

DETERMINATION OF THE RESISTANCE TO ENVIRONMENTAL FACTORS OF THE INTERSPECIFIC HYBRIDS OF VINES (*VITIS VINIFERA* L. x *MUSCADINIA ROTUNDIFOLIA* MICHX.)

Alexandrov E.

Institute of Genetics, Physiology and Plant Protection of the Academy of Sciences of Moldova, 20 Padurii, street, MD-2002, Chisinau, Republic of Moldova; e_alexandrov@mail.ru

Abstract. As a result of interbreeding culture grapevine (*Vitis vinifera* L.), $2n = 38$, with American grapevines (*Muscadinia rotundifolia* Michx.), $2n = 40$ interspecific hybrids were created with diploid set of chromosomes $2n = 38$. Grow requirements to the genetic resources needed to improve the cultures valuable increased resistance to biotic and abiotic factors. Feels a need to ensure the heightened autochthonous products necessities for the industrial branches of the national economy. The flowering plants adapts to the environmental conditions using various methods and the changes morfo-anatomic hold a decisive role under conditions the high environmental temperatures. The changes for adaptation of the plants can be studied on the basis of morphological and anatomical characters of the leaf, because this plant is the organ of plastic and responsive to changes in the environment. Ecological adaptation of the plants of the environment conditions of the hydric of the variability is realized based morphology and anatomy quantitative indicators leaf. So far they have created many varieties of vines, and yet has not acquired perfect of vines the variety, that has meet the maximum agro biological and technological properties. The achievements are well known in the selection of grapevine varieties resulted in obtaining high quality and resistance to biotic and abiotic factors, such as those from France, Italy, Germany, Bulgaria, Hungary, Romania, Moldova, Ukraine etc. but it should be noted that cultivation of the variety of vines requires mandatory the grafting their the rootstock north American (resistant to phylloxera), which greatly increases the cost of planting material production and the creation of plantations of vines.

Keywords: anatomy, buds, environmental factors, interspecific hybrids, leaf, root, vines.

INTRODUCTION

For thousands of years the grapevine was included in the breeding process, so nowadays have come to be known approximately 12 000 species / varieties. However, so far failed to creating of the variety "ideal" that brings together the most valuable features of different varieties. Thus, the current the problem of obtaining new varieties of vines, characters agro-biological to satisfy the maximum requirements to the table grapes intended for fresh consumption, and towards those intended for industrial processing (juices, concentrates, wines, spirits).

The development of viticulture until the XIX century and is distinguished by creating varieties of vines varieties, such as: *Rara Neagră*, *Coarna Neagră*, *Bătuta Neagră*, *Frâncușa*, *Feteasca Albă*, *Feteasca Neagră*, *Feteasca Regală*, *Galbena*, *Plăvaie*, *Grasă*, *Zghiharda* etc. These varieties were grown on their own roots and planting material was multiplied by the method of cuttings.

In the second half of the XIXth century (1863), European viticulture is subject to a radical turnaround in the cultivation of the vine conditional upon: *Phylloxera vastatrix* / *Daktulosphaira vitifoliae* (Fitch 1855); *Plasmopara viticola* (Berk. & M.A. Curtis) Berl. & De Toni, (1888); *Oidium sp.*; / *Uncinula necator* (Schwein.) Burrill. The methods of direct fight against the invasion of phylloxera, they have not led to the expected results. Resolve

the situation in viticulture, at the time, it was only possible by introducing hybrids of direct producer vines (Seibel 1, Seibel 1000, Teras-20, Floot d'Or, Baco, Couderc, Rayon d'Or, etc.) and varieties of grafted vines. Thus grafting of grapevine was implemented everywhere because there is no other solution.

Achievements are well known in the selection grapevine resulted in obtaining new varieties of high quality and resistance to biotic and abiotic factors, such as the: France (Chardonnay, Cabernet Sauvignon, Pinot Noir, Merlot, Muscat Ottonel etc.), Italy (Fleurtaï, Soreli, Early Sauvignon; Petit Sauvignon, Sauvignon d'ore; Petit Cabernet, Royal Cabernet, Royal Merlot, Petit Merlot, Julius etc), Germany (Soliaris, Hiberna-GM etc.), Bulgaria (Pleven, Bulgaria, Mavrud, Melnik, Pamid etc.), Hungary (Bianca, Valentin, Vinitor, Gloria, Zenit, Ijaki, Chincem etc.), Romania (Napoca, Victoria, Brumăriu, Transilvania, Someșan, Splendid, Ozana, Paula, Gelu, Raluca, Arcaș, etc.), Moldova (Viorica, Legenda, Reton, Luminița, Alb de Ialoveni, Negru de Ialoveni; Apiren alb, Apiren roz, Negru de Grozești, Kiș-miș moldovenesc, Kiș-miș lucistâi; Moldova, Guzun, Suruceni alb, Leana, Ialoveni rezistent, Codreanca, Tudor etc.), Ukraine (Arkadia, Vostok, Ghercules, Dnestrovchii rozovii, Zolotistii ustoicivii, Kiș-miș tairovshii, Muscat jemciujnii, Muscat tairovshii; Aromatnii, Golubok, Ilciovschii rannii, Muscat odesschii, Odesschii Ciornii, Ovidiopolshii, Rubin tairovshii, Suholimanschii belii etc.) etc. It is should be noted that the cultivation of all varieties of the vine grafting plants in requires mandatory their North American rootstock (resistant to phylloxera), which greatly increases the cost of planting material production and the creation of of vines plantations. (Cotea V., Cotea V., 1998; Tîrdea, C., Sîrbu Gh., Tîrdea A., 2010; Gaina, B., Alexandrov, E., 2015).

MATERIAL AND METHODS

Interspecific hybrids of vines *Vitis vinifera* L. x *Muscadinia rotundifolia* Michx. they were involved in that study. For determine the resistance to drought of the vine express method was applied based on morphological and anatomical characters of the leaf lamina, consisting of: leaf lamina thickness, the average area of the leaf lamina, the average volume of leaf lamina, the report the average area of leaf lamina and average volume leaf lamina (Codreanu V., 2006; Gaina B., 1992; Gaina B., Alexandrov E., 2015).

Winter hardiness of interspecific hybrids to the (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) determined based on the buds the shoots a year. Filloxera strength of interspecific hybrids to the (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) was determined based on the anatomy of the roots (Cristina Bunescu, 2014; Gaina B., 1992; Tîrdea, C., Sîrbu Gh., Tîrdea A., 2010).

RESULTS AND DISCUSSIONS

As a result of studying the quantitative anatomy of lamina leaf the grapevine (*Vitis* L.) were revealed morphological and anatomical four characters, which causes greater relative resistance to drought, namely: lower mean surface leaf lamina; the average thickness greater leaf lamina; greater average volume of leaf lamina; lower ratio of average area of leaf lamina and average volume leaf lamina (S:V).

Interspecific hybrids leaf lamina the thickness of vines BC3 hybrid it is 312.01 μm DRX-M4-508 and 299.54 μm DRX-M4-583 (Alexandrov, E, Gaina, B., 2015; Alexandrov, E., 2010; Alexandrov, E., 2012; Alexandrov, E., 2015; Codreanu, V., 2006). The average surface lower lamina leaf of vines hybrids within the limits of 70.36 cm^2 hybrid DRX-M4-

547 and 72.36 cm² hybrid DRX-M4-583. The average volume greater of leaf lamina hybrids of vines is within 3.18741 cm³ hybrid DRX-M4-508 and M4-677 2.70873 hybrid-DRX.

Table 1.
Characters biometric hybrids of the leaf lamina interspecific hybrids of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.)

Hybrid	Average surface of the leaf lamina (cm ²)	The average volume of leaf lamina (cm ³)	The report the average surface: the average volume of leaf lamina (S:V)	The average thickness of the leaf lamina (μm)
DRX-M4-508	102,05	3,1841	32,05	312,01
DRX-M4-583	72,36	2,1438	33,75	299,54
DRX-M4-677	107,83	2,7087	39,80	251,20
DRX-M4-547	70,36	1,7329	40,60	246,29
DRX-55	62,80	1,5464	40,61	246,24
DRX-M4-542	88,81	2,1785	40,76	230,03
DRX-M4-660	101,76	2,3982	42,43	236,90
DRX-M4-545	95,56	2,2180	43,08	232,11
DRX-M4-560	84,03	1,8926	44,39	225,23

Lower ratio of average area of leaf lamina the average volume of leaf lamina of the hybrids of vines has been found to be limited by 32.05, hybrid DRX-M4-508, and 33.75, hybrid DRX-M4 -583. If the ratio S : V is lower, the relative to drought resistance is higher, so hybrid DRX-55 has the highest resistance to drought. At other study found that hybrids and they have a rather high resistance to drought: DRX-M4-660; - 677; - 560; - 508; - 583 (Tab. 1.).

Winter hardiness of these hybrids is within into 4 groups depending on the percentage of each hybrid vivid buds. The hybrids from the group I winter hardiness have the highest percentage of vivid buds. To this group belong hybrids DRX-M4-502 (96.78% of buds vii), DRX-M4-537 (95.24%), DRX-M4-545 (95.13%), DRX-M4-578 (92.31%) (Tab. 2.). The first attempts on studying of resistance grapevine to the phylloxera were initiated in France by the Ravaz (1909) and shall draw up a scale for determining the resistance grapevine to the phylloxera building on comparing the level of infection and degradation of species of the vine. Assuming that the resistant American grapevines (*Muscadinia rotundifolia* Michx.) and non-resistant grapevines culture (*Vitis vinifera* L.).

Millardet A. has tried to determine the relationship between anatomical structure of roots and resistance to phylloxera. It was found that the resistance to grapevine of the phylloxera root anatomical structure has a fairly compact cells are small in size and nodule formation occurs when the periderm fissure cicatrization.

Prince I., based on three cases the studies determined of attack of phylloxera:

1. The phylloxera poking roots, and leaves, over a short period of time leaves the place, as a result, forming a point necrotic dead cell and consisting of the oxidized phenolic substances (ex.: *Muscadinia rotundifolia* Michx., *Vitis cinerea* Arnold.).

2. The phylloxera, the young leaves, make the creation of galas of different sizes, but the roots formed nodules and tuberoses (ex.: *V. riparia*, *V. rupestris*, *V. berlandieri* etc.).

3. The phylloxera, the young leaves and the leaves the do not form galas puncture site, the result forming necrotic points. Instead, the phylloxera root and grows very intense

and tuberoses forming nodules of varying size (ex.: *V.vinifera* L. *V.amurensis* and *V.labrusca*).

Table 2.

Winter hardiness of interspecific hybrids to the (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) determined based on the buds the shoots a year.

Hybrid	Buds examined, (unit.)	Buds vivid, (unit.)	The percentage of vivid buds, (%)	Buds dead, (unit.)	The percentage of dead buds, (unit.)	The level the resistance
DRX-M4-502	31	30	96,78	1	3,22	1
DRX-M4-537	21	20	95,24	1	4,76	1
DRX-M4-538	65	59	90,77	6	9,23	1
DRX-M4-545	41	39	95,13	2	4,87	1
DRX-M4-578	39	36	92,31	3	7,69	1
DRX-55	42	33	78,58	9	21,42	2
DRX-M4-504	8	7	87,50	1	12,50	2
DRX-M4-510	49	39	79,60	10	20,41	2
DRX-M4-535	82	71	86,59	11	13,41	2
DRX-M4-541	64	55	85,94	9	14,06	2
DRX-M4-579	35	31	88,57	4	11,43	2
DRX-M4-580	104	88	84,62	16	15,38	2
DRX-M3-3-1	14	10	71,43	4	28,57	3
DRX-M4-508	34	24	70,59	10	29,41	3
DRX-M4-512	14	10	71,43	4	28,57	3
DRX-M4-602	28	18	64,29	10	35,71	3
DRX-M4-660	11	7	63,64	4	36,36	3
DRX-M4-511	30	17	56,67	13	43,33	4

Has been demonstrated that to the grapevines resistant to the phylloxera increased when injected by the phylloxera substances forming galas (amylase, protease, etc.) occurs redox process using phenolic substances present in tissue cells, the surrounding cells perish, and not training takes place galas. Phenolic substances in this case have the function of inactivating substances (inhibitors) (Cotea V., Cotea V., 1998; Tîrdea, C., Sîrbu Gh., Tîrdea A., 2010). Golodriga I. studying the physiological and biochemical characteristics, morphology and anatomy of grapevine phylloxera-resistant and pathogenic microflora have determined that parenchymal tissues of roots have smaller cells, located most compact between them. In the roots of the secondary structure is present phloem (Golodriga P., et al., 1982). The forms of phylloxera-resistant vines have the property of forming genotypic wound periderm. Wound periderm is an obstacle to the spread of pathogenic microflora. The not resist at phylloxera vines and rotting wound periderm only partially insulates part the healthy root affected. Nedov P., Guler A. in the dependence studying anatomical the correlation between quantitative indices of the vine roots with secondary anatomical structure and species and varieties resistance to phylloxera vines and pathogenic microflora, concluded that the wound periderm forms the roots of varieties and species resistant to phylloxera vines and rotting; phylloxera varieties responsive to wound periderm poorly formed or not formed at all.

By studying the characters physicochemical and morphological and anatomical resistance grapevine against phylloxera and pathogenic microflora it is concluded that vines

with increased resistance to phylloxera has parenchymal tissues of the root composed of smaller cells located most compact between them. Phloem have secondary roots. The phylloxera-resistant grapevines has the property to shape wound periderm, which has bactericidal properties and stop the spread of pathogens. The plants attacked by the phylloxera initiates the process by creating self-defense wound periderm. The formation process of wound periderm of different species is resistant to the phylloxera is well developed and is not resistant to the undeveloped. The vines resistant to the phylloxera periderm wound develop well as a result of the attack of the insect, that the response of the organism is formed periderm wound, which insulates by small tuberosities pathogens, thus stopping the spread of pathogens that lead to the root decay. In the cells in these tissues is increasing the synthesis of nucleic acids, proteins and starch.

The not resist at the phylloxera vines, wound periderm grows weak and insulates areas only partially damaged by the healthy and is not able to halt the spread of pathogens (Maroger, E., 1924; Pouget, R., 1990; Tîrdea, C., Sîrbu Gh., Tîrdea A., 2010). Given the physiological particularity of the insects was found that autotrophic to the sterol is an important particularity in the nutrition of insects. A plant tissue is the only source of sterols for phytophagous insects. Based on the analysis of correlation and dispersion was found that the species of less resistant of vines of the leaves the tissues contain β -sitosterol more and less cholesterol in comparison with rezsitente species to phylloxera. The species of vines resistant to by phylloxera contain in the tissues of β -sitosterol 73-82% the total quantity of the sterol and 12-14% cholesterol and the species susceptible to phylloxera contain 89-99% of β -sitosterol and 1,5-4,0 % cholesterol (Nedov, P. et alt., 1995; Pouget, R., 1990).

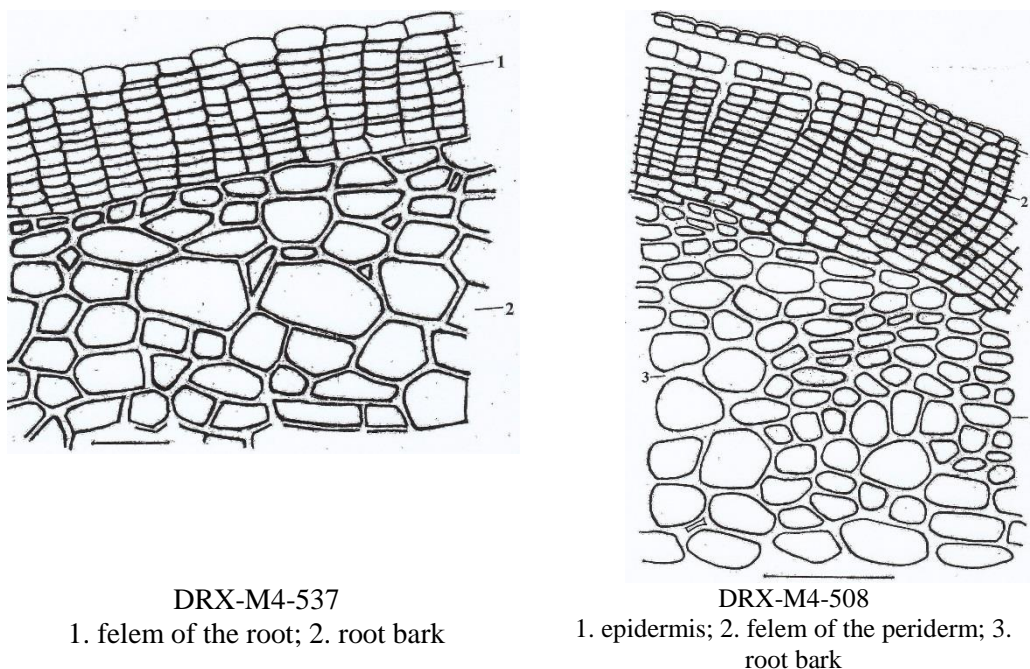
According to some studies has been found that using of physiologically active substances with the function of stimulation growth of plants, as gibberellins, crezacin, mival, auxin etc. can influence of on the development process of phylloxera, especially on the ability of the pest propagation. This is due to changes in plant the biochemical processes under the influence of the physiologically active, inhibiting the ability of propagation of phylloxera. The studies undertaken by the researchers Askerov Uh., Kazahmedov R. in Dagestan have demonstrated that using the physiologically active substances have reduced capacity by 50% propagating phylloxera (Askerov, A., Kazahmedov, R., 2011).

The grapevines phylloxera-resistant forming of wound periderm, which has bactericidal properties and stop the process of spread of the pathogens. The thickness of the first root periderm on interspecific hybrid of vineyards studied varies from 80 μm to 124 mm, and be composed of 8-12 rows of compact the cells located next to each other (Tab. 3.).

Table 3.

The thickness of the first periderm root of vineyards interspecific hybrids to the (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.)

Hybrids	The thickness of the first root periderm (μm)	The number of cell layers of the periderm	The length of the cells (μm)	The width of the cell (μm)
DRX-55	105-116	9-12	12-20	6-9
DRX-M3-3-1	90-103	9-10	10-16	6-9
DRX-M4-508	83-105	8-10	10-12	7-9
DRX-M4-537	80-90	8-9	18-24	6-11
DRX-M4-541	80-95	8-9	9-18	6-10
DRX-M5-4-6	93-124	10-12	9-18	6-10



DRX-M4-537
1. felem of the root; 2. root bark

DRX-M4-508
1. epidermis; 2. felem of the periderm; 3. root bark

Fig. 1. The cross section through a sector of the root with the secondary anatomical structure of the interspecific hybrids of vines (*V. vinifera* L. x *M. rotundifolia* Michx)

The first root periderm tissue of the interspecific hybrids to be formed in the layer of cells situated below the rizoderm. The layer of the felem (cork) of the first periderm be composed of 8-10 of cells rows tangential of radial elongated, compact located between them.

The length of these the cells varies from 30 μm to 45 μm , and their width varies between 8 - 12.5 μm . Felem tissue thickness varies from 75 μm to 93 μm . The next layer of tissue felem, if formed in the same year, developing from the deepest layers of the root bark. The 2nd layer of the film is located below the tissue layer brown crust with a thickness of 93 - 110 μm . (Fig. 1.).

The total thickness of this layer of dead tissue, consisting of two layers of tissue felem the outside and inside and a layer of bark, between two layers of tissue felem, thickness 170-180 μm , and protects the roots of phylloxera action and other pathogens.

At the species and the varieties of resistant to the phylloxera vines, affected by the phylloxera roots the tissues are functional and physiological process is intensifying defense. However, the species and varieties nonresistant to phylloxera vines, the affected tissues of roots in a short time are losing functionality and perishing.

Wapshere A., Helm K. (1987) on the basis the studies conducted on resistance to phylloxera determines three directions in the development of the genus *Vitis* L. North America:

- 1) Full resistance to phylloxera. On the roots and leaves is not formed nodules and galas (*Muscadinia rotundifolia* Michx.).
- 2) Partial resistance to phylloxera. On the roots and leaves are formed nodule and very little galas.
- 3) Tolerance. On the roots and leaves are formed nodule and galas, but the impact on the plants under natural conditions is insignificant.

Codreanu V. (2006) on the basis of investigations carried out proposes two directions of development of species of vines in relation to phylloxera in North America:

1) Partial resistance the phylloxera.

2) Tolerance. A low level of forming galle on the leaves and nodules on the roots, without visible damaging effect upon the plants.

As a result of studies it was found that in the case the phylloxera-resistant grapevine, the roots tuberosities are isolated from the rest of by the periderm tissue to the wound, which ensures the destruction and elimination of the roots tuberosities. The anatomical stem grapevine *Muscadinia rotundifolia* Michx. it was established the following:

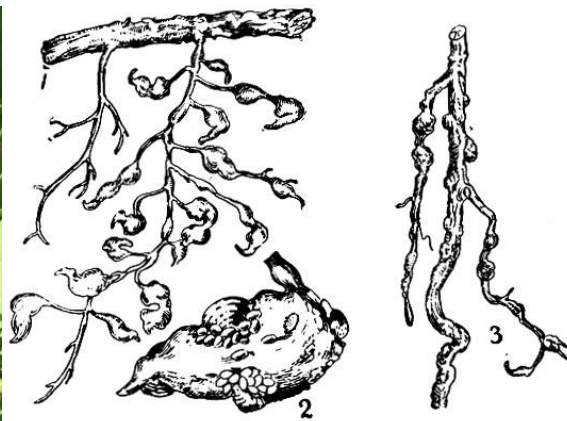
- Felogen the strain is formed under the epidermis;
- Less differentiated epidermis and has lenticels;
- The phloem, on the whole perimeter is surrounded of one - four layers of bast fibers;
- Is less developed the marrow and medullary rays are narrow.

On the basis of studies conducted on the vine interspecific hybrids, did not detected the presence of phylloxera (*Phylloxera vstrastris* Planch).

The varieties of vines (*Vitis vinifera* L.) nonresistant to phylloxera, in resulting on the roots are formed nodules (galas). As a result takes place the distortion of (death) cells and tissues, ultimately across a short period of time the infected tissues are dying. In these cases the wound periderm to respective its roots are formed very weak or maybe missing (Fig. 2).



foliar phylloxera (gala)



radicular phylloxera (<http://wine.historic.ru>)

Fig. 2. Phylloxera (*Phylloxera vstrastris* Planch.)

The filloxera leaf determines the appearance of on the lower leaf side of galas, form of a irregular boxes at the beginning of yellow-green, and rust. The radicular filloxera, stings and suck sap from the roots. In places attacked tissues deform, himself hypertrophy and bumps occurring called "nodule" and "tuberosities".

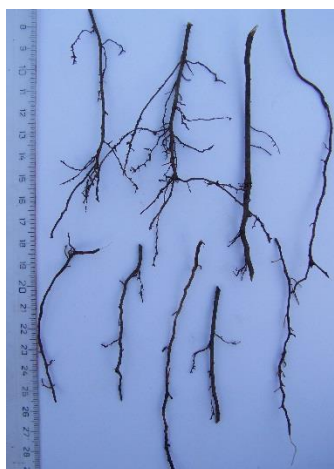
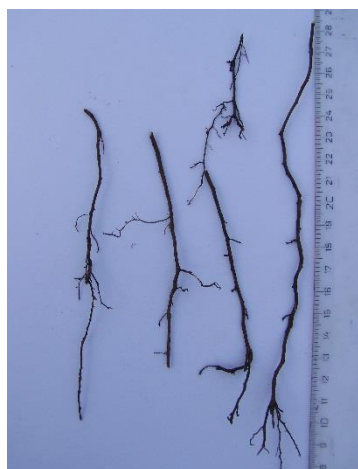
Nodules are produced on the thin the roots and on the its roots appearing the thickest tuberosities, with 4-10 mm long and 1-3 mm thick. Are dried the roots nodule total, and in the tuberosity, tissue necrosis and break with the formation of gates for entering various microorganisms.



DRX-M4-545

DRX-M4-542

Fig. 3. Interspecific hybrids of the vines (*V.vinifera* L. x *M.rotundifolia* Michx.)



DRX-55

DRX-M₃-324



DRX-M₄-537

DRX-M₄-660

Fig. 4. The roots of the interspecific hybrids of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.)

CONCLUSIONS

1. As a result of interbreeding culture grapevine (*Vitis vinifera* L.), $2n = 38$, with American grapevines (*Muscadinia rotundifolia* Michx.), $2n = 40$ interspecific hybrids were created with diploid set of chromosomes $2n = 38$.

2. The interspecific hybrids of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) grow on their own roots and have the a normal development and are the productive.

3. Interspecific hybrids of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) can be multiplied by cuttings and grown on their own roots, which would allow reducing some stages and finance expense in the production process of planting material and cultivation of the vine.

4. Interspecific hybrids resistance to phylloxera of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) is assured of first root periderm consists of the cell layer located under rizoderm, and increased concentrations of such chemicals, as phenols, resveratrolii etc.

5. Improving grapevine is resulting in the expected results just in case the interspecific hybridization method of use based on initial taxons complementary to the various eco-geographical groups, creating indigenous of vines varieties. In this case a combined genotype of the desired characteristics and properties of the parent forms. The formation takes place of adaptation genotypic properties. An obvious expression of the adaptation of varieties created, it is possible only in case to obtain them in different species interbreeding result (taxons) of vines. Although it possessing resistance to the disease and pests, they also holds an advanced adaptation to the climatic conditions, thus accentuating the process of cultivation.

6. The new varieties of vines must possess a period precocious maturation of the grapes to ensure the planting and their cultivation and northern borders of the areas where they are viticulture and to ensure at the same time the mechanization and automation to the maximum possible agro-technical processes.

REFERENCES

1. Alexandrov, E, Gaina, B., (2015), The study of heavy metals in berries of vineyards distance hybrids *Vitis vinifera* L. x *Muscadinia rotundifolia* Michx. În: Agriculture - Science and Practice, nr. 3-4 (94-95), ISSN: 1221-5317, Cluj-Napoca, România, pag. 52-56.
2. Alexandrov, E., (2010), Hibridarea distantă la vița de vie (*Vitis vinifera* L. x *Vitisrotundifolia*Michx.). Chișinău. „Print-Cargo” SRL. 192 pag.
3. Alexandrov, E., (2012), Hibrizii distanți ai viței de vie (*Vitisvinifera* L. x *Muscadinia rotundifolia*Michx.). Aspecte biomorfologice și uvologice. Chișinău. Tipogr. AȘM., 140 pag.
4. Alexandrov, E., (2015) Biochemical features of the distant hybrides in F4 (*V.vinifera* L. x *M.rotundifolia* Michx.) and of *V.vinifera* L. În: Agriculture - Science and Practice, nr. 1-2 (93-94), ISSN: 1221-5317, Cluj-Napoca, România, pag. 41-48.
5. Alexandrov, E., (2015), New requirements to create of vine varieties economic and environmental significance. În: Agriculture - Science and Practice, nr. 3-4 (94-95), ISSN: 1221-5317, Cluj-Napoca, România, pag. 44-51.
6. Askerov, A., Kazahmedov, R., (2011), Primenenie fiziologhiceschi activnyh soedinenii dlea regulatii cislennosti fillokseriy. In: Vinodelie i vinogradarstvo. №. 5, p. 42-43.
7. Codreanu, V., (2006), Anatomia comparată a viței de vie (*Vitis* L.). Chișinău: Comb. Poligraf., 252 p.
8. Cotea V., Cotea V., (1998), Viticultură, ampelografie și oenologie. București: Editura Didactică și pedagogică, R.A., 357 p.

9. Gaina, B., (1992), Naucinye osnovy povysenia kachestva i ghygienichnosti productov pererabotki vinograda. Disertatia na soiskanie ucionoi stepeni doktora nehniceskih nauk v forme naucinovo doclada. Ialta, 80 p.
10. Gaina, B., Alexandrov, E., (2015), Pagini din istoria si actualitatea viticulturii. Chisinău: Lexon-Plus, (Tipografia Reclama). ISBN 978-9975-3079-3-2. 260 p.
11. Golodriga P., et alt., (1982), Fiziologo-biohimiceskie i morfoanatomiceskie aspekty problemy immuniteta vinogradnovo rastenia. În: Selischozeastvennaia biologhia, v.14, №.4. p. 448-454.
12. Maroger, E., (1924), La goutte d'eau. Paris: Societe generale d'imprimerie et d'edition., 1924. 428 p.
13. Nedov P., Guler P., (1987), Normalinaia i patologhicescaia anatomia cornei vinograda. Chisinau: Stiinta, 151 p.
14. Nedov, P. et alt., (1995), Rolul fitosterolilor în rezistența viței de vie la filoxeră. În: Culegerea de lucrări științifice (către jubileul de 85 de ani ai INVV), p. 72-77.
15. Pouget, R., (1990), Histoire de la lutte contre le Phylloxera de la vigne en France. In: Bulletin de l-O.I.V., Vol. 63, Nr.715-716, p. 869.
16. Print, Ia., (1965), Vinogradnaia filloxera i mery boriby s nei. Moskva: Nauka, 294 p.
17. Tîrdea, C., Sîrbu Gh., Tîrdea A., (2010), Tratat de vinificatie. Ed. Ion Ionescu de la Brad, Iasi, 764 pag.
18. Wapshere, A., Helm, K., (1987), Phylloxera and Vitis. An Experimentally Testable Coevalutionary Hypothesis. In: Am. J. Enol. Vitic., vol. 38, nr.3, p. 216-222