and cytological *characteristics*. By defining the differences in certain *characteristics* are a step forward in the identification of the variety, in determining whether it is the same variety or its clone, may be determined its origin and affiliation etc.

Specifically in this paper, ampelographic characteristics are examined according to a list of secondary O.I.V. Code descriptors. The list proposed by EU-PROJECT GENRES 081 - 09/2001, (O.I.V descriptor list for grapevine varieties and Vitis species. 2009, Second edition).

Cytological characteristics are examined according to the order chapters 12 and 13 of O.I.V descriptor list for grapevine varieties and Vitis species. Examined are the number of chromosomes, pollen germination, degree of fertilization and degree of polyploidy. For the examination of these characteristics are used standard classical methods shown in detail below.

According to the O.I.V descriptor list

A. Cytological characters

- Chromosome number
- Ploidy level (e.g. aneuploid or structural rearrangement)
- Pollen viability Specify the method i.e. germination in a solution or grain staining
- Meiosis chromosome associations Mean of 50 microspore mother cells, observed during metaphase I
- Other cytological characters (e.g. stomata density and size)

B. Identified genes

Among the results is used statistical processing according (SPSS) program with clear views of tables, 1 dendogram and 2 charts.

Methods and techniques for preparing the material for examination

The germination of the pollen was examined *in vitro*, with planting pollen grains in fertile base of 15% saccharose solution, in a preparation hanging drop and with keeping it in a thermostat on a temperature of 21ºC. After that the germinated pollen grains were counted and photographed under a microscope.

Fertilization, as part of the genetic status, was examined by determining the self - fertilization (autogamous) and cross - fertilization (ksenogamous).

For determination of the effect of covering with dust in conditions of isolation a choice of bunches of flowers immediately prior flowering was made, they were marked, the flowers were reduced and counted and were isolated with cellophane bags and tied. After the fecundation the cellophane bags were opened so that the bunches of grape could grow. After the veraisson the fecundated grains were counted. For establishing the effect of free covering with dust, bunches of flowers were chosen that would serve for making comparison with the previously isolated bunches of flowers and those were marked and in some cases reduced. The flowers prior flowering was also counted, and after the veraisson the fecundated grains, the rest of the flowers and the unfecundated grains were counted and the percentage was calculated.

For obtaining material for observation under a microscope, it is necessary prior germination of the seeds of the examined grape cultivars and the examined crossing combination, which is performed by keeping the seeds in isolated plates, slightly covered with water, alternating 6 hours on a temperature of -2ºC to -3ºC, in a refrigerator and on 25ºC in a thermostat or a room temperature next to some heater. After the germination of the seeds they were slightly dried and planted in pots filled with garden soil and bio-fertilizer. For examination of the mitosis at the grape cultivars, germinated roots 5-10 mm long were used.

For counting the chromosomes and observation of some phases of the mitosis the cytological technique of Thio and Levan was used, as well as the standard "Squash" method of Battaglia. The roots were treated with the cytostatic 8–hydro-oxyquinoline (0,002 M) during a period of time from 12 to 24 hours at room temperature. The fixation was performed with a fixative after Klark (alcohol-acetic acid, in a ratio 3 : 1) during a period of 24 to 48 hours, then the material was transferred into 75% ethyl alcohol in which it was kept for a longer period at a temperature of 4ºC, until its application (ALLEWELDT *et al.*, 1994; VASCONCELOS *et al*, 2009). The coloring was performed with reagens of Schiff (leuco basic fuchin) according the method of Darlington and La Cour and with Hematoxylin after Gomori according to the method of Konstantinov. Prior coloring, the roots were hydro-isolated in lN HCl, previously heated on a temperature of 60ºC with a duration of 11 to 14 minutes. The coloring with Schiff reagens was achieved within a period of 1 to 2 hours at room temperature, and after that the colored meristematic tissue was isolated and macerated on object glass in 1% solution of aceto-orcein, where additional coloring of the chromosomes was achieved. The coloring with Hematoxylin after Gomori took 45 minutes to 1 hour, at 60ºC, then the material was rinsed with 45% acetic acid and it was macerated on an object glass in a drop of the same acid. Out of the better preparations with well distributed metaphasic chromosomes, permanent preparations were further made with application of liquid CO_2 in stream, according the method of Bowen. After being shortly frozen, the preparations were rinsed with absolute alcohol and were fitted in Euparal. During the observation Reichert photo-microscope was used, and micro photographing was also made with it (VASCONCELOS *et al*, 2009; WOLF *et al.*, 1999).

RESULTS AND DISCUSSION

According to the ampelographic description of O.I.V. the system of codes from the descriptor list and the statistical analysis of the data, we can see that the biggest differences between the examined varieties have for the properties marked as OIV 155, OIV 459 and OIV 504. For example, according to OIV 155 (shooting), characteristic - fertility of basal buds (1-3) the varieties Ohrid white and Ohrid black have a grade of 9 and have very high fertility of basal buds (BOŽINOVIĆ 2010; WOLF *et al*., 1999). The variety Konchanka has grade 5 and she has medium fertility of basal buds. White winter variety has a grade of 1 and has a very low fertility of basal buds (BOŽINOVIĆ 2010, ROYTCHEV 1997). Table 1 presents secondary ampelographic descriptors with grade.

It indicates that the varieties Ohrid white and Ohrid black of their habitus have deployed different potential for fertility and yield, unlike the varieties Konchanka and White winter (ARADHYA *et al*, 2003; AVRAMOV 1991.

Table 1. Secondary ampelographic descriptors with grade

OIV Code N°	Descriptor	Characteristics	Konchanka	White winter variety	Ohrid white variety	Ohrid black, variety
OIV 006	Shoot	attitude	3	3	1	1
OIV 155	Shoot	fertility of basal buds (1-3)	5	1	9	9
OIV 204	Bunch	density	5	7	7	5
OIV 206	Bunch	length of peduncle	3	5	3	3
OIV 301		Time of bud burst	5	5	5	5
OIV 303		Begin of berry ripening (veraison)	5	9	5	5
OIV 351		Vigor of shoot growth	5	5	5	5
OIV 452	Leaf	Degree of resistance to *Plasmopara*	5	5	5	5
OIV 455	Leaf	Degree of resistance to *Oidium*	5	5	5	5
OIV 459	Leaf	Degree of resistance to *Botrytis*	5	9	3	5
OIV 502	Bunch	weight of a single bunch	5	5	5	3
OIV 503	Berry	single berry weight	5	5	3	5
OIV 504		Yield per m^2	5	9	5	7
OIV 505		Sugar content of must	7	5	7	7
OIV 506		Total acid content	3	3	3	3

Furthermore, according to OIV 459 (leaf), characteristic - degree of resistance to *Botrytis,* the varieties Konchanka and Ohrid black have a grade of 5 and have medium resistance to gray rot - *Botrytis* The variety White winter has grade 9 and she has a high resistance to gray rot - *Botrytis.* Ohrid white variety has a score of 3 and has a low resistance to gray rot – *Botrytis* (THIS *et al.,* 2004).

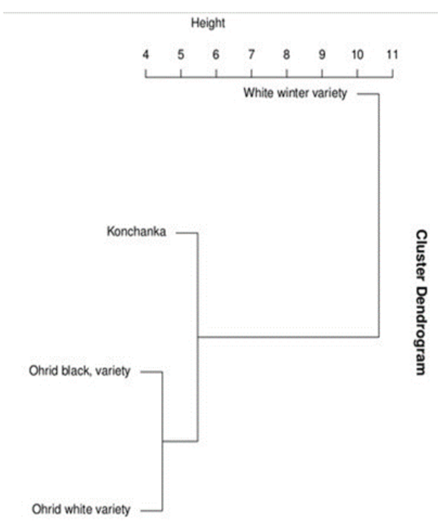
According to OIV 504, characteristic - yield per m^2, the varieties Konchanka and Ohrid white have a grade of 5 and have medium yield per m^2. The variety White winter has grade 9 and she has a very high yield. Ohrid black variety has a score of 7 and has a high yield per m^2 (BOŽINOVIĆ 2010, NASTEV 1977).

From the obtained results can be seen that among the others characteristics analyzed the differences are smaller and less significant.

From the statistical analysis of comparable characteristics (a cluster analysis), it can be concluded that the highest degree of difference has between the varieties Ohrid white and Ohrid black from one side and the variety White winter on the other side. The variety Konchanka according similarity is somewhere in the middle, between the varieties Ohrid white and Ohrid black. The lowest degree of difference between the varieties have Ohrid white and Ohrid black.

From the completed description and identification of the varieties can be seen the fact that the varieties Ohrid white and Ohrid black are closest according to their origin, they farther origin has variety Konchanka, and remotest origin one has the variety White winter.

In Figure 1 and Figure 2 are shown with graph dendogram differences between the varieties.



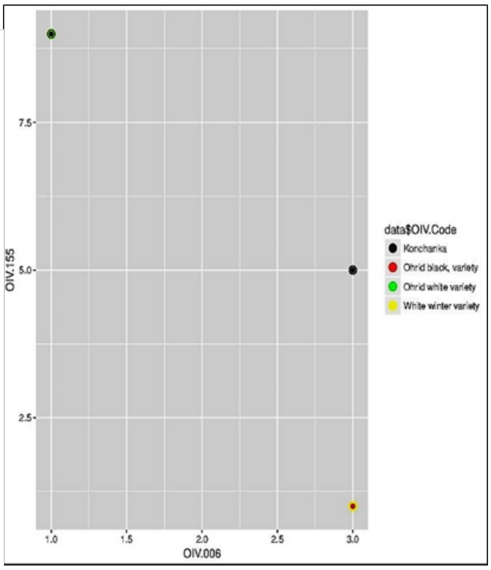


Figure 1. Dendogram of statistical processing Figure2.Chart for displaying degree of difference

The analyzed characteristics are ampelographic (anatomical, morphological and physiological characteristics) and to a large extent contribute to solving the problems and dilemmas regarding the origin and affiliation of the varieties (ARADHYA *et al.*, 2003; O.I.V. 2007). But the previous features are not enough and it is necessary to perform other more accurate, in-depth analyzes that focus on the cellular level (cytological and cytogenetic analyzes).

Within a ampelographic research were performed and cytological research for determination of cytogenetic status of the examined varieties. Firstly are examined the percentage of self-pollination (autogamy) and cross-pollination (xenogamy), percentage of alive pollen (vitality) percentage of pollen germination (GALLARDO *et al.*, 2009; MAGHRADZE *et al.*, 2009; MENEGHETTI *et al.*, 2009).

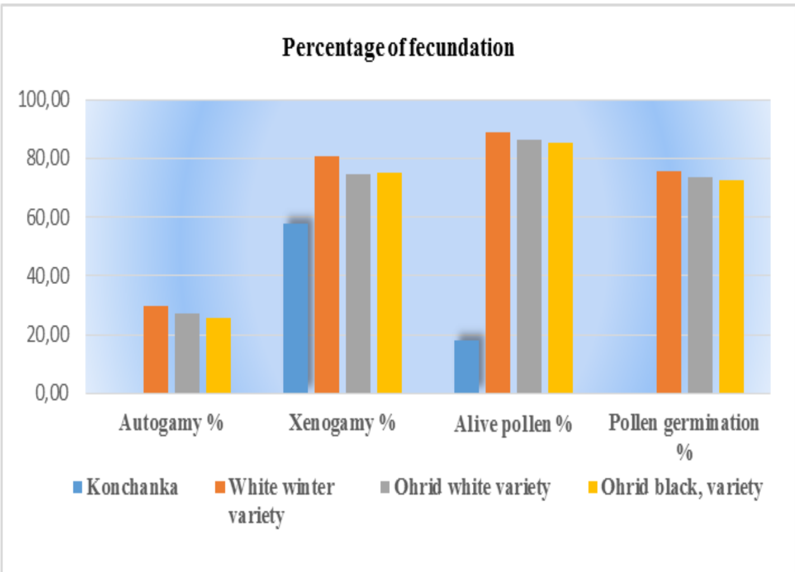
From the table 2 shows that the highest percentage of self-pollination (autogamy), vitality and germination of pollen has a variety White winter, and lowest percentage of all these parameters has the variety Konchanka (NASTEV 1977).

Table 2. Percentage of fecundation in cases of covering with dust in isolated conditions (self-pollination) and in normal conditions (cross-pollination), percentage of alive pollen and percentage of pollen germination

Cultivars	Isolated conditions (autogamy) %	Normal conditions (xenogamy) %	Alive pollen %	Pollen germination %
Konchanka	0,00	57,80	17,85	0,00
White winter variety	29,92	80,76	88,71	75,55
Ohrid white variety	27,15	74,80	86,40	73,70
Ohrid black, variety	25,97	75,20	85,55	72,58

The varieties Ohrid white and Ohrid black have a good percentage of fertilization and good percentage pollen germination. The variety Konchanka has morphologically hermaphroditic, functionally female flower, and other varieties have morphologically and functionally hermaphroditic flower. The variety Konchanka has 0.00% autogamy and 0.00% of pollen germination. The variety White winter has high percentage of pollen germination and is often used for pollination of other varieties (ALLEWELDT *et al*., 1994; ARADHYA *et al.,* 2003; MULLINS *et al*., 1992.

Also, the percentage of pollination and the germination of pollen are presented in an overview in graph 1.



Graph 1 Percentage of pollination (fecundation and the germination of pollen

From the group of cytological characteristics is observed mitosis and are performed differentiation and counting of metaphase chromosomes from somatic cells (sprouted seeds by grapes). Determined is the number of chromosomes 2n = 38, n = 19 at the the four tested varieties. According to the performed analyses, i.e. counting of chromosomes, no changes were observed in the chromosome number (chromosome set) in somatic cells. No other variations and chromosomal abnormalities were observed. Chromosome set and polyploidy are presented in table 3.

Table 3. Chromosome constitutions in a normally diploid organism with 2n = 38 chromosomes (labeled A, B, and C) in the basic set

Name	Designation	Constitution	Number of chromosomes
Monoploid	*n*	ABC	19
Diploid	2*n*	AABBCC	38
Triploid	3*n*	AAABBBCCC	57
Tetraploid	4*n*	AAAABBBBCCCC	76
Monosomic	2*n* − 1	ABBCC	37
		AABCC	37
		AABBC	37
Trisomic	2*n* + 1	AAABBCC	39
		AABBBCC	39
		AABBCCC	39

Also according to the marking, mapping and counting of the chromosomes at the a certain number of cells in metaphase has been determined level of polyploidy. The four varieties belong to the diploid varieties originating genus *Vitis*, subgenus *Euvitis* with 2n = 38 chromosomes (CIPRIANI *et al.*, 2010; YAVAR *et al.*, 2010).

In this case, the chromosomes in metaphase I in meiosis were also examined by marking, mapping and observing chromosomes in an average of 50 stem cells (macrosporogenesis) and marking, mapping and observing chromosomes in an average of 100 pollen cells (microsporogenesis) (ANHALT *et al.*,2011;BLAICH *et al.*, 2007; CALÒ *et al.*, 2008).

In all four varieties not found an anomaly in the structure and number of chromosomes (CIPRIANI *et al.*, 2010; LAIDIG *et al.*, 2009). But only in the variety Konchanka exist defect in cell division of the pollen (microsporogenesis) where chromosomes are late for acceptance of dividing spindle and produced triads, replacing the tetrads and therefore creates irregular forms in pollen which are infertile and not germinate. The presence of this anomaly in the variety Konchanka, indicates that by origin it is similar to some domesticated varieties in R.N. Macedonia - Drenak, Chaus, Kadarka (AVRAMOV 1991, BOŽINOVIĆ 2010).

Figures 3 to 15 show chromosomes in mitosis, meiosis, pollen grains, flowers and fertilized blossom of the varieties examined.

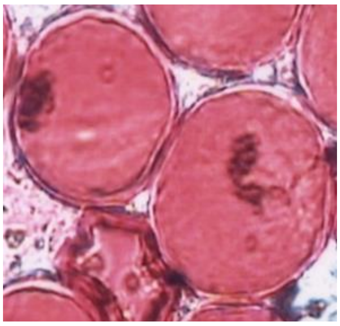


Figure 3. Chromosomes in meiosis in Konchanka

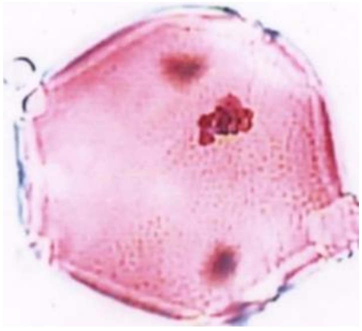


Figure 4. Meiosis at the pollen and dividing spindle in Ohrid black variety

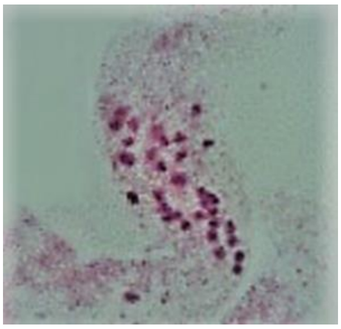


Figure 5. Chromosomes in mitosis in Ohrid white variety

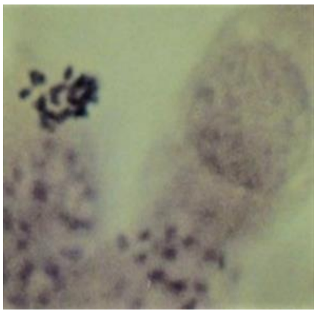


Figure 6. Chromosomes in mitosis in White winter

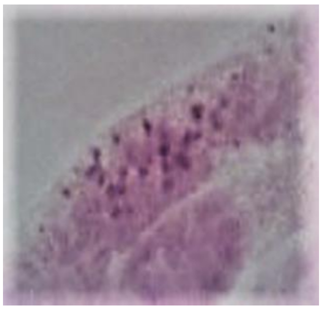


Figure 7. Chromosomes in mitosis in Ohrid black variety

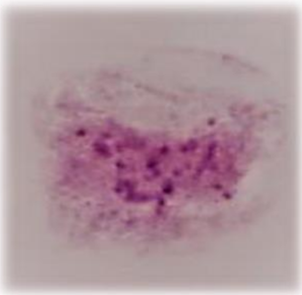


Figure 8. Chromosomes in mitosis in Konchanka

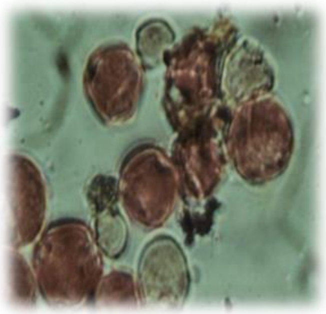


Figure 9. Live pollen in Ohrid black variety

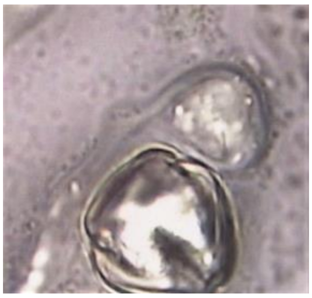


Figure 10. Sprouted pollen in White winter

Figure 11. Konchanka

Figure 12. White winter

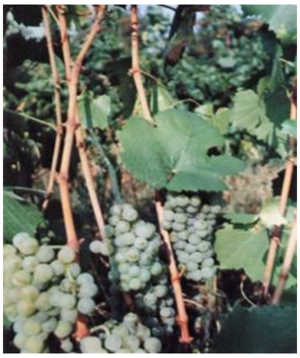


Figure 13. Ohrid white variety

Figure14. Ohrid black variety

A
Fertilized blossom in Konchanka

B
Functionally female blossom in Konchanka

C
Hermaphroditic Blossom In Ohrid white variety

Figure 15. (A, B, C) Structure of blossom

CONCLUSION

According of the conducted researches the following conclusions can be presented:

1. Since ampelographic description on O.I.V. Code system and the statistical analysis of data, we can see that the greatest differences among the examined varieties have about the properties marked as OIV 155, OIV 459 and OIV 504. Based on completed description and identification of the varieties can be seen the fact that the varieties Ohrid white and Ohrid black are closest according to their origin, they farther origin has variety Konchanka, and remotest origin one has the variety White winter. Konchanka and White winter belong to the eco-geographical group - convarietas Orientalis, subconvarietas Antasiatica. Ohrid white variety and Ohrid black variety belong to the eco-geographical group - convarietas pontica, subconvarietas balcanica. According to the ampelographic characteristics, the examined varieties are typical representatives of the Balkan and Oriental ecological group of varieties and as evidence they are similar to their relatives (the characteristics are very similar or identical).

2. The examination of pollination and fertilization can be ascertained that the highest percentage of self-pollination (autogamy), vitality and germination of pollen has a variety White winter, and lowest percentage of all these parameters has the variety Konchanka. The varieties Ohrid white and Ohrid black have a good percentage of fertilization and good percentage pollen germination. The poor pollination and fertilization in the Konchanka variety is due to the functionally female flower, and for this variety it is necessary to find a pollinator. In the reproductive organs, irregularities were observed in meiosis and defective sterile pollen was observed.

3. According to the cytological characteristics, the four varieties belong to the diploid varieties originating genus *Vitis*, subgenus *Euvitis* with the number of chromosomes 2n = 38, n = 19 at the four tested varieties.

4. No anomaly was found in the structure and number of somatic chromosomes in all four varieties. But only in the variety Konchanka there is a defect in the cell division of the pollen (microsporogenesis) where the chromosomes are late to accept the division spindle and the produced triads, replacing the tetrads and therefore creating irregular forms in the pollen that are infertile and do not germinate. The presence of this anomaly in the Konchanka variety indicates that it is similar in origin to some domestic varieties.

5. In this paper, apart from the examination of the ampelographic and cytological characteristics of four autochthonous grape varieties (Konchanka, White winter, Ohrid white and Ohrid black), their further identification and research is needed. For their full determination and identification, it is necessary to examine additional characteristics: ampelographic, ampelometric, DNA analysis, identification with markers, etc. These cultivars have a large number of positive genes that should be studied and used in further hybridization and clonal selection. Autochthonous varieties grapevine represent an endless source of genetic fund (carriers of genes) in a country. All over the world, that fund needs to be preserved and conserved so that it can be used for further positive grapevine selection.

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IDENTIFIKACIJA I ISPITIVANJE POJEDINIH CITOGENETSKIH KARAKTERISTIKA NEKIH AUTOHTONIH SORTI VINOVE LOZE U REPUBLICI SEVERNOJ MAKEDONIJI

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Izvod

U Republici Severnoj Makedoniji ima veliki broj autohtonih ili domaćih sorti vinove loze koje se gaje kao pojedinačne loze ili u malim, ograničenim zasadima (plantažama). Do početka 20 veka i pre napada filoksere u našoj zemlji autohtone sorte su bile znatno zastupljenije. Autohtone sorte postojale su i dugo su se gajile u nekoliko vinograda i odlikovale su se stabilnim i značajnim svojstvima. Ove sorte su prilagođene uslovima sredine u kojoj se gaje i nosioci su stabilnih gena koji se mogu koristiti u daljoj selekciji i hibridizaciji za dobijanje novih sorti grožđa. Zbog toga je veoma važno da zemlja (region) u svom asortimanu ima autohtone sorte. U ovom radu razmatrane su četiri autohtone sorte grožđa - dve stone (Končanka i Belo zimsko) i dve vinske (Ohridsko belo i Ohridsko crno). Pokušali smo, prema ampelografskom opisu i određenim karakteristikama reproduktivnog sistema, da utvrdimo njihovo porijeklo. Prema fenotipskim karakteristikama koje se odnose na centre porekla sorti, proučavane sorte - Končanka i Belo zimsko pripadaju istočnim sortama - *Convarietas orientalis, Subconvarietas antasiatica*, a proučavane sorte Ohridsko belo i Ohridsko crno pripadaju crnomorskoj grupi sorti, Balkanske sorte - *Convarietas. pontica, Subconvarietas balcanica*. Među ispitivanim varijetetima, detalno su opisana svojstva iz druge grupe deskriptora prema prijedlozima O.I.V. Prema nekim kodovima (karakteristikama) postoji velika razlika između sorti. Takođe, radi detaljnije diferencijacije sorti ispitivana su citološka svojstva - klijavost i vitalnost polena, broj hromozoma u mitozi i mejozi, nivo ploidnosti, procenat oplodnje (fekundacija), samooplodnje (autogamija) i unakrsna oplodnja (ksenogamija). Statistička obrada ampelografskih podataka je u skladu sa klasterskim programom (SPSS) koji radi na binarnoj sličnosti ili različitosti kao merama koje se koriste za grupisanje podataka i dalje formiranje jasnog prikaza dendograma.

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