

# We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

4,800

Open access books available

122,000

International authors and editors

135M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index  
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?  
Contact [book.department@intechopen.com](mailto:book.department@intechopen.com)

Numbers displayed above are based on latest data collected.  
For more information visit [www.intechopen.com](http://www.intechopen.com)



---

# Centuries-Old Results of Cultivation and Diversity of Genetic Resources of Grapes in Azerbaijan

---

Mirza Musayev and Zeynal Akparov

Additional information is available at the end of the chapter

<http://dx.doi.org/10.5772/52387>

---

## 1. Introduction

The Azerbaijan Republic is an ancient country located on the South-East of the Caucasus Mountains and on the North-West of the Iranian Plateau, at the crossroads of Eastern Europe and Southwest Asia. Extreme diversity of the soil and climatic conditions of Azerbaijan support a very rich diversity of plant genetic resources. More than 4700 higher plants have been registered here, 237 of which are endemic. Historically wild fruits are used by people for food, as medicinal crops and for other purposes. Azerbaijan is considered one of the evolution centers of cultivated plants. Practically all present-day major cultivated plants appeared for the first time in Azerbaijan several millennia B.C. As an example, evidence of ancient horticulture was discovered in a settlement west of Goy-Gol in the early second millennium B.C. Fruit crops (apple, pear, apricot, pomegranate, quince, fig, almond, walnut, hazelnut etc.) and grape have been cultivated to meet the demands of the population for foodstuff and other products. Most of these crops are still considered major agricultural crops in the country. In the book of the ancient Greek scientist Strabon - "Geography" was indicated a high prevalence of fruits in Azerbaijan: "The whole country is rich in wild and cultural fruits, evergreens, even olive grows here".

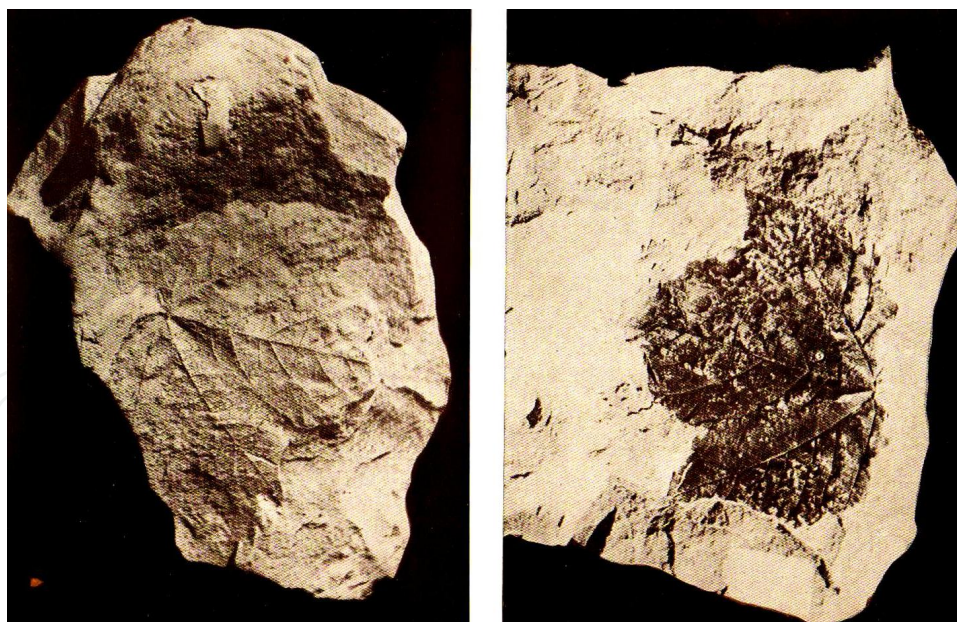
On the territory of Azerbaijan are distributed 149 species of fruit crops belonging to 39 genera and 15 families. The big number of genera and species of wild fruit and fruit-berry plants sprouting in forests and rural regions of Azerbaijan provides the greatest diversity of fruit crops: *Amygdalus communis* L., *Armeniaca vulgaris* Lam., *Berberis vulgaris* L., *Castanea sativa* Mill., *Cerasus avium* (L.) Moench, *C.vulgaris* Mill., *Cornus mas* L., *Corylus avellana* L., *Crataegus orientalis* Pall. ex M. Bieb., *Cydonia oblonga* Mill., *Ficus carica* L., *Fragaria vesca* L., *Hippophae rhamnoides* L., *Juglans regia* L., *Malus domestica* Borkh., *Mespilus germanica* L., *Morus* L., *Persica vulgaris* Mill., *Pistacia mutica* Fisch. & C. A. Mey., *Pistacia vera* L., *Prunus cerasifera*

Ehrh., *Punica granatum* L., *P.domestica* L., *P.spinosa* L., *Elaeagnus angustifolia* L., *Pyrus communis* L., *Rubus* L., *Olea europaea* L., *Vitis vinifera* L. subsp. *sativa* D.C., *V.vinifera* L. subsp. *sylvestris* (C. C. Gmel.) Hegi. and etc. [1,2,3,4,5,6]

Vine-growing was one of the most ancient and widespread professions in the economic life of our people. As evidenced from archaeological excavations, paleobotanical studies, ampelographic information, folklore and written history sources, Azerbaijan has proven to be one of the cultural centers of vine-growing.

The territory of Azerbaijan has very favourable conditions for improvement of *Vitis* and development of vine-growing. Primitive men who primarily utilized hunting and fishing to provide sustenance also collected wild fruits and berries, including wild grape.

In 1963 in the western part of Bozdagh (Goy Gol region) while conducting geological investigations, Azerbaijan scientists discovered an abundance of plant remains in Absheron sediments which formed 1-2 million years ago. Most of the residues were impressions of wild grape leaves on stone. Formation of wild grape in this area (approximately 500. 000 years ago) was demonstrated by grape leaf impressions found in Nakhchivan [7]. This discovery proves that the region is one the ancient vine-growing centers (Figure 1.). These discoveries are very valuable, not only for historians, but also for specialists of other sciences – paleobotany, ampelographics, fruit-growers, geologists, soil scientists.



**Figure 1.** *V.vinifera* L. subsp. *sylvestris* (C. C. Gmel.) Hegi. Leaf impressions in stone. Discovered in the Eastern part of Araz River in Nakhchivan AR (according to I.M. Palibin, 1964)

Researchers indicated that the origin of cultivated grape was within geographic areas where wild grape was endemic. According to N.I.Vavilov, like animals, plant domestication is also possible in areas that are enriched with available wild species. Through his long term inves-

tigations, he determined that Azerbaijan and the Southern Caucasus Mountains are the main centers of crop origin, including grape [8,9,10].

Archaeological materials are considered important sources in highlighting the socio-economic life of people, and also for studying the historical development of vine-growing. There are a number of findings on the vine-growing culture of ancient Azeri people in the archaeological record. In some cases, parts of grape bunches dried in soil or rotted, but the majority of grape bunches only became charred and kept its form and size when discovered in ancient pots or storage vessels.

The oldest examples of findings on vine-growing in Azerbaijan territory date to the V-IV millennium BC. In these noted millenniums an important event occurred in the lives of ancient families, our ancestors passed from a hunter/gatherer society to a sedentary life and husbandry culture.

During archaeological excavations near Aghstafa region in 1962, various plant remains, including grape seed, were found in "Shomutepe" monument and were dated to V-IV millennium BC. Investigations had shown the culture and year parameters of grape seeds. Mainly on the basis of this finding it was shown that the history of cultured vine-growing in Azerbaijan has at least 7 millenniums.

Grape seeds, stone tools for vine production and different cultural material samples which were found at Uzerliktepe monument, Goy Gol region, and ancient monuments in Nakhchivan during archaeological excavations near Aghdam region showed that vine-growing had played an important role in farmers' lives. Grape seeds found in Uzerliktepe date to 3500 years ago. Scientists determined that they were table grape varieties. Grape seeds found in Uzerliktepe were of different sizes. The biggest seed was 6.5 mm, separate seeds of grape were nearly 18-20 mm. Findings in Ganjachay territory show that the people were occupied with horticulture, as well as vine-growing during the Bronze Age. Chemical analysis of remain which were found in earthenware crockery belonging to last Bronze Age proved that it consisted of wine sediments and grape seeds. Wine pitchers were also found in tombs from the end of the Bronze Age in Mingechevir region. Besides jewellerys, weapons, kitchen utensils and food, as well as wine bottles had been found in Bronze Age grave monuments in Goy Gol region and Haloylutepe. In the bottom of crockery, grape seed sediments and wine remains were observed. It was determined that all these were put near the deceased person in connection with confidence to 'The Hereafter.'

During archaeological excavations in old Saritepe settlement in the west part of Gazakh region, big pitchers were discovered that contained grape seed and seed fragments. Professor A.M. Negrul who investigated the grape seeds determined that they belonged to a cultivated grape variety. Those investigations concerned artifacts dated to II millennium BC. The big pitchers found in Saritepe have a great importance as proof of grape juice extraction and wine production. One of the grape juice pitchers with a height of 2m and 1000 litre capacity is being kept in the historical museum of Azerbaijan.

Cultivated grape seeds were also found at approximately 5 m depth in Meydantepe from II millennium BC in Kultepe settlement in Nakhchivan.



During a 1970 excavation, other cultural samples, as well as lots of burnt grape seed remains belonging to the first half of I millennium AD (app. IV-V centuries) were discovered in Galagah. In Galagah, a piece of stone crockery used in grape juice extraction was found. Separate seeds of grape and stone crockery proved that this place was a production center for wine-making.

In III-VIII centuries, wine-making played an important role in the economic life of the Mingechevir population. In Mingechevir the main archeological discoveries had been grape seeds. A number of wineskin remains were discovered here. In these wineskins there were grape seeds and ancient wine remains.

While conducting archaeological excavations it was determined that urban population of Beylagan were also occupied with vine-growing. First period stratum of Beylagan (VI-VIII centuries), were vine-growers as evidenced by numerous discoveries of grape seeds. At the result of 1962-68 excavation, burnt grape bunches were discovered in a building complex characterizing XI-XIII century settlements.

Different fruit remains, as well as grape seeds, were found in ruins of Gabala region of Azerbaijan. Grape seeds were found in economic wells and basin-shaped earthenware crockery.

All of these archaeological excavations provide good evidence on grape remains, economic pitchers and tools (hoe, spade, hook, gardening shears, trough), as well as dishes (strainer, jug, basin, glass, bowl and etc.) which are endemic to any given region.

Populations used the grape for juice extract, prepared non-alcoholic drinks and made various food stuffs of these juices and syrups.

Grape squashing stones were found in cultured stratum of settlements and places belonging to III-VIII centuries of Ganja, Pirhesenli village of Aghsu region and Mingechevir.

Vine-growing provided the Azerbaijan population with grape juice and syrups, currants, bakmaz, vinegar, abgora and other products. The production of these required great experience, a large labour force and a variety of differently formed dishes. During excavations lots of potteries were unearthed. Clay strainers had been used in juice filtering. Clay strainers belonging to II millennium BC and VII century were found in II Kultepe and Julfa region, Bronze Age cultured stratum of Mingechevir and Gabala region. Earthenware crockery used as a strainer in wine-making which belonged to III-II centuries was discovered in a graveyard near Gubakhalili settlement of Ismayilli region. Such strainers were also obtained in Seyfeli village and places throughout the Shamkir region.

Paleobotanical findings, artificial irrigation ornamental remains, differently sized and formed potteries, also glass wares and tools which were found through archaeological excavations show the high degree of development of vine-growing in Azerbaijan.

Written sources of information (Latin, Greek, Syrian, Arabic, Persian, Turkish) are very important in determining the developmental history of vine-growing, as well as the husbandry culture of Azerbaijan population. There is plenty of information in ancient scholars' works on these issues. The Greek scholar Herodotus, who lived in V century BC, gave information

about events relative to VI century on vine-growing in Azerbaijan. Abundance and quality of Azerbaijan grape is even more significant than in Iran, Babylon or Greece. The Roman scholar Great Plini (23-79 years BC) admired inexhaustible resources and advanced farming culture of Azerbaijan territory: "I have never seen such sweet grape anywhere. This nation can cultivate the land better than Egyptians".

The famous Greek geographer Strabon (I century BC- I century AD) noted the great role of vine-growing in the economic life of Azerbaijan: "There (in Azerbaijan) grapevines were cut off once in five years, new grapevines began to yield fruit from the second year, yield was higher and even some parts of grape stayed on grapevines".

In some zones of Azerbaijan planting of grapevines in winter is connected with climate. In some regions of Azerbaijan, especially in the Nakhchivan Autonomous Republic covering viticulture. In recent years, cultivation of grapevines is more widely spread in "Khiyaban" in Azerbaijan. Grapevines that are cultivated in "Khiyaban" not have to do pruning every year. A higher yield is obtained though cutting off the dried parts and useless shoots once every 5-6 years. Strabon's information on high yield of grape is also connected with grapevine productivity. It is known that, grape mainly is harvested in the months of September-October. If taking into account comparative climate changes, in ancient Azerbaijan the grape was collected in September-October months too. In certain years, the productivity of grapevines was higher, and it had been impossible to harvest everything until December. When Strabon noted not collecting part of the grape harvest, he namely intended this issue.

In modern Azerbaijan vine-growing and wine-making are considered among the most profitable fields of agriculture. Although local grape varieties are cultivated on big farms, they are an insignificant part of the national grape collection. And this cannot provide sustainable and safe preservation of local valuable grape varieties. Therefore, local grape varieties and wild grape forms spread in our republic (in old vineyards, little peasant-farmer households, courtyards, etc.) should be collected, included in the collection, and evaluated for their possible utilization.

Recently, new ampelographic collections have been established and enriched with local and introduced grape varieties and wild grape species in Genetic Resources Institute of ANAS.

At the conclusion of our latest investigations, it was known that of the more than 600 local and introduced grape varieties spread throughout Azerbaijan, 75 of them had already been lost, with more than 100 varieties currently being threatened.

Most of threatened local grape varieties were collected as a result of expeditions (in old vineyards, peasant-farmer households and courtyards) organized in different regions of our Republic.

## 2. Material and Methods

Materials of research work consisted of grapevines and yields of local grape varieties and wild grape forms.

Ampelographic description of grape varieties and wild grapevines had been implemented on the basis of common methods [11,12,13,14,15].

Phytopathological and immunological descriptions and assessments of grapevines on natural background were carried out by appropriate methods [16].

Finally, varieties and forms were evaluated by modern methods [17, 18] for their reaction to various stresses.

Total genomic DNA was isolated from young grape leaves. The leaves were ground in liquid nitrogen. For DNA isolation the CTAB based extraction procedure was used [19]. When necessary, extracted DNAs were purified with GenElute columns (Sigma-Aldrich, St. Louis, MO). In the case of silica dried leaves DNA was isolated by Plant genomic DNA extraction miniprep system (VIOGENE, USA). Sequence diversity polymorphisms of wild grape samples were investigated at two non-coding plastid DNA regions (the *trnH-psbA* intergenic spacer and the *rpl16* intron).

The *trnH-psbA* intergenic spacer was amplified with the primers "trnH" and "psbA". The *rpl16* intron was amplified with the primers "rpl16-5" and "rpl16-3" [20,21]. The primers were synthesized by Integrated DNA Technologies, Inc. (Coralville, IA), and Sequencing Service of Institute of Biochemistry and Biophysics, Polish Academy of Science (Poland).

PCR conditions included 1 minute denaturing at 94°C, 30 cycles of 94°C denaturing (1 minute), 55°C annealing (1 minute), and 72°C extension (2 minutes), followed by a final extension step at 72°C (5 minutes). PCR products were purified with GenElute PCR Clean-Up Kits (Sigma-Aldrich, St. Louis, MO), dye-labeled using a Big Dye Terminator Kit (Applied Biosystems, Foster City, CA) and analyzed on either Applied Biosystems 3100 or 3700 genetic analyzers (Biology Department of Washington University, St. Louis, MO and Laboratory Services Division of the University of Guelph, ON, Canada). MEGA and SeqMan softwares were used for sequence analysis.

While on expeditions, the coordinates of wild grapevines areas were defined by GPS. Relevant photos were taken with digital cameras, some ampelographic indicators and phytoecotic traits were described.

### 3. Results and Discussion

Recently, world interest in wild grape has increased and this resulted in a widening of investigations in this field. By studying wild grape, we can infer some questions on grape phytoecogenesis and use the varieties which possessed positive bio-agricultural traits and different biotic-abiotic factors resistant genes as donor in grape selection. For this purpose, research on collection, improvement, investigation and sustainable utilization of genetic resources of wild grape are being implemented in Azerbaijan Republic and organized joint expeditions in different regions.

In our Republic wild grape samples are spread widely in large areas and along the banks and shores of river, lake and sea, and on mountain slopes of Absheron, Nakhchivan AR,



Ganja-Gazakh, Garabagh, Mil-Mughan, Shirvan and Talysh regions. A number of studies were implemented in Khachmaz, Guba, Khudat, Nabran, Gusar, Shamakhi, Ismayilli, Aghsu, Oghuz, Gabala, Shaky, Zagatala, Lankaran and Fuzuli regions for studying the genetic resources of grape.

At the same time it may be concluded that wild grape spread throughout the whole territory of Azerbaijan in a very ancient form. Wild grape - *V. vinifera* L. subsp. *sylvestris* (C. C. Gmel.) Hegi. of Azerbaijan is distinguished with specific characters. It grows on the territory of Azerbaijan from 12 m below sea-level (Kyur riverside, Salyan region) to 2000 m above sea-level (Gusar region). There are two kinds of wild grape in Azerbaijan: *typica* Negr. (with hairs) and *aberrans* Negr. (hairless).



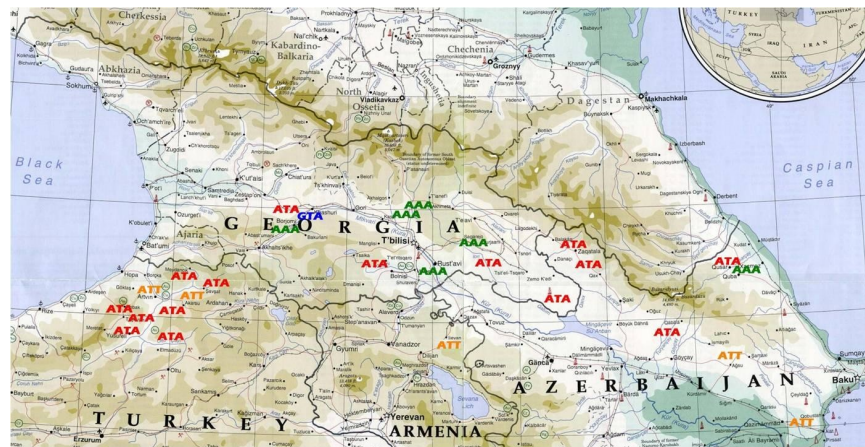
**Figure 2.** Formation of wild grape in Nabran. Coastal Area of the Caspian Sea.

The geographic origins of grapevine domestication are not currently known. According to many researchers, the Caucasus region (north-western Turkey, northern Iraq, southern Russia, Azerbaijan, Georgia) and adjacent areas (Anatolia, modern day Syria, Lebanon, Israel), are the geographic areas where grapes were most likely first domesticated [10,22,23,24]. Special climate conditions in this area occurred which were favorable for the diversification of wild varieties from which cultivated grapes were domesticated. At the same time, having extraordinary abundance of the wild species of grape (*V. vinifera* L. subsp. *sylvestris* (C. C. Gmel.) Hegi.), Azerbaijan and the whole South Caucasus region are regarded as the potential places for domestication of cultivated grapes. It is here that the natural distribution of *V. vinifera* most closely approaches the probable origin of Western agriculture [24]. This assumption is



proven by the recent chemical analysis of archeological pottery from Georgia and Eastern Anatolia which showed that winemaking dates back to early VI millennium BC in these regions (McGovern, in preparation). Distribution area of *V.vinifera* L. subsp. *sylvestris* (C. C. Gmel.) Hegi. is very wide: It's a Europe, northern Africa and the Middle East, including Mediterranean, Black and Caspian Sea Basins from Spain to Turkmenistan [25].

The main goal of the proposed study was the investigation of plastid DNA sequence diversity in a geographically diverse set of South Caucasian *V.vinifera* L. subsp. *sylvestris* (C. C. Gmel.) Hegi. To date no study has broadly assessed DNA sequence variation of wild grapevines in this way. The greater Caucasus region is widely believed to be the area in which grape domestication began [22,26], and the study of genetic diversity in this region is viewed as key to understanding grape domestication in general. This information is of great interest from an ethno-botanical standpoint, but also relates to crop improvement. It's well known that cultivated varieties of grapevine differ greatly in their resistance to pests and diseases, and ancestral wild populations are obvious first targets for use in breeding and genetic engineering.



**Figure 3.** The distribution of haplotypes in the SouthCaucasus.

For clarification of some questions and characteristics of domestication of wild grapes of the South Caucasus, we studied samples of the wild grape of the South Caucasus region. Forty-five wild grape (*V.vinifera* L. subsp. *sylvestris* (C. C. Gmel.) Hegi.) samples from the South Caucasus were analyzed. This group included 19 samples from the Republic of Georgia, 10 samples from Azerbaijan, 2 samples from Armenia and 14 samples from Turkey. A plastid DNA sequence variation study revealed the presence of three polymorphic sites in DNA: one in *trnH-psbA* intergenic region and two in the *rpl16* intron area. According to this observation investigated samples of Caucasian *V.vinifera* L. subsp. *sylvestris* (C. C. Gmel.) Hegi. were divided into four different haplotypes: AAA, ATT, GTA and ATA [27]. For each haplotype the first nucleotide represents single polymorphism at the *trnH-psbA* intergenic region and another two nucleotides at two targeted sites from *rpl16* intron area. The AAA haplotype is restricted to East Georgia and Azerbaijan, the ATA haplotype is distributed randomly across the entire study area, the ATT haplotype is distributed in the southern part of the

study area from the Black Sea to the Caspian Sea. The single GTA haplotype was only found in the South-West part of Georgia (Figure 3).

The AAA haplotype is observed in both wild and cultivated (*V. vinifera* subsp. *vinifera*) grape samples from the Caucasus. This observation and the presence of all other plastid haplotypes observed in a previous study of worldwide set of grape cultivars highlight both unique and high levels of genetic variation in wild grape (*V. vinifera* L. subsp. *sylvestris* (C. C. Gmel.) Hegi.) from the greater Caucasus region.

Sequence Group AAA			
Population	Geographic Region	River Basin	Coordinates
Quba distr.,village Alpan	North Azerbaijan	Quruçay	N 41° 21' 17,2'' EO 48° 22' 01,2''
Quba distr.,village Ağbil	North Azerbaijan	Quruçay	N 41°26' 03,7' EO 48°33' 49,1'
Quba distr.,village Ağbil	North Azerbaijan	Quruçay	N 41° 26' 03,7' EO 48° 33 ' 49,1'
Quba distr.,village Susay-Qışlaq	North Azerbaijan	Quruçay	N 41° 28' 02,3' EO 48° 34' 43,3'
Sequence Group ATT			
Population	Geographic Region	River Basin	Coordinates
Ağsu distr.	Central Azerbaijan	Girdmancay	N 40° 55' EO 48° 15'
Qobustan distr., in gorge	East Azerbaijan	-	N 40° 10' E 49° 20'
Sequence Group ATA			
Population	Geographic Region	River Basin	Coordinates
Quba distr., village Susay-Qışlaq	North-East Azerbaijan	Qusarçay	N 41°28.25,5' EO 48°36.14,0'
Balakan distr.	North-West	Balakancay	N 41° 43' EO 46° 25'
Qabala distr.	North-West	Turyancay	N 40° 47' 814'' EO 47° 38' 334''
Zaqatala distr.	North-West	Alazan	N 41° 25' EO 46° 45'

**Table 1.** Sample information of sequenced samples from Azerbaijan

In Nabran forests of Guba-Khachmaz region black and dark purple coloured grape forms were found.

While exploring in Guba-Khachmaz region it was discovered that Guba region is enriched with wild grape. In forests of this region (Uzunmeshe, Alpan, Khujbala, Digah, Aghbil, Sus-

ay Gishlag, Dallakand villages) along Guruchay, Gusarchay, Gudyalchay rivers lots of wild grape forms were found.

In forests of Khachmaz (Pir forest), Shaky (Oraban), Lankaran (Seligavul) and Gabala (Shongar) regions small seeded black-skinned wild grape varieties were also observed.



**Figure 4.** Samples of wild grapes in forest number 1 (Khachmaz d.)

On the banks of Kondalanchay River in Fuzuli region black, dark red and dark purple coloured grape (seeded forms) were observed.

In general, more than 3000 samples of wild grapes were found in explored regions and phytocenotic features of their geographic areas were described.

In Azerbaijan while investigation of areal of wild grape – *V. vinifera* L. subsp. *sylvestris* (C. C. Gmel.) Hegi. it was determined that various forms of wild grape spread widely together with the following fruit-berry and forest plant varieties and species: medlar – *Mespilus germanica* L., cornel – *Cornus mas* L., walnut – *Juglans regia* L., hazelnut – *Corylus avellana* L., pomegranate – *Punica granatum* L., chestnut – *Castanea sativa* Mill., quince – *Cydonia obonga* Mill., apricot – *Armeniaca vulgaris* Lam., caucasian hawthorn – *Crataegus caucasica* C. Koch., eastern hawthorn - *Crataegus orientalis* Pall., red hawthorn – *Crataegus kyrtostyla* Fingerh., blackberry – *Rubus caucasicus* Focke., sea buckthorn – *Hippophae rhamnoides* L., willow – *Salix*



*caucasica* Andress., poplar – *Populus gracilis* A. Grassh., hornbeam – *Carpinus caucasica* A. Grossh., elm – *Ulmus foliaceae* Gilib., oak – *Quercus iverica* Stev., birch– *Acer campestre* L., *Pal-iurus spina* Christi Mill., tamarisk – *Tamarix ramosissima* Led., horse tail – *Equisetum* L., elder berry – *Sambucus nigra* L.



**Figure 5.** Sample of wild grape in Gabala (Shongar).

It was determined that different populations of wild grape in our republic spread mainly in two formation - tugay (streamside forest) and typical broad-leaved forests. On the banks of Kungut River (Oraban village) of Sheki, Guruchay, Gusarchay, Gudyalchay rivers (Uzunmeshe, Alpan, Khujbala, Digah, Akbil, Susay Gishlag, Dallakand villages) of Guba region wild grapevines spread mainly in tugay forests densely and widely. But typical forest formation of wild grape was found in Agharehimoba, Godekli, Gimilgishlag, Gadashoba and Nerecan villages and forests (forest number 1, Pir forest) of Khachmaz region, Seligavul forest of Lankaran region and Shongar spring of Gabala region.



Wild grape samples distinguish each other for their biomorphological traits. As a rule, male grapevines are strong, functional female grapevines are weak. All samples of wild grape can be divided into 4 groups for leaves size: very small (length up to 4,0-8,0 cm), small (length up to 8,0-12,0), medium (length 12,0-15,0 cm) and large leaved (length more than 15 cm). Most of studied varieties involved small and medium leaved group. Wild grape samples can be divided into 3 groups for leaves sub-sections: whole, medium and cross-section leaves. Some samples are covered with white net-shaped blooms, but in some cases lower leaf surfaces are bare. Samples are distinguished by leave margins. Sides are mainly sharp, triangular and round shaped. Stalk hollows are namely lira-shaped, but rarely sides are parallel and bottoms are flat. Wild grape samples are two of two sexes, that is they have male or female flower groups [28].

Self-pollinated perfect flowered groups of wild grape samples were not observed. According to some researchers' opinions, types of flower groups of wild grape are very important morphological trait for defining grape origin, because wild grape is divided into two subspecies. Bunch flowers of wild grape can be distinguished from each other through their forms, they are small or medium sized. As a rule, the bunch flowers of male grapevines are big and cone-shaped. But bunch flowers of female grapevines are small, cone-shaped-cylindrical or cylinder-shaped.

Bunches of wild grape are small, the length being 7,0-13 cm and the width from 6-8 cm. There are 1-2 bunches on productive shoots. Bunches are mainly set on 3<sup>rd</sup>-5<sup>th</sup> churn-stuffs of new shoots. Skin of grape is black or reddish black. Seeds are oval-shaped. The surface is covered with a thick wax layer. Most wild grape varieties are resistant to mildew and oidium disease.

More famous local varieties of grapevine are cultivated in Absheron, Garabagh, Ganja-Gazakh, Shirvan, Guba-Khachmaz regions and Nakhchevan AR of Azerbaijan. Hundreds (according to some sources, more than 600) of landraces of grapevine are grown in the Republic. At the present time the total area of vineyards in Azerbaijan more than 16,000 hectares.

White, red, black and pink colored table, technical and seedless grapevine varieties: Agh shani, Absheron's gyzy uzumu, Alvan, Amiri, Askari, Agh Sahibi, Agh Aldara, At uzum, Agh-ri, Arnaqrna, Bandi, Rishbaba, Chilal, Kishmishi, Tulkuguyrugu, Huseyni, Madrasa, Marmari, Qara Aldara, Qoc uzumu, Tabrizi, Molla Ahmadi, Novrast, Karimgandi, Durna gozu, Davagozu, Kechiamcayi, Khazri, Khalili, Gara shani, Gizil uzum, Chil uzum, Beylagani, Kharci, Khan uzum, Pishras, Malayi, Mahmudabi, Misgali, Khindogny, Hafizeli, Hachabash, Haji Abbas, Hamashara, Sarigila, Shiray, Shirvanshahi, Shireyi, Shirshira, Shafeyi, Shakarbura, Shahangir, Shakari, Sisag and others are cultivated here. Most of them are only grown in definite areas and private courtyards by amateur gardeners [29,30].

A number of grape varieties in current use were the material resources of our ancestors. Each biomorphological trait of these varieties was selected corresponding with land and climatic condition of our republic. These varieties are named for their size, colour, view of bunches, form, taste and quality, as well as names of areas, villages and persons.

Ancient experience in grapevine cultivation allowed the Azeri to improve their secrets about vine care. Every viticultural technique is a product of local experience in different regions and historical periods. Each one has been adapted to the local conditions and this is why we have such a variety of training systems, like “Khiyaban”, “Molla cheperi”, “Keleser”, “Serilen forma”, “Yarimgovs”, “Chardak” and others.

High qualitative products-jams, “doshab”, vinegar, “abgora”, “sucuq”, “kishmish”, “movuc”, “lavashana”, juice, syrup, vines, alcohol which made from grapevine in different regions of Azerbaijan show that grapevine-growing has developed expediently.

*From its colour* – Agh shani, Agh sahibi, Ala shani, Benovsheyi, Gara shani, Garagile, Girmizi chileyi, Goy gezendayi, Gara serme, Gizili, Mermeri uzum, and etc.

*From its quality, taste, aroma* – Gulabi, Kishmishi, Shekeri, Tembeyi, Shireyi, Kerimgendi and others.

*From its view, trunk size* – Gushureyi, Misgali, Tulkuguyrughu, Devegozu, Tulagozu, Kechimemesi, Inekemceyi, Pishik uzum, Goyungozu, Ayiboghan, Gelinbarmaghi and others.

*From its skin thickness* – Dash uzum, Galingabig, Nazikgabig.

*From its seed size and bunch form* – Sapdadurmaz, Hachabash, Bendi.

*From names of villages and regions* – Beylegani, Tebrizi, Shabrani, Derbendi, Ordubadi, Shirvanshahi, Tatli, Merendi, Medrese, Shakhtakhti, Nakhchivan gara uzumu, Beneniyari, Agh aldere, Zeyneddin uzumu.

*From producer's name* – Khelili, Huseyni, Asgari, Sekine xanum, Mukhtari, Jelali, Khatini, Khanimi, Meshedi Ali.

*From name of old tribes* – Khalaj variety in Mil-Mughan region.

Locally selected varieties of grape can be found outside their historical formation areas and today they are grown by amateur gardeners and in peasant-farmer households. These varieties are met in the following areas:

Absheron region – here approximately more than 50 valuable local grape varieties are grown. Agh shani, Gara shani, Ala shani, Sarigile, Haji Abbas, Khatuni, Pishraz, Gavangir, Goybendam, Rishbaba, Khalbasar, Absheron Gelinbarmaghi, Absheron Gizil uzumu, Gara gushureyi, Absheron kechiemceyi, Nadirgulu, Gara Derbendi, Salyani, Zabrat uzumu, Sirkeyi, Movuju, Gala kishmish, Shireyi, Turabi, Shabrani, Gaz khani, Merendil, Garachi, Seyid Amiri, Sebze, Mashtagha khatunisi, Yalanchi shani, Alimemmed, Gargha dili, Sikhsalkhim, Beledi, Gilami and other varieties are the most qualitative and valuable grape varieties.

Ganja-Gazakh region– Tebrizi, Bayanshire, Tatli, Khircha kishmish, Shal uzum.

Shirvan region– Medrese, Shirvanshahi, Devegozu, Shamakhi merendisi, Sisag, Khezri, Chil uzum, Kechiemceyi, Khan uzumu, At uzumu, Beylegani, Shekeri, Khungi, Elvan.

Guba-Khachmaz – (there are approximately 50 grape varieties) - Devechi Agh chileyisi, Devechi giziluzumu, Shabrani, Chileyi, Girmizi chileyi, Derbendi, Khetmi, Khaldar.

Garabagh region – Amiri, Ari merendi, Gara merendi, Gushureyi, Aghdam giziluzumu, Zeynebi, Gul merendi, Aghdam kechiemceyi, Kal uzum, Aghdam khazarisi, Khindogni, Atmerendi.

Nakhchivan AR – (more than 100 valuable grape varieties are cultivated) - Ayiboghan, Agh khalili, Agh uzum, Agh kurdeshi, Bendi, Girmizi Inekemceyi, Gara kurdeshi, Gara khalili, Gara shafeyi, Gizili sebze, Girmizi tayfi, Girmizi shafeyi, Girmizi huseyni, Inekemceyi, Kechiemceyi, Kehraba, Miskali, Nakhchivan girmizi shanisi, Nakhchivan agh tayfisi, Nakhchivan gara shanisi, Nakhchivan gizil uzumu, Nakhchivan huseynisi, Nebi, Nekhshebi, Sari shafeyi, Khatinbarmaghi, Khatini, Hachabash, Gulabi, Abbasi, Agh aldere, Badamli, Batikh, Beneniyar, Talibi, Goyungozu, Durzali, Zeyneddin uzumu, Meshedi Ali, Narinjigile Pishik uzumu, Sari aldere, Sahibi, Teberze, Khanimi, Gara khazani, Shangirey, Hafizeli and others.

Up to the period of adoption of Islam the vine-growing was mainly developed in direction of wine-making, therefore technical varieties dominated in vineyards. At that time Medrese, Meleyi, Agh aldere, Gara uzum, Khetmi, Henegirna and other varieties were cultivated widely in these areas. After adoption of Islam wine-making was prohibited and cultivation of table grapes was stopped. In historical sources it was noted that in these areas lots of kishmishi and table varieties had been cultivated. Some of them (Agh Shani, Gara Shani, Sarigile, Tebrizi, Kishmishi, Khelili, Kurdeshi, Bendi, Nakhchivan huseynisi, Misgali, Nakhchivan gizil uzumu, Shefeyi, Gulabi, Inekemceyi and other varieties) are national selection samples of our ancestors. Different products such as dried raisins and movuc (dried grapes with seeds) were produced and even these products were exported to Near Eastern countries. Formerly, a number of grape varieties had been observed by travellers, merchants and these varieties had spread widely to other regions, several countries of the world and had been named with appropriate synonyms.

Physiological complete maturity period is a characteristic inherited for each variety. Varieties, clones and new forms studied in genefund are distinguished from each other by their maturing periods. It was determined by investigations that maturing periods of fruits of local grape varieties in Azerbaijan Republic can be divided into the following groups:

The earliest maturing (approximately 120 days) varieties: Girmizi huseyni, Agh khelili, Gara khelili, Agh kurdashi, Gara kurdashi;

Early maturing (120-130 days) varieties: Gara pishras, Salyani, Agh chileyi, Gara kishmishi, Gehveyi kishmishi, Yumrugile sari kishmishi;

Middle fast growing (131-140 days) varieties: Agh kishmishi, Nakhchivan huseynisi;

Middle growing (141-150 days) varieties: Agh Shani, Asgari, Beylagani, Gavangir, Gulabi, Gara shani, Sarigile, Fatmayi, Absheron gelinbarmaghi, Tebriz, Shireyi, Girmizi kishmishi, Xirdagile kishmishi, Sari shafeyi, Shekerbura;

Middle late maturing (161-170) varieties: Gavangir, Ala shani, Haji Abbas, Bendi, Goybendem, Julu merendi, Inekemceyi, Shamakhi merendisi, Girmizi shafeyi, Nakhchivan agh tayfisi, Kechiemceyi, Gulabi, Bendi, Negshebi, Miskali, Nakhchivan gara shanisi, Hachabash, Khatinbarmaghi, Khezani, Meshedi Ali, Zeyneddin uzumu, Shangirey, Narinjigile, Henegir-

na, Shakhtakhti, Jelali, Gara serme, Meleyi, Bilev uzumu, Ayiboghan, Khanimi, Hafizeli, Talibi, Mukhtari, Sari shireyi;

The latest maturing (171 days and more) varieties: Agh derbendi, Devechi gizil uzumu, Khezeri, Kechiemceyi, Nakhchivan girmizi shanisi, Nakhchivan gizil uzumu, Khatini, Kehreba uzum, Agh uzum, Nebi, Gizili sebze, Beneniyar, Durzali, Sari aldere, Agh aldere, Goyungozu, Sahibi, Abbasi, Gara aldere, Batikh, Gara henegirna, Khetmi, Khanlari, Zalkha, Dashgara, Rizagha, Agh uzum, Chol uzumu, Zereni gorasi, Nakhchivan gara uzumu, Girmizi henegirna, Goy uzum, Innabi, Khan uzumu, Agh kelenpur, Girmizi gemeri, Khalli uzum, Pishik uzumu, Badamli.

Existing local grape varieties are distinguished from each other by their usage in our Republic. Here table, technical and universal varieties are known. Between them the table grape is more dominant.

Table grape varieties: These grape varieties are used fresh. Absheron gelinbarmaghi, Absheron khatini, Absheron kechiemceyi, Absheron gizil uzumu, Agh gavra, Absheron merendisi, Salyan uzumu, Shireyi, Agh kishmishi, Agh Beylagani, Khalaj, Khalbasar, Khan uzum, Aghdam khezerisi, Fatmayi, Gavangir, Haji Abbas, Gul merendi, Aghdam kechiemceyi, Agh goybendem, Gara kishmishi, Girmizi kishmishi, Gehveyi kishmishi, Yumrugile sari kishmishi, Mermeri, Sari aldere, Sarigile, Seyid Amiri, Siyezen agh uzumu, Shabrani, Sari kishmishi, Khirdagile sari kishmishi, Asgari, Ayiboghan, Agh khalili, Agh uzum, Agh kurdashi, Bendi, Girmizi Inekemceyi, Gara kurdashi, Gara khelili, Gara shafeyi, Gizili sebze, Girmizi shafeyi, Girmizi chileyi, Girmizi kherji, Girmizi merendi, Girmizi huseyni, Inekemceyi, Kechiemceyi, Kehreba, Miskali, Nakhchivan girmizi shanisi, Nakhchivan agh tayfasi, Nakhchivan gara shanisi, Nakhchivan gara shanisi, Nakhchivan gizil uzumu, Nakhchivan huseynisi, Nebi, Nekhshebi, Sari shafeyi, Shamakhi merendisi, Khatinbarmaghi, Khatini, Gara salyan uzumu, Hachabash, Gulabi are table grapes.

Technical grape varieties: They are used in making different alcoholic and non alcoholic drinks, total juice extract exceeds 75,0%. Arayatli gara uzum, Ari merendi, Bayanchire, Shirvanshai, Medrese, Tatli, Aghdam gizil uzumu, Sherabi, Arazvari, Agh kelenpur, Hama-shara, Khindogni, Gara khatuni, Agh Almerdan, Bilev uzumu, Gara serme, Gara henegirna, Goch uzumu, Girmizi gemeri, Girmizi henegirna, Dashgara, Dagh uzumu, Dabbi gulabi, Jelali, Zalkha, Zereni gorasi, Innabi, Mukhtari, Meleyi, Nakhchivan gara uzumu, Rizagha, Sari shireyi, Sari uzum, Gara aldere, Tulagozu, Talibi, Khalli uzum, Khan uzumu, Khanlari, Kherji, Khetmi, Chol uzumu, Shahtakhti, Shahangul, Shekerbura, Haji Ahmadi, Henegirna, Goy uzum are technical varieties.





**Figure 6.** Shamakhi merendisi



**Figure 7.** Gara henegirna



**Figure 8.** Agh Aldere

Universal varieties: These are both table and technical varieties distinguished by their biomorphological and agrobiological traits. They ripen in different times and possess separate agrobiological parameters. These varieties are used fresh and for technical purposes. Abbasi, Agh aldere, Agh gulabi, Khungi, Gara merendi, Gara okuz gozu, Gara sebze, Boz merendi, Badamli, Batikh, Beneniyar, Talibi, Goyungozu, Durzali, Zeyneddin uzumu, Mehsemi Ali, Mahmudu, Narinjigile, Pishik uzumu, Sari aldere, Sahibi, Tabarza, Khanimi, Gara khazani, Shangirey, Shekerbura, Hafizeli are universal varieties.

Expeditions and investigations were implemented for the purpose of identification, collection and inventory of local grape varieties in Azerbaijan. Areas of local grape varieties and wild grapevine expansion were found through expeditions and investigations, etiquette of grapevines were noted and their morphological-biological and immunological characteristics were determined and mechanical and chemical investigation (in lab condition) of yield were carried out.

During expeditions and studies arranged in Absheron region, Gavangir, Fatmayi, Haji Abbas, Sarigile, Absheron gelinbarmaghi and Ala shani table grape varieties were sampled fresh. Gavangir and Sarigile varieties exhibited higher juice extraction yield than others. Therefore doshab and grape juice are produced of them. It was known that bunches and seeds of these varieties are medium and large-sized and this is characteristic for table varieties. The biggest individual seeds belong to Absheron gelinbarmaghi (berries size – 18-23x16-22 mm), Haji Abbas (berries size - 20-26x19-24 mm), Ala shani (berries size – 16-24x15-23 mm) varieties. This preference was reflected on the weight of 100 individual grape seeds. Sweetness of individual seeds of grape was 17,2 (Gavangir) -27,9 gr/100 cm<sup>3</sup> (Sarigile). Average weight of bunches was lower in Sarigile (170 gram) and Fatmayi (180 gram) varieties, in Absheron gelinbarmaghi (250 gram), Ala shani (240-278 gram), Haji Ab-

bas (286 gram) was medium, but in Gavangir variety, average bunch weight was higher (386,4 gram) [28].

Nº	Region and names of varieties	Bunches size, cm	Seeds size, mm	Number of seeds	Weight of 1000 seeds, gr.	Average weight of bunches, gr.	Sweetness of seeds, gr/100cm <sup>3</sup>	Seed acidity, gr/dm <sup>3</sup>	Seed Vegetation period, day
Garabagh-Mil region (Fuzuli, Beylagan region)									
1	Agh Beylagani	18-22x11-15	18-23x17-22	104	266	276,0	19,6	4,62	166
2	Gelinbarmaghi	18-26x12-16	28-36x20-22	84	542	386,5	18,6	5,76	177
3	Nubari	8-17x5-8	10-15x10-15	52	216	126,8	15,9	6,05	120
4	Ari uzumu	11-21x7-10	15-17x15-16	102	224	200,0	19,2	5,70	146
5	Arayatli gara uzum	13-16x7-9	15-18x14,5-17, 5	96	307	180,0	18,2	6,00	139
6	Agh Gavra	20-28x16-20	26-32x19-22	88	396	335	18,6	5,27	177
7	Surmeyi	16-26x11-15	22-26x15-18	72	423,7	210,6	16,2	5,89	147
8	Fuzuli kechimemesi (Kehrabayi)	13-27x8-14	27-35x19-20	96	527,8	441	15,2	6,41	152
9	Gizil uzum	18-21x7-8	15-18x14,5-17, 5	108	298,5	234,5	17,5	5,18	176
10	Gozel uzum	15-27x7-12	20-27x14-19	88	424	322	17,0	6,04	171
11	Alikhanli kechimemesi	13-15x8-12	20-27x13-17	82	336	253	16,0	5,97	155
12	Bey uzumu	17-28x12-15	23-28x18-21	130	421	564,8	17,5	5,15	155
<b>Absheron region</b>									
1	Gavangir	15-20x10-14	14-20x14-19	152	230,8-28 6,4	386,4	17,2	6,60	162
2	Fatmayi	18-24x10-14	15-21x14-20	125	210	180,0	18,5	5,25	150
3	Haji Abbas	18-25x12-19	20-26x19-24	92	336	286,0	18,2-24,6	5,62-3 ,46	162-168
4	Sarigile	15-22x10-15	15-21x12-20	84	240	170,0	21,8-27,9	3,9-7, 3	146
5	Absheron gelinbarmaghi	17-22x14-18	18-23x16-22	80	406	250	20,3	5,7	152
6	Ala shani	14-22x12-16	16-24x15-23	112	325	240-278	18,5	6,5	156

**Table 2.** Some morphological and technological traits of local grape varieties collected through expedition

It was known at the result of phenological observations that studied varieties ripen averagely (Sarigile, Fatmayi, Absheron gelinbarmaghi) and lately (Gavangir, Haji Abbas, Ala shani) (table 2).

Agh shani is one of the oldest and most widely spread valuable table grape varieties of Azerbaijan. While investigating a population of Agh shani variety 4 variations in seed size/shape were observed: – oblong; big seedy – grew in middle period; lately maturing, more and medium-sized seeds of grape; pea-shaped seeds. Through study of several morphological, biological and technological traits of noted variation, it was determined that they are sufficiently distinguished from each other for most of their parameters (table 3).

Nº	Variations of Agh shani variety	Bunches size, cm	Seeds size, mm	Correlation of seeds length to the width L/W	Number of seeds	Average weight of bunches, gram	Weight of 100 seeds, gram	Amount of seeds per bunch, %	Part of sweet seeds, %	Acidity, gr/d	Vegetation period, day	Number of bunches on grapevines	Productivity, kg	
1	Longish Agh shani	12-18x8-11	21-24x15-18	1,31-1,55	70	234	340	2,5	95,7	22,6	4,62	136	22	4,8
2	Big seedy Agh shani	15-22x10-14	23-28x21-23	1,1-1,3	87	382	446	3,2	94,5	20,4	5,86	148	16	6,0
3	Agh shani which has more seeds	14-20x10-12	16-20x14-16	1,16-1,25	140	296	236	4,6	96,2	18,8	6,02	160	20	6,3
4	Pea-shaped Agh shani	8-18x5-12	18-22x16-20	1,05	97	126	346	68,0	86,5	20,6	5,72	152	26	2,4

**Table 3.** Some morphological and agro-technological traits of variations of Agh shani variety

It was determined through immunological assessments of local grape varieties from Absheron that they were resistant to oidium disease (2-2,5 points) and tolerant (3-3,5 points). The



climate of Absheron is dry-subtropical and therefore in most cases development of mildew disease is not a major problem there. Thus mildew disease was not observed in evaluated varieties. At the result of observations it was known that Gavangir and Fatmayi (3-3,5 points), Haji Abbas, Sarigile, Absheron gelinbarmaghi, Ala shani varieties (2,5 point) were tolerant to grey rot disease (table 4).

№	Regions and varieties	mildew		oidium		grey rot
		leave	fruit	leave	fruit	fruit
<b>Garabagh-Mil region</b>						
1	Agh Beylagani	4	4	3	3	3
2	Gelinbarmaghi	4	4	3	3	3
3	Nubari	3	3	3	3	2,5
4	Ari uzumu	3	3	3	3	2,5
5	Arayatlı gara uzum	3,5	3,5	3	3	2,5
6	Agh Gavra	3	3	3	3	2,5
7	Surmeyi	2,5	2,5	3,5	3,5	5
8	Fuzuli kechimemesi	3	3	3	3	3
9	Gizil uzum	3,5	3,5	3,5	3,5	3,5
10	Gozel uzum	3,5	3,5	3	3	2,5
11	Alikhanli kechimemesi	3	3	3	3	2,5
12	Bey uzumu	3	3	3	3	2,5
<b>Absheron region</b>						
1	Gavangir			3	3	3
2	Fatmayi			2,5	2,5	3
3	Haji Abbas			3	3	2,5
4	Sarigile			3	3	2,5
5	Absheron gelinbarmaghi			2,5	2,5	2,5
6	Ala shani			2,5	2,5	2,5
7	Note: 0-point-immune 1 point – more resistant 2-2,5 points - resistant 3-3,5 points - tolerant 4-4,5 points – not resistant 5 points –not more resistant					

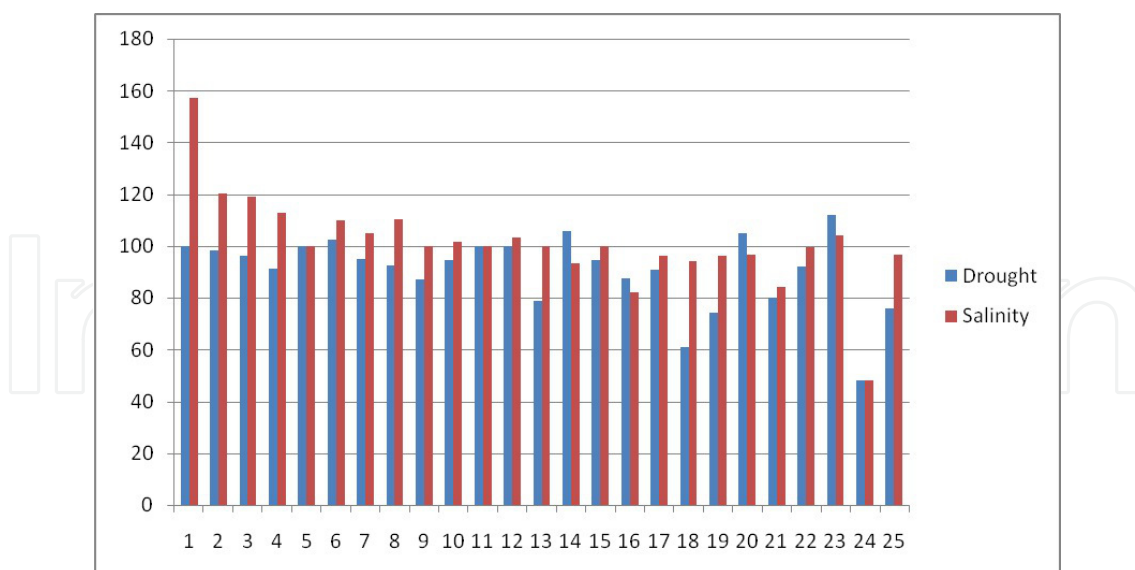
**Table 4.** Resistance of local grape varieties to main fungus diseases on the natural background found through expedition, point

Of the 25 local and 2 introduced grape varieties that were found while exploring in Garabagh-Mil region, 12 of them were low spread local varieties. Agh Beylagani, Gelinbarmaghi, Nubari, Ari uzumu, Arayatli gara uzumu, Agh Gavra, Surmeyi, Fuzuli kechimemesi (Kehrabayi), Gizil uzum, Alikhanli kechimemesi, Bey uzumu are the low spread local grape varieties. It was known during morphometric measurements that their bunches were medium (Nubari, Arayatli gara uzum, Alikhanli kechimemesi) and large-sized (Agh Beylagani, Gelinbarmaghi, Agh Gavra, Surmeyi, Fuzuli kechimemesi, Gizil uzum, Gozel uzum, Bey uzumu). Separate seeds of studied varieties were different-coloured, formed, mainly small (Nubari), medium (Ari uzumu, Arayatli gara uzumu, Gizil uzum), large (Agh beylagani) and largest (Gelinbarmaghi, Agh gavra, Surmeyi, Fuzuli kechimemesi, Gozel uzum, Alikhanli kechimemesi, Bey uzumu) sized (table 2).

It was determined through phytopathological evaluation of above-mentioned varieties against mildew, oidium and grey rot diseases in natural situation that Agh Beylagani and Gelinbarmaghi varieties were not resistant to mildew disease (4 points), but showed average resistance (3 points) to oidium and grey rot diseases. Surmeyi variety was tolerant (3,5 points) to mildew and oidium diseases, but bunches were intolerant (5 points) to grey rot disease. Other varieties showed resistance (3-3,5 points) to mildew and oidium diseases. It was also defined that Nubari, Ari uzumu, Arayatli gara uzumu, Agh Gavra, Gozel uzum, Alikhanli kechimemesi, Bey uzumu varieties were resistant (2,5 points) to grey rot disease (table 4). Above-mentioned varieties are local and they are mainly used fresh. Agh Beylagani, Gelinbarmaghi, Agh Gavra, Fuzuli kechimemesi, Gozel uzum, Alikhanli kechimemesi, Bey uzumu can be stored for a long time and sometimes clusters are kept on grapevines till winter. Black-seeded Arayatli gara uzumu and Ari uzumu varieties possess high juice extraction and sweetness; therefore, red table wines are made of these varieties by local people [28].

Research studies on evaluation of biological-agricultural traits of grape varieties and forms (local, introduced) cultivated in ampelographic collection gardens and experimental fields were implemented. While evaluating disease and pests resistance of 74 studied varieties and forms, it was determined that a number of varieties were infected by oidium disease. Among them 17 varieties – Agh uzum, Fuzuli kechimemesi, Gara Asma, Parkent, Sari Karan, Oktyabrski, Vishnyoviy, Tozlayici, and others showed tolerance (3-3,5 points). Only Bayanshire variety was tolerant to mildew disease. 4 varieties and forms –Nakhchivan gulabisi, Gara Nakhchivan Khatini, Kishmish Khishrau and form number 2 were resistant to pests and were less infected (1 point).

Salt and drought resistance of 25 table and seedless (kishmish) grape varieties were studied for their main physiological traits (stress depression of pigment complex in osmotic solution (sucrose 2% NaCL) in complete formation stage of leaves). It was known that studied varieties demonstrated different reaction to stress factors and plants showed unlike attitude to salt and drought. And it was possible to select resistant varieties on these bases. Experimentation yielded those varieties with sufficient salt and drought resistance were Gırmızı kishmish, Kishmish Yangiyer, Belgradskiy bessemyannıy, Qara Qushureyi, Ruşaki, Kishmish Batır, Zerefshan kishmishi, Kishmish Batır, Sarı kishmish, Gırmızı turkmen kishmishi varieties and these varieties were distinguished for non-stress depression in chlorophyll [31,32,33].



**Figure 9.** Changing the amount of chlorophyll in some grape varieties and forms of stress due to salinity and drought. 1.Gırmızı kishmish., 2.Zerefshan kishmishi., 3.Kishmish Yangiyer., 4.Ruşaki., 5.Polubessemyanıy., 6.İrtişar., 7.Bidane., 8.Vatkana., 9.Belgradskiy bessemyanıy., 10.Kishmish Xişrau., 11.Tezyetishen., 12.Kishmish Terakli., 13. Soqdiana., 14.Sarı kishmish., 15.Oktiyabiskiy., 16.Agh kishmish., 17.Vishnyoviy., 18.Girde kishmish., 19.Form 21-18-36., 20.Gırmızı turkmen kishmishi., 22.Qara Qushureyi., 23.Kishmish Batır., 24.Vatkana-2., 25.Form 1.

It was defined that, since ancient times people had engaged with cultivation of new varieties and forms possessed different biological-agricultural traits. This tradition is also being continued today. Though the abundance of grape varieties of traditional breeding in Azerbaijan Republic, selection of new, of highly productive varieties, with big berries, with a high biologically active substances in berries, with a valuable economic characteristics, resistant to pests and diseases, as well as to stressful environmental factors were continued and some results were obtained in this field.

#### 4. Conclusions

For the purpose of collecting ancient naturally selected varieties and their wild relatives of grape, a number of expeditions were organized in different regions of our Republic, their areal was determined, biological-agricultural traits of collected varieties and forms were evaluated, and for the first time ampelographic descriptions of newly threatened varieties were given and collected varieties were certificated and included in database. Some phytopathological, immunological and physiological parameters of grape varieties conserved in collection were evaluated and new resistant varieties were selected. Collected materials were included in gene pool, enriching the collections. Taking into account economic efficiency the growing of above mentioned grape varieties can have great perspectives, not only in Azerbaijan, but also in countries with similar climatic conditions. Therefore conservation of plant genetic diversity of grapes existed in Azerbaijan Republic, selection of productive samples, evaluation and protection are one of the most important problems in modern time.

## Author details

Mirza Musayev\* and Zeynal Akparov

\*Address all correspondence to: [m\\_musayev4@yahoo.com](mailto:m_musayev4@yahoo.com)

Laboratory of Subtropical Plants and Grapevine, Genetic Resources Institute of the Azerbaijan National Academy of Sciences, Baku, Azerbaijan

## References

- [1] Mammadov, M, Asadov, K, & Mammadov, F. M. (2000). Dendrology. *Baku.*, 388, (in Azeri).
- [2] Asadov, K, & Asadov, A. (2001). Wild fruits of Azerbaijan. *Baku*, 252, (in Russ).
- [3] Hasanov, Z, & Aliyev, C. (2011). Horticulture. *Baku*, 520, (in Azeri).
- [4] Akparov, Z, Imamaliev, Q, & Musayev, M. (2003). Diversity of the genetic fund of fruit plants in Azerbaijan. *Journal Azerbaijan & Azerbaijanis*, [3-4], *Baku* [3-4], 98-100.
- [5] Maghradze, D, Akparov, Z, Bobokashvili, Z, Musayev, M, & Mammadov, A. (2012). The importance, usage, and prospective of crop wild relatives of fruits, grapevine, and nuts in Georgia and Azerbaijan. Proceedings of the 1<sup>st</sup> International Symposium on Wild Relatives of Subtropical and Temperate Fruit and Nut Crops., Davis, California, USA, March 19-23, 2011., *Acta Horticulturae*, 33-40.
- [6] Akparov, Z, & Musayev, M. (2012). Diversity of the fruit plant genetic resources in the Azerbaijan. Proceedings of the 1<sup>st</sup> International Symposium on Wild Relatives of Subtropical and Temperate Fruit and Nut Crops. Davis, California, USA, March 19-23, 2011., *Acta Horticulturae*, 948, ISHS, May, 33-40.
- [7] Babaev, T. (1988). Azerbaijan is an ancient wine-growing land. *Baku*, 86.
- [8] Vavilov, N. I. (1926). Centres of origin for cultivated plants. *Proceedings of Applied Botany, Genetics and Breeding.*, 16(2), in Russ.
- [9] Vavilov, N. I. (1931). Wild relatives of fruit trees of Asia part of the USSR and the Caucasus and problems of fruit trees origin. *Proc. of Appl. Bot. Genet. and Plant Breeding*, 26(3), in Russ.
- [10] Zhukovskii, P. (1964). Cultivated plants and their wild relatives. 2nd edition. Leningrad. Publishing house "Kolos". (in Russ), 790.
- [11] Lazarevsky, M. A. (1963). The study of grape varieties. Rostov University Publishing, (in Russ), 152.



- [12] Makarov, S. N. (1964). Scientific basis of method of experimental work in viticulture. *Proceedings, Volume IX. Chisinau: Map Moldovenyaska*, 280, in Russ.
- [13] Morozova, G. (1987). Viticulture with the basics ampelography. M. Kolos, (in Russ), 251.
- [14] Prostoserdov, N. (1963). The study of grapes for determining its use. M., Food promizdat, 80, in Russ.
- [15] Smirnov, K, Kalmykova, T, Morozova, G, & 1987. Viticulture. M Agropromizdat in Russ, 367.
- [16] Chisinau, S. (1985). New methods of phytopathological and immunological studies in viticulture.(in Russ). 138.
- [17] Kushnirenko, M D, et al. (1976). Methods for assessing plant resistance to unfavorable environmental conditions. Leningrad: Kolos (in Russ), 87.
- [18] Udovenko, G. (1988). Diagnosis of plant resistance to stress. Leningrad, 22-46, in Russ.
- [19] Lodhi, M. A, Ye, G, Weeden, N. F, Reisch, B. I, & 1994. A Simple and efficient method for DNA ex-traction from grapevine cultivars and *Vitis* species. *Plant Molecular Biology Reporter*, 12, 6-13.
- [20] Schaal, B, Beck, J, Hsu, S, Beridze, C, Gamkrelidze, T, Gogniashvili, M, Pipia, M, Tabidze, I, This, V, Bacilieri, P, Gotsiridze, R, & Glonti, V. M. (2010). Plastid DNA sequence diversity in a worldwide set of grapevine cultivars (*Vitis vinifera* L. subsp. *vinifera*). Abstracts of 10th International Conference on Grapevine Breeding and Genetics., 65, Geneva, New York.
- [21] Beridze, T, Pipia, I, Beck, J, Hsu, S-C, Gamkrelidze, M, Gogniashvili, M, Tabidze, V, This, P, Bacilieri, R, Gotsiridze, V, Glonti, M, & Schaal, B. (2011). Plastid DNA sequence diversity in a worldwide set of grapevine cultivars (*Vitis vinifera* L. subsp. *vinifera*). *Bulletin of the Georgian National Academy of Sciences*, 5(1), 91-96.
- [22] Negrul, A. (1946). Ampelography of USSR. v.I, Moscow. (in Russ).
- [23] Sauer, J. D. (1993). Historical Geography of Crop Plants. CRC Press, Boca. Raton USA.
- [24] Jackson, R. S. (1994). Wine Science Principles and Application. Academic Press New York.
- [25] Arroyo-garcia, R, Ruiz-garcia, L, Bolling, L, Ocete, R, Lopez, M. A, Arnold, C, & Ergul, A. (2006). Genetic evidence for multiple centers of grapevine (*Vitis vinifera* L.) domestication. *Molecular Ecology*, 15, 3707-3714.
- [26] Phillips, R. (2000). A Short History of Wine. Harper Collins, New York.
- [27] Pipia, I, Gogniashvili, M, Tabidze, V, Beridze, T, Gamkrelidze, M, Gotsiridze, V, Meliyani, G, Musayev, M, Salimov, V, Beck, J, & Schaal, B. (2011). Plastid DNA Sequence

Diversity in Wild Grape Samples (*Vitis vinifera* L. subsp. *sylvestris*) from the Caucasus Region". Materials of XXXIV World Congress of Vine and Wine, Porto, Portugal.

- [28] Akparov, Z, Musayev, M, Mammadov, A, & Salimov, V. (2010). Study of the genetic resources of grapevine in Azerbaijan. *Journal "Agricultural science in Azerbaijan* [1-2], *Baku* [1-2], 40-44, in Azeri.
- [29] Salimov, V, & Musayev, M. (2007). Genetic resources of grapevine in Azerbaijan. <http://www.vitis.ru/pdf/rs>.
- [30] Musayev, M. (2003). Grapevine genetic resources in Azerbaijan. Report of a Working Group on Vitis. First Meeting. 12-14 June, Palic, Serbia and Montenegro. Rome. Italy., *Bioversity International*, 2008., 57, [www.ecpgr.cgiar.org/workgroups/vitis/Vitis1\\_WEB.pdf](http://www.ecpgr.cgiar.org/workgroups/vitis/Vitis1_WEB.pdf).
- [31] Aliyev, R, Huseynova, T, & Musayev, M. (2007). Definition of drought resistance in some varieties of grapes. *Conference materials. Baku*,, 107-108, in Azeri.
- [32] Musayev, M, & Huseynova, T. (2007). Ecological and physiological diagnosis of some varieties of grapes. *Conference materials Baku*,, 226, in Azeri.
- [33] Aliyev, R, Huseynova, T, & Musayev, M. (2007). Biodiversity of grapes on the plant resistance to drought and salinity. VIII International Symposium "New and nonconventional plants and the prospect of their use." Proceedings of the Symposium. Volume II. Moscow,, 33-35, in Russ.
- [34] Allahverdiyev, R. K., Suleymanov, C. S., et al. (1973). *Ampelography Azerbaijan SSR. Baku*, 490.

