MOBILIZATION AND EXPLORATION OF GENETIC RESOURCES IN DEVELOPMENT OF SUSTAINABLE VITICULTURE IN CONTEXT OF RESTRICTIVE FACTORS

MOBILIZAREA ŞI EXPLORAREA RESURSELOR GENETICE ÎN DEZVOLTAREA UNEI VITICULTURI SUSTENABILE ÎN CONTEXTUL FACTORILOR RESTRICTIVI

***SAVIN GH.*[1]*, CORNEA V.*[1]
e-mail: ghsavin@yahoo.com

Abstract*. The viticulture of the Republic of Moldova, situated at the northern limit of industrial viticulture, during the millennia supports climate risk factors. Grapevine assortment evolved to varieties with advanced resistance to winter conditions and an increased adaptability. The phenomenon of „Climate Change", documented in recent decades, already manifested by increased frequency and pronounced intensity of adverse conditions (extreme temperatures, drought, etc.), requires us to use, in this context, the presented genetic resources, as well as researching and introducing of existing in the world genetic sources with a potential for broadening the base of resistance to unfavorable factors, preserving and enhancing quality and productivity, competitiveness of viticulture. Biological material created until now, existing genetic resources were found to be promising, and the assortment need diversification, focusing on increasing adaptability and biological resistance.*
Key words: *grapevine, genetic resources, restrictive factors, climate change, adaptability*

Rezumat. *Viticultura Republicii Moldova, situată la frontiera de nord a viticulturii industriale, suportă de milenii factorii de risc climatic. Sortimentul viticol a evoluat spre soiuri cu rezistență avansată la condițiile de iernare şi cu adaptabilitate sporită. Fenomenul „Modificarea climei", atestat în ultimele decenii, ce se manifestă deja prin frecvența sporită şi intensitatea mai pronunțată a condițiilor nefavorabile (temperaturi extreme, secete prelungite etc.), ne obligă să valorificăm, în acest context, resursele genetice care le avem la dispoziție, documentându-ne totodată şi introducând surse genetice care există în lume, cu un potențial de lărgire a bazei de rezistență la factorii nefavorabili, păstrând şi amplificând calitatea şi productivitatea, competitivitatea viticulturii. Materialul biologic creat până în prezent, resursele genetice deja existente s-au constatat a fi de perspectivă, iar sortimentul necesită diversificare, accentul fiind pus pe sporirea adaptabilității şi a rezistenței biologice.*
Cuvinte cheie: *vița de vie, resurse genetice, factori restrictivi, modificări climatice, adaptabilitate*

INTRODUCTION

Climatic particularities of our geographical area create risks for the industrial cultivation of the grapevine, with significant economic impact (Constantinov *et al.*,

[1] Research and Practical Institute for Horticulture and Food Technology, Republic of Moldova

2008; Vronskih, 2011): winter thermal regime is diverse and fluctuate significantly, even within 24 hours, the temperature can reach absolute minimum of -27...-34°C, and the intervention of air masses from the Mediterranean provoke thaws up to 45-60 days; irregular distribution of rainfall causing prolonged drought or flooding. Fluctuations of these parameters vary different: annual averages may differ by up to 3,1 times; the means for one and the same season - up to 18 times, and for one and the same month - up to 500 times. During the past decades are manifested more strongly the effects of the phenomenon of climate change.

These phenomena influence to a greater extent the main ecological factors on which depends the development of viticulture, which is attested worldwide (Jones and Davis, 2000), and confirmed by research in border regions of R. Moldova (Donici *et al.,* 2007; Rotaru and Colibaba, 2011; Bucur and Dejeu, 2014). In those circumstances, in order for reducing the negative economic impact, proved to be effective some agrotechnical processes (Enache and Donici, 2014), planting of some grapevine varieties with economic importance in their untraditional areas (Mustea *et al.,* 2011) and old autochthonous varieties Frâncuşa, Fetească albă and Fetească regală showed a high potential of adaptability to climatic stresses under three vines areas in the hills of Moldova (Rotaru and Colibaba, 2011).

We consider the improving of assortment with new varieties with advanced biological resistance, adaptability and increased ecological plasticity, which are based on the potential of the diversity of grapevine genetic resources, one of the main ways for diminishing of consequences of these phenomena. Strategy of accumulation and study, for use in breeding programs, of genetic resources is designed, in part, and through these fluctuations and instability, the objective being to create a new generation of varieties for diverse use with competitive quality and productivity, including the material for an organic vitiviniculture, but with increased resistance (Savin 2012, 2014).

MATERIAL AND METHOD

General characteristic of weather conditions in Republic of Moldova over the last decade was based on data State Hidrometeorological Service (http://meteo.md/). Information on multiannual developments and forecasts of climatic parameter values and nature of impacts of climate change phenomenon were presented on the sources of literature.

Genetic resources have been evaluated over the years in the grapevine gene pool of Scientific and Practical Institute of Horticulture and Food Technologies, located in the south of the mun. Chişinău (46°58'39.65" N and 28°46'21.68" E). Description of genotypes was performed according the OIV descriptor list (1983).

RESULTS AND DISCUSSIONS

Analysis of annual averages values of main meteorological parameters indicates an increasing, over the last decade, of multiannual climate average of air temperatures with +0,4…+ 2,6°C, while in 2007 and 2012 was achieved the record of maximum temperature in the history of instrumental observations in R.Moldova (+41,5°C and +42,4°C) (http://meteo.md/). It also noted the increased duration (3-15

times higher than the norm) of manifestation of extreme weather (very low or very high temperatures). In 2012, and especially 2015 was maintained throughout the soil and atmospheric drought (attributed to very strong drought), and taking into account the affected area, the phenomenon is classified as catastrophic drought.

The analysis evolution of climatic parameters in Moldova for longer periods of time confirms the general trend in changing their (Constantinov *et al.,* 2008; Vronskih, 2011): during the last 30-40 years an increase in average air temperature estimated at + 1,41 ° C, and within each season there is most pronounced fluctuation during the winter, namely increasing of average winter temperatures during the years 1955-1985 (from -3,32°C to -1,56°C); while the amount of active temperature rose from +3790°C to + 3810°C (by +320°C or +4,92° C per year on average).

Evaluation of various climate change scenarios for R.Moldova, for various periods of time, made under climate models CSIRO-Mk2, HadCM2 and ECHAM4 and aimed to evaluate the increase of the mean annual temperature (Nicolenco, 2000), duration of periods without precipitation (Petreanu and Mironov, 2000) shows the same trend. Overall, for all models, is forecast that annual average temperature increases from 1,4-2,1 ° C over the period 2010-2039 to 3,3-4,6°C by the end of XXI century. According to the used models the duration of periods without precipitation is forecast to grow, compared with the current statistical norm of 10-103 days, with 7-35 days during the next 15 years and by 16-77 days by the end of XXI century.

The consequences of these changes, at global and local level, are multiple and complex, reducing, ultimately, to the socio-economic impact. The results of a study on the impacts of climate change on the economy of Washington State (Impacts of Climate Change on Washington's Economy, 2006) had highlighted different aspects of this phenomenon: the climatic (glacier melting, reducing precipitation as snowfalls, frequent floods and vegetation fires, rising of sea level); direct economic (increased costs and expenses to extinguish the vegetation fire and to conserve water sources, reducing incomes from tourism, redevelopment planning in relation to sea level rise); social (will be affected the quantity and quality of sources of raw material and first of drinking water; harm to human health - premature mortality, health expenditure, epidemics fluctuations, decreased quality of life, etc.); biological and agricultural (higher temperatures affect the physiology of plants, animals and humans; migration of pests and diseases, the impact to the forest resources, etc.). The economic impact seems to be more pronounced not because of the change in mean values, but because of the frequent manifestation of extreme events and the cumulative effect will increase due to the interaction between the various sectors of industry and economy. In the same study was found a mixed impact of climate change on viticulture, a branch of significant socio-economic importance (by revenue, by the number of involved people etc.) for the Washington state: some traditional areas of some varieties will be abandoned due to exceeding temperature tolerance limits, other, colder will be populated.

It is estimated that the effect of climate change will have on viticulture economic impact, caused primarily by the change in the quality, typicality of final

traditional product (Jones et al., 2000) as a result of displacement of optimal climate values for forming the production (an increase in average temperatures by 2,1° C is predicted to advance the deployment of phenological phases 10 to 20 days). On analyzing of a period of 28 years (1979-2006), under vine growing zone Dealurile Bujorului (Donici, 2007), it appears, since 2000, average temperature increasing by 1,5-2,0 ° C and as a result reducing the difference between the starting date of the phenological phases for varieties Fetească regală, Babească neagră and Merlot, and in the years when water deficit occurs grape production is reduced. The same phenomenon is noted in condition of R.Moldova (Vronskikh, 2011) - reduced production of grapes at the average by 17,4% in years with extreme temperatures in summer. At the same time, being performed a comparative analysis of the average production in Moldova for four crops (winter wheat, maize, sunflower and sugar beet) in the most favorable and most dry years (1961-1990) their difference is not found significant (Palii, 2000). The impact of unfavorable weather conditions was diminished by the implementation, during this period, of new varieties, hybrids and compliance and improve of used phytotechnical processes. In this context the resolution OIV-VITI 517-2015 provides recommendations on adaptation to new climatic conditions of planting material (varieties, clones, rootstocks etc.), of care techniques etc. Therefore, reducing the impact of these destabilizing factors should be based on judicious use in breeding programs of diversity of grapevine genetic resources, taking into consideration the presence of a high potential for adaptability to climatic stresses of old autochthonous varieties. Given the complex nature of the forecasts of climate change is difficult to formulate univocal requirements for the future assortment, however, essentially they are related to the genetic limits of variety, so the heritage of genetic diversity, which would allow anticipated decrease of possible negative phenomena.

Efficient solving of the problem of advanced resistance of grapevine to restrictive factors can be solved by creating new varieties, where is ensured by the genetic constitution of plant. The evolution of this process, initiated in the early century XIX, resulting during the years by development and implementation, including in R.Moldova, of some hybrid, varieties having resistance to environmental stress factors, achieving in recent decades an advanced quality of production, including seedlessness and productivity (Savin, 2012). Thus, this approach has confirmed its effectiveness, possess an significant potential, inclusive in solving the future problems of viticulture. Therefore, the success of creating new varieties that would ensure a sustainable, ecological vitiviniculture, therefore competitive, depends on the diversity of available genetic resources.

Given the stated objectives, over the years has increased the share of created genotypes that possess complex qualities: early maturation, seedless, biological resistance. In Institute's grapevine gene pool were introduced from the Central Asia genotypes with early maturation, large berry, seedless; from viticulture centers of Europe – elite and varieties with increased or advanced resistance, including ennobled hybrids with advanced resistant; from the collections of University Davis, USA –

resistant seedless varieties and *V.vinifera* L. seedless elite with large berry. Thus, in the gene pool has been considerably expanded the diversity of origin of sources of character with strategic importance for the development of viticulture (Savin, 2012) (Table 1).

Table 1

Diversity of sources of characters with strategic importance for grapevine breeding

Ecological-Geographic origin	Genotypic origin	Example of genotypes
Advanced or increased resistance to stressful factors		
North America	*V. labrusca, V. riparia, V. rupestris, V. licecumii*	Isabela, Campbell, Delaware, Extra
The Far East	*V. amurensis*	No 1, No 10
Complex interspecific hybrids	Interspecific	Villard blanc, Pierrelli
V. vinifera varieties from Euro-Asiatic area	*V. vinifera*	Riesling de Rhin, Rkațiteli, Coarnă neagră, Fetească neagră,
New sources, with complex characteristics, from over the world	Interspecific	Prezentabil, Bianca, Cunleany, Cristal, Hibernal, Regent, Moldova, Urojainâi, Decabrischii, Apiren negru de Grozeşti, Apiren roz Basarabean, Apiren roz extratimpuriu
Seedlessness		
Middle Asia, Caucasus, Middle East	*V. vinifera*	Kiş-miş krasnâi turkmenskii, Kiş-miş mramornâi, Sultanina, Corinth
USA	*V. vinifera*, *V. labrusca,* Interspecific	Centennial seedless, Flaim seedless, Romulus, Perlette
New diversified sources from over the world	*V. vinifera*, Interspecific	Kiş-miş lucistâi, Kiş-miş moldovenesc, Călina, Apiren alb, Apiren roz, Mecita, Kiş-miş ciornâi zimostoikii
Early ripening, productivity		
Old *V.vinifera varieties*	*V. vinifera*,	Madelein Angevine
New diversified sources	*V. vinifera*, Interspecific	Aromat de Iaşi, Favorit, Prezentabil, Apiren roz extratimpuriu, Himrood

Old autochthonous varieties have in genotype adaptability to abiotic environment, including drought, winter conditions and some pathogens (Constantinescu *et al.,* 1959-1971) and also have a valuable potential in creation of sustainable viticulture.

CONCLUSIONS

1. The phenomenon of climate change is manifested more frequently over the past decades by increasing the mean annual temperature, more pronounced intensity of extreme weather events, the same trend is expected for the future, and their actions will have a significant economic impact on viticulture.

2. Presented grapevine genetic resources that hold in different combinations important characteristics: quality, including seedlessness, productivity, early

maturation, resistance to stress factors,â presents a biological material with strategic potential available for breeding programs, with important meanings in the context of diminishing of consequences of climate disturbances.

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