Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 19, Issue 1, 2019
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ORGANIC VITICULTURE: REAL OPPORTUNITIES FOR IMPLEMENTATION

Eugeniu ALEXANDROV

Institute of Genetics, Physiology and Plant Protection, 20 Padurii Street, 2002, Chisinau, Republic of Moldova, Phone: +373 22 770447, Fax: +373 22 556180, Mobile: +373 79450998, E-mail: e_alexandrov@mail.ru

Corresponding author: e_alexandrov@mail.ru

Abstract

Organic viticulture is becoming increasingly popular around the world. This trend is based on a system of technological methods aimed at maintaining the biodiversity of grapevine, the successful cultivation and consumption of grapes with minimal use of chemical treatments, and therefore with minimal content of their residues in the crop. Viticulture would benefit from the creation of new varieties of grapevine, with stable productive potential, to produce high-quality derivative products. As a result of interspecific hybridization (Vitis vinifera L. ssp. sativa D.C. x Muscadinia rotundifolia Michx.), promising own-rooted table grape and wine grape varieties have been created and identified, for example: Malena, Nistreana and Algumax, and Augustina, Alexandrina and Ametist, respectively. The cultivation of interspecific genotypes of grapevine can reduce the negative impact on the environment by reducing the number of chemical treatments of plants.

***Key words*:** organic, grapevine, interspecific genotypes, breeding

INTRODUCTION

Organic viticulture is becoming increasingly popular around the world. This trend is based on a system of technological methods aimed at maintaining the biodiversity of grapevine, the successful cultivation and consumption of grapes with minimal use of chemical treatments, and therefore with minimal content of their residues in the crop [2, 3, 19].
A research on this issue was carried out by the Research Institute of Organic Agriculture, in Switzerland, which published data on the total area of organic vineyards in the world. In 2015, this area was more than 400 thousand hectares. It has been found out that the transition of vineyards from traditional to organic technologies takes 3 years, after which the grape harvest is considered to comply with the established requirements. As for the growth rate of the area of vineyards cultivated according to the organic technologies, it was established that from 2005 to 2015, it trebled. The world leaders, in terms of area of organic vineyards and production of organic grapes, are Spain – with 85 thousand hectares, France – 75 thousand hectares, Italy – 65 thousand hectares, Mexico – 35 thousand hectares and China – 20 thousand hectares. Currently, the shares of areas of organic vineyards in European countries are as follows: Austria – 10.7 %, Italy – 10.3 %, Spain – 8.9 %, France – 8.7 %, Germany – 7.5 %, Portugal – 1.5 % [19]. More than 270 thousand hectares of organic vineyards are cultivated on the European continent, which makes up 67.5 % of the total area of organic vineyards in the world. This new trend in grape cultivation is developing rapidly in China, Turkey, Italy, Germany, Argentina, Chile, Australia and South Africa.

MATERIALS AND METHODS

The subject of the research was the collection of grapevine plants of the Institute of Genetics, Physiology and Plant Protection, Chisinau, Republic of Moldova. The collection includes 140 genotypes of interspecific and intraspecific, grafted and own-rooted genotypes of grapevine. The method of distant hybridization was used to create interspecific own-rooted genotypes of grapevine [4-7]. Studies were conducted in accordance with the methods of describing grapevine varieties [1, 8, 9], Methodical Recommendations for Grapevine Breeding, Study of grapes to determine how to use them. Uvology [11]. The physicochemical assessment of derivative products of interspecific genotypes of grapes was performed in accordance with the methods for analysing derivative products [12, 10, 16]. To determine the resistance of the studied genotypes to phylloxera, pathogenic microorganisms etc., the methods mentioned in Normal and Pathological Anatomy of Grapevine Roots and Complex Protection of Grapevine [14-17] were used.

RESULTS AND DISCUSSIONS

In the European market, there is a great demand for organic grapes, and it equally applies to grapes intended for consumption while fresh (table varieties) and those for the production of wine and distilled drinks. The organic cultivation of grapevine leads, on the one hand, to a reduction in the contamination of grapes with residues of the substances used to protect them from diseases and pests, and on the other hand, to a lower degree of environmental pollution (soil, water and air).

The European Union supports organic viticulture, by subsidizing this type of activity of winegrowers (at the transition stages from traditional to organic cultivation of grapevine), covering the losses of economic agents whose vineyards have suffered from hail, epiphytotic diseases and prolonged rains that have led to crop loss. However, taking into account the fact that the demand for organic grapes (table and wine grapes) is constantly raising, not only in Europe, but also in North America and East Asia, at present, their price is 40-60 % or even 100 % higher. This, of course, attracts winegrowers, and today about 10 % of vineyards in the countries of the European Union are certified as “organic”. In France, in Alsace, some programs have been created to inform people about the peculiarities of the organic cultivation of grapevine, and their students are representatives of the grape-growing and winemaking industry of most EU countries, as well as Canada, the USA, Israel, Australia, New Zealand, China etc.

Currently, the technology of cultivation of organic grapevine must be consistent with certain standards: for example, the use of copper is limited to 3 kg per hectare per year, and the maximum sulphur application – 6 kg per hectare per year. There are countries where these standards differ in the direction of a slight decrease, but in all cases, the extract (infusion) of nettle, bark and leaves of oak, leaves of walnut, calendula etc. are widely used along with fungicides based on copper and sulphur.

However, the cultivation of grapes according to the organic technologies in the Republic of Moldova faces certain difficulties, which are the main reason behind the slow introduction of this new trend of the grape-growing and winemaking. One of them is the absence of biopreparations, produced on an industrial basis, to inhibit the growth of micromycetes (*Botrytis cinerea* etc.) and pests (leafroller moths etc.). For example, in France, a biopreparation made from *Trichoderma viride* is produced under the brand name Trichodermin B14; it has been proven to suppress the growth of mould fungi on berries and leaves in rainy weather by more than 60 % [13]. However, it has been found that this biofungicide loses a part of its action during the months with dry weather (August-September) which reduces the effectiveness of the treatment and increases the risk of micromycete infection at the beginning of the rainy period (September-October) [18]. Moreover, it has been found that the action of Trichodermin B14 is inhibited by residues of copper ions on leaves and berries, which remain after previous treatments of vineyards. In this case, the scientists from the French National Institute for Agricultural Research [3] have begun to grow the biomass of the antagonist *Trichoderma viride*, against grey mould, enriched with copper ions. Under these conditions, the biofungicide was resistant to the inhibiting effect of copper residues on leaves and berries and provided more than 75 % growth inhibition in mould fungi.

Another problem in organic viticulture is the isolation of areas with grapevine in the stages of conversion (within 3 years) from those cultivated nearby, by traditional technology. As a rule, the easiest way of solving this problem is to choose an entire vineyard (plantation), surrounded by other agricultural crops (fodder grasses, sometimes cereals etc.), or shelterbelts, often encountered in our country. The generally accepted rules for organic cultivation of grapes also stipulate the absence of any source of chemical or biological pollution (wastewater treatment plants, chemical plants, landfills etc.). In our opinion, the prices for the certification of plantations, which have been established by international organizations, licensed in this regard, are too high and unjustified, especially in cases of small plantations of grapes and other berries, fruits etc.

Other advantages of organic methods are a significant reduction in environmental pollution, lower costs for the purchase and use of expensive chemicals, as well as higher sale prices for wine and table grapes. In the EU markets, the price of certified organic grapes is 40-60 % or even 100 % higher as compared with the price of grapes cultivated by traditional methods.

Among the main problems faced by this new technology of cultivation of grapevine, there are the difficulties of using classical varieties of the genus *Vitis vinifera* L., because of the high susceptibility to the attack of micromycetes and pests, and the low frost tolerance. These are very important factors under the harsh conditions of the continental climate in our country, with high humidity and heavy rains in spring, which create favourable conditions for the development of dangerous diseases and pests, and which complicate the timely and effective use of chemical remedies in the framework of the organic technology. On the other hand, in the second half of summer and early autumn, the weather contributes to the development of other diseases, among which, powdery mildew (caused by *Oidium*) and grey mould of grapes are the most dangerous. The way out of this difficult situation may be the wide use of new grapevine varieties with higher resistance to biotic and abiotic environmental conditions [4]. The last fifty years of breeding grapevine have resulted in the creation of some promising varieties of wine grapes to be cultivated by organic methods: Viorica, Legend, Riton, Luminita, (Moldova), Bianca, Chardonel, Aletta, (Hungary), Vidal Blanc, Triumph of Alsace, Shamborsin (France), Fleurtai, Soreli, Savignon Cretos, Julius, Sagiovese etros, Merlot Chorus, Cabernet, Jerez, Julio, Caberigne Cretos, Julius, Sagiovese etret (Italy), Cabernet Jura, Pinotin, Cabernet blanc (Switzerland), Aromatny, Muscat Odessa, Zagreus, Rubin Tairovsky, Aghat Tairovsky, Golubok, Illichivsky early, Sparkling, Ovidiopol, Odessa Black, Rodnichek etc. (Ukraine). Grapevine varieties with high resistance to diseases and pests have been obtained and recommended for breeding and cultivation in Crimea – by the Institute of Viticulture and Winemaking “Magarach”, in Russia – by the All-Russian Research Institute of Viticulture and Winemaking “Ya.I. Potapenko”, in Bulgaria – by the National Institute of Viticulture and Oenology in Pleven, in Romania – by the Research and Development Institute for Viticulture and Winemaking “Valea Călugărească”. However, the above-listed varieties are susceptible to phylloxera, which makes it necessary to create vineyards from planting material grafted on phylloxera-resistant rootstocks. The viticulture sector needs new grape varieties, with stable productive potential, for the production of high-quality derivative products. The European grapevine varieties of *Vitis vinifera* L. ssp. *sativa* D.C., registered in the Republic of Moldova, as well as in other wine-producing countries, are susceptible to phylloxera (*Phylloxera vastatrix* Planch.) and that is why vineyards should be created from planting material grafted on phylloxera-resistant rootstocks. Besides, because grapevine is sensitive to low temperatures in winter, additional measures are necessary to protect plants during the period of vegetative rest.

To obtain competitive products, it is necessary to use mandatory chemical treatments to prevent or destroy pests, micromycetes and other pathogenic agents. However, these treatments affect the cost of production and pollute the environment. The creation of own-rooted grapevine plantations is a good prospect, but for this, it is necessary to enrich the grape assortment with new genotypes, resistant to diseases and pests. As a result of research, a methodology was developed for the creation of own-rooted interspecific genotypes of grapevine *Vitis vinifera* L. ssp. *sativa* D.C. x *Muscadinia rotundifolia* Michx., resistant to biotic and abiotic factors. Donors of valuable agrotechnological traits were included in the breeding process, as a result of which high-quality, stable and productive grapevine genotypes were created.

Mastering the biological potential of interspecific genotypes will allow obtaining high-quality products from grapes, reducing costs and the use of chemicals in the process of controlling micromycetes and pests. The created genotypes have significant agrobiological and technological potential, which allows developing further research in the field of genetics and breeding of grapevine, using the method of distant hybridization. Thus, after of crossing *V. vinifera* x *M. rotundifolia*, interspecific genotypes of grapevine have been created in BC_3, with acquired agrobiological and technological properties, which allow expanding the area where grapevine can be cultivated in the northern regions and reducing the number of chemical treatments that will contribute to obtaining ecological products and protecting the environment. In the process of identifying the genetic functionality of the related taxa, *V. vinifera* and *M. rotundifolia*, characterized by low combining ability, it was found that this obstacle could be overcome by backcrossing. A wide range of recombinants, which allows improving the efficiency of distant hybridization in the process of selection of valuable characteristics, has been obtained as a result of this process. The differences in the classification of interspecific genotypes of grapevine based on DNA profiles (SSR markers) and ampelographic criteria prove the importance of *genotype x environment* specific interactions in the development of biological and technological features of the hybrid. The multilateral research on biological and agrotechnological features, the participation in hybridization of the genotypes of different ecological and geographical origin of *V. vinifera* and *M. rotundifolia* and the elimination of aneuploid forms during subsequent crosses leads to the stabilization of the interspecific genome (2n = 38) with valuable agrobiological features and stability. The interspecific genotypes *V. vinifera* x *M. rotundifolia* can be propagated by cuttings from own-rooted, competitive planting material, to obtain early-ripening grapes.

When creating new grapevine varieties, by interspecific and intraspecific hybridization, it is very important to take into account the concentration, in the berries, of such chemicals as resveratrol, which ensures the resistance of the plant to adverse environmental factors. A comparative analysis of the concentration of resveratrol in the juice of wild grapes and its concentration in the berries, obtained after hybridization, has shown that, in the juice of wild grapes, the concentration of resveratrol is approximately two times higher than in subsequent generations, obtained as a result of hybridization. That is, as more generations are created, moving away from the wild representatives of the species, the concentration of resveratrol in the juice of the grapes keeps decreasing. The created interspecific genotypes of grapevine have been studied in detail according to agrobiological and technological criteria.

The evaluation of the quality of grapes and derived products, over the years, has made it possible to select and cultivate promising own-rooted genotypes of grapevine. The interspecific genotypes of *V. vinifera* x *M. rotundifolia* are easily propagated by cuttings and can be cultivated on their own roots, thereby offering the opportunity to skip some practical steps, as well as reduce financial costs in the process of producing planting material and growing grapevine. According to the uvological and oenological criteria, the grapes of the new genotypes are not inferior to the classical varieties of *V. vinifera* in their biochemical composition and organoleptic qualities. Besides, they can be grown in the northern areas, where most plants of *Vitis vinifera* L. ssp. *sativa* D.C. do not withstand low temperatures in winter. Studying the physicochemical properties of blue-violet grapes of the interspecific genotypes (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.), it has been found that phenols, resveratrol and pectins are present in them in larger quantities than in green-yellow grapes, also exceeding the amount of these substances in the berries of the varieties of *V. vinifera* L. The quantity of resveratrol in the juice of berries of the interspecific genotypes of grapevine is 6.68 mg/l in berries with a green-yellow hue (BC_3-510 etc.), 9.3 mg/l in berries with a pink hue (BC_3-520 etc.) and 14 mg/l in berries with a blue-violet hue (BC_2-3-1, BC_3-660 etc.). From the populations of interspecific genotypes BC_3 (*V. vinifera* x *M. rotundifolia*), several promising own-rooted varieties have been selected, among them, there are table grapes, such as Malena, Nistreana and Algumax, and wine grapes: Augustina, Alexandrina and Ametist.

CONCLUSIONS

From the populations of interspecific genotypes BC_3 (*V. vinifera* x *M. rotundifolia*), several promising own-rooted varieties of table grapes have been selected, such as Malena, Nistreana and Algumax, and other selected varieties, such as Augustina, Alexandrina and Ametist, can be used as table grapes too, but also as wine grapes.

Growing interspecific genotypes of grapevine will decrease the negative impact on the environment by reducing the number of chemical treatments.

Due to the high resistance of distant hybrids to pests and diseases, the costs associated with the creation of planting material are reduced. Besides, as mentioned above, the number of chemical treatments during the cultivation process is reduced, thus minimizing environmental pollution.

In addition, the area of cultivation of grapevine can be expanded to the north, where the climatic conditions are unfavourable for the varieties of *V. vinifera*, which cannot tolerate the low winter temperatures, while the studied interspecific genotypes are more winter-hardy.

REFERENCES

[1]Alexandrescu, I., Oslobeanu, M., Jianu, L., Pituc, P., 1972, Mica enciclopedie de viticulture (The small encyclopedia of viticulture). ”Glasul Bucovinei” Publishing House, Iași, 1972.

[2]Alexandrov, E., 2017, The genotypes feed-back to the environmental factors. In: Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development. Vol. 17, Issue 1: 43-48.

[3]Alexandrov, E., 2016, The concentration of the chemical compounds and the color of berry to the varieties of the interspecific hybrids to the vines (Vitis vinifera L. x Muscadinia rotundifolia Michx.). In: Scientific Papers Series Management, Economic in Agriculture and Rural Development, Vol. 16, Issue 1: 53-56.

[4]Alexandrov, E., 2016, Interspecific hybrids of vines (Vitis vinifera L. x Muscadinia rotundifolia Michx.) with increased resistance to biotic and abiotic factors. In: Scientific Papers Series Management, Economic in Agriculture and Rural Development, Vol. 16, Issue 1: 39-44.

[5]Alexandrov E., 2015, New requirements in the creation of varieties of vine with the economic and ecological effect in the conditions of climate change. In: Scientific Papers Series Management, Economic in Agriculture and Rural Development, vol. 15, Issue 3: 35-42.

[6]Alexandrov E., 2012, Hibrizii distanţi ai viţei de vie (vitis vinifera l. x muscadinia rotundifolia michx.). aspecte biomorfologice şi uvologice. (The distant hybrids of vine (vitis vinifera l. x muscadinia rotundifolia michx.). Biomorphological and uvological aspects), Chişinău, 140 p.

[7]Alexandrov E. 2010, Hibridarea distantă la viţa de vie (Vitis vinifera L. x Vitis rotundifolia Michx.). (Distant hybridisation in vine (Vitis vinifera L. x Vitis rotundifolia Michx.)). Chişinău: „Print-Cargo” SRL, 192 p.

[8] Ampelograficheskiy atals sortov i form vinograda selektsii Natsional'nogo Nauchnogo Tsentra «Instituta vinogradarstva i vinodeliya im. V.Ye.Tairova». (The ampelographic atlas of varieties and forms of grapes for breeding by the National Scientific Center “Institute of Viticulture and Winemaking named after VE Tairov”.) K.: Agrar. Nauka, 2014. 138 s.

[9]Entsiklopediya vinogradarstva (Encyclopedia of viticulture). v 3-kh tomakh. Kishinev. 1986-1987.

[10]Gaina, B., Lafon-Lafourcade, S., Dubos, B., 1981-1983, Incidence eonologique du traitment biologique de la vigne par Trichoderma veride a l`egard de la pourrituregrise. Inestitudd`oenologiqic, Raport des activites de recherches, p.75.

[11]Gaina, B., Alexandrov, E., 2015, Pagini din istoria si actualitatea viticulturii (Pages from viticulture

history and actuality). Chisinău: Lexon-Plus, Reclama Printing Hiuse, 260 p.
[12]Gaina, B., 1990, Enologiya i biotekhnologiya produktov pererabotki vinograda (Enology and biotechnology of grape processing products). Shtiintsa, Kishinev, 167 s.
[13]Gaina, B., Pucheu-Plante, B., Lafon-Lafourcade, S., 1981-1983, Insidene de develepment des moisissures sur le raisin a l`egard de la qalites des mouts e des vins. Inestitud d`oenologiqic, Raport des activites de recherches, p.61.
[14]Nedov, P., 1977, Imunitet vinograda k filloksere i vozbuditelyam gniyeniya korney (Immunity grapes to phylloxera and pathogens root rot.). Shtiintsa, Kishinev, 169 s.
[15]Nedov P., 1978, Filloksernaya problema i selektsiya vinograda na komleksnyy imunitet k vreditelyam i boleznyam. Genetika i selektsiya vinograda na imunitet (The phylloxeric problem and the selection of grapes for complex immunity to pests and diseases. Genetics and selection of grapes for immunity). Trudy Vsesoyuznogo Simpoziuma. Kiyev, s. 35-45.
[16]Nedov, P., Guler, P., 1987, Normal'naya i patologicheskaya anatomiya korney vinograda (Normal and pathological anatomy of the roots of grapes.). Kishinev: Shtiintsa, 151 s.
[17]Print, I., 1965, Vinogradnaya filloksera i mery bor'by s ney (Grape phylloxera and measures to combat it.). Moskva: Nauka,294 s.
[18]Ungureanu, P.N., 1960, Osnovy vinodeliya Moldovy (Basics of Moldova winemaking). Trudy MNIISViV, Tom. 5, Izd. Kartea Moldovenyaske. Kishinev. 1960, 296 s.
[19]Vlasov, V.V., Mulyukina, N.A., Zelenyanskaya, N.N. i dr., 2018, Vinograd (Grapes). Odessa, Astroprint. 616 s.