

Biodiversity of fruit plants in Azerbaijan: Prospects of conservation and utilization

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ABSTRACT

Azerbaijan considered as the primary or secondary center of origin, domestication and diversity of many fruits, grapevines and nuts, taking their basis from the wild relatives of the region. The land races and wild relatives in Azerbaijan are conserved in protected areas and botanical gardens, as well as ex-situ and on-farm conservation in field collections of the National Gene Bank. At present, more than 4000 accessions of fruit plants are maintained in field collections of GRI (Genetic Resources Institute (GRI), Ministry of Science and Education Republic of Azerbaijan). GRI maintains valuable collections of apple, pear, quince, medlar, pomegranate, grapevine, fig, cherry, apricot, almond, pistachio, almond, pomegranate, sea-buckthorn and other crops. Despite the broad utilization of native varieties in conventional agriculture, the traditions of usage of wild relatives for food, food additives or environmental purposes are still kept among populations like fresh fruit consumption as a raw material for processing and making traditional food, including in a food chain as a feed for domestic animals, initial materials for breeding. Except for fruit utilization, wild relatives are also used as rootstocks, live fences; honey, decorative and medical plants, and wind-brake in plantations.

Keywords: Conservation, fruit crops, landraces, utilization, wild relatives

INTRODUCTION

Azerbaijan is one of the richest countries regarding agricultural biodiversity of plants, animals and microorganisms in the world. Agricultural biodiversity can only be protected and sustainable by rural communities using traditional and ecological agricultural techniques and implementations. Many of these globally important environmental and human friendly traditional agricultural production and information systems are abandoned by producers due to the development of modern agricultural techniques and marketing problems. Thus they are under danger of vanishing.

Traditional agricultural knowledge which is related to indigenous technologies and traditional farming and crop beliefs associated with different cycles of crop cultivation or utilization such kind of species, is deteriorating faster than their biological/genetic diversity which are used by local farmers for different purposes of their consumption. Local people are often excellent resource managers

when they are allowed to manage their own resources for their own benefit. Land races are the products of their selection and even multiplication over long periods of time. Therefore, their participation to the conservation of bio/agro-biodiversity is essential to identify how more complex traditional systems can be adapted to modern needs, while still retaining the bio/agro-biodiversity of both agro-ecosystem and its surroundings.

Flora of Azerbaijan Republic contains more than 5000 species of vascular plants, including 800 ether-oil yielding, 600 medicinal, 500 spices-aromatic, 500 of vitamin-important, 850 dyeing and 1500 species with tannin, have been revealed, 237 of which are endemic. They grow along Major and Minor Caucasus slopes and in subtropics of Talish Mountains.

The **South Caucasus**, also known as **Transcaucasia** or the **Transcaucasus**, is a geographical region on the border of Eastern

Europe and West Asia, straddling the southern Caucasus Mountains. The South Caucasus and the North Caucasus together comprise the larger Caucasus geographical region that divides Eurasia. The South Caucasus in particular, Azerbaijan, considered is considered to be the primary or secondary center of the origin, domestication and diversity of many fruits, grapevine and nuts, taking their basis from the crop wild relatives (CWR) of the region, while the wild relatives (WR) of major fruits and nuts like grapevine, apple, pear, quince, medlar, pomegranate, fig, cherry, apricot, almond, hazelnut, walnut, chestnut, pistachio and others are presented with many genera in the flora of these countries. According to Zhukovskii (1964), the South Caucasus should be considered as a hearth of evolution for cultivated plants of great independent importance.

Vavilov (1926), in his works about the world centers of origin of cultivated plants includes South Caucasus in the Southwest Asia Center and pointed out (Vavilov, 1931) existence of about 80 species and genus of fruit trees in the Caucasus. He specifies the South Caucasus as the major region for fruits in the Caucasus, the centre of origin and center of domestication of grapevine, pears, cherry plum, pomegranate, sweet cherry, walnut, quince, almond, fig, medlar, Cornelian cherry, *Punica granatum* L., *Cidonia oblonga* Mill., *Diospyros lotus* L., *Pyrus elaeagnifolia* Pall., *Pyrus syriaca*

N 41°17.5470' E47°02.4890' 504,4 m;
N 40°52.127 E 48° 05.769 475 m;
N 40°58'33.09" E47°51'48.46" 839 m;
N 41°04.883 E 47° 17.933 526 m;
N 41°21' 59,5" E 048° 24' 03,0" 905m;
N 41°29' 53,4" E 048° 43' 17,3" 122 m;
N 38°53,357' E048°43,556';
N 38°32,555' E048°49,582';
N 41°08.1130' E47°10.9500' 351,9 m

OBSERVATIONS

Each region of Azerbaijan has its own specific and qualitative fruit varieties. Below we described the names of some varieties of national selection of fruit crops discovered during expedition to the regions of Azerbaijan:

Boiss., *Cerasus incana* Spach., *Cerasus micocarpa* Boiss., *Amigdalus georgica* Desf., *Ficus carica* L., *Corylus colurna* L., *Corylus colchica* Alb., *Prunus divaricata* Lebed., *Cerasu savium* (L.) Moench, *Mespilus germanica* L., *Vitis vinifera* L., *Cornus mas* L.). He also indicates growing and wide form origin processes for *Laurocerasus officinalis* L., *Castanea sativa* Mill., *Amygdalus fenzliana* (Fritsch) Lipsky., *Amygdalus orientalis* Mill., *Pyrus communis* L., *Corulus avellana* L., *Juglans regia* L. here. The area of distribution for *Pyrus communis* L., *Malus domestica* Borkh., *Corylus avellana* and *Jeglans regia* are wide and goes out of the Caucasus, but in the South Caucasus they have rich local germplasms.

MATERIALS AND METHODS

Materials for research included the wild relatives and local varieties of fruit crops grown in field collections of the Genetic Resources Institute Ministry of Science and Education Republic of Azerbaijan and other institutions and by farmers in different regions of the country.

Phenological phases, growth, biomorphological description and productivity, fruit quality traits, resistance to disease and pests were studied by using the common description methods of fruit plants as described by Marozova (1987); Smirnov *et al.* (1987); Michurinsk (1980); Sedova (1999). The different varieties and forms of fruits from different regions were collected from following geographical locations as follows:

N 40° 36.811 E48° 26.688 1044 m.
N 40°47.781 E 48° 19.141 835 m.
N 41°00.695 E47° 27.435 481 m
N 41°17.9240' E47°6.6430' 764,4 m
N 41°38.611 E 48°45.156 18 m.
N 41°33.504 E 48° 42.920 67 m.
N 38°32,571' E048°49,539'
N 39°26' 46" E 45° 35' 31" 1304 m.

1. Shirvan region: Its location is 39°55' 53" N 48°55' 133" E. It is famous for its pomegranate and quince. A number of local varieties of pomegranate (*Punica granatum* L.) namely Guloysha, Malas, Shahnar, Balmursal, Girmizigabig, Nazikgabig and etc.; of quince

(*Cydonia oblonga* Mill.) namely Jardam, Garaheyva, Sari heyva, Armuduheyva, Qaraman, as well as of plum, sloe, grapevine and etc. are cultivated in Shirvan region.

2. Shaki-Zagatala region: Zagatala location is Latitude: 41° 37' 53.76" N Longitude: 46° 38' 41.24" E. It borders Russia to the north and Georgia to the west, as well as the economic regions of Quba-Khachmaz, Mountainous Shirvan, Central Aran, and Ganja-Dashkasan. This region for its walnut and hazelnut; In this region ancient landraces of hazelnut (*Corylus avellana* L.) namely Ata-Baba, Yaghlifindig, Sachaglifindig, Ganja findigi; of walnut (*Juglans regia* L.) namely Jar, Dundi, Gum, Tala, Zagatala; of chestnut (*Castanea sativa* Mill.) namely Khanlig, Ashig, Farash, Barguvara and etc. are grown.

3. Guba-Khachmaz region: Its location is N 41° 24' 7.758", E 48° 40' 30.3924". This region possesses more than hundred varieties of apple namely, Qizil Ahmedi, Sari tursh, Jirhaji, Sikhijani, Ayyubi, Shirvangozeli, Jibir, Gand alma; pear varieties like Peyghambari armud, Abasbeyi, Agh armud, Alpanqaly, Qarpyz armud, Nar armud, Kurduku, Daqur, Qefeyi, Yir Nadiri armud, Dash armud, Sapyburma armud, Qara tuluq, Sheker armud, Zencirbend, Yspigi, Pas armudu, etc. were spread widely in fruit gardens, especially in amateur gardeners' courtyards. But some of these varieties are on the verge of extinction, they are very rare and in very small quantities, for example - apple varieties Sari tursh, Qara Tursh, Ayyubi, Jibir, Gand alma; pear varieties Peyghambari armud, Alpanqaly, Qarpyz armud, Daqur, Qefeyi, Bardaq armud, Buz armud, Sapyburma armud, Qara tuluq, Sheker armud, Zencirbend, Yspigi; grape varieties Hinbi and Shikhveli (Hajiyev and Musayev, 2022).

In Nabran forests of **Guba-Khachmaz region** dark and dark purple coloured grape forms were found. While expedition in Guba-Khachmaz region it was known that, Guba region is enriched with wild grape. In forests of this region (Uzunmeshe, Alpan, Khujbala, Digah, Aghbil, SusayGishlag, 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 seedy dark wild grape varieties were also determined.

Typical forest formation of wild grape was found in Agharehimoba, Godekli, Gimilgishlag, Gadashoba, Nerecan and etc. villages and forests (forest number 1, Pir forest) of Khachmaz region, Seligavul forest of Lankaran region and Shongar spring of Gabala region and coastal formation was found in Nabran forests of Khachmaz region (Musayev and Akparov, 2013)

On the banks of Kungutriver (Oraban village) of Sheki, Guruchay, Gusarchay, Gudyalchay rivers (Uzunmeshe, Alpan, Khujbala, Digah, Akbil, SusayGishlag, Dallakand villages) of Guba region wild grapevines spread mainly in tugay forests densely and widely.

Wild sea-buckthorn brushes are widely spread in most regions of the Republic – Guba Khachmaz, Shaky-Zagatala, Shirvan, Talysh, Garabagh, Nakhchivan AR and etc. While natural seabuckthorn populations are mainly spread in Ismayilli, Shamakhi, Aghsu, Gabala, Shaky, Gakh, Zagatala, Guba, Gusar and etc. regions. Sea-buckthorn is growing very well almost in all places, being part of riparian forest 'tugay' (Musayev and Akparov, 2012; Musayev, 2013; Letchamo *et al.*, 2018).

4. Absheron region: Its geographical position is N 40° 10' 17.9292", E 49° 42' 23.5908". The region contains varieties of grape, fig, pistachio, almond, oleaster (*Elaeagnus angustifolia* L., *E. caspica* Grossh.), mulberry, quince and pomegranate where these crops grow naturally or cultivated by farmers in their holdings and orchards. Aboriginal varieties of olive (*Olea europaea* L.) namely Shirinzeytun, Azerbaijan zeytunu, Armuduzeytun, Bakizeytunu; of fig (*Ficus carica* L.) namely Absheron sari injiri, Buzovburnu, Goy injir, Garainjir, Bozinjir, Sumakhinjiri, Payizinjiri; of almond (*Amygdalus communis* L.) namely Nazikgabig, Sarayi, Mardakan; of pistachio (*Pistacia vera* L.) namely Amirjan, Bulbula, Narinji, Zumrud and etc. are cultivated in Absheron region.

5. Garabagh region: Its location is N 39°45' 36" E 46°45' 01" This territory possess a number of fruit crops like landraces of apple, pear, quince sweet cherry, cherry, pomegranate, fig, grape and other fruits which were used by local people.

6. Nakhchivan Autonomous Republic: Its location is N 39°12' 32" E 45°24' 44" This region have more valuable varieties of grapevine and stone-fruits are cultivated. There are some famous varieties of apricot (*Armeniaca vulgaris* Lam.); varieties of peach (*Persica vulgaris* Mill.) namely Salami, Zafarani, Juyur, Aghkustu, Aghnazli; varieties of plum namely Garaalbukhara, Sari albukhara, Khatini; varieties of alycha (*Prunus cerasifera* Ehrh. var. *divaricata* (Ledeb.) L.H.Bailey) namely Goychasultani, Shabrani, Payizmalasi, Aghalycha; varieties of walnut namely Sugra, Seyfi, Araz, Disar and etc.

7. Ganja-Gazakh region: Its location is N 40°40' 58" E 46°21' 38" This region, there are many aboriginal varieties of stoned-fruits and berries and subtropical fruits as well as grapevine, for example, cornelian cherry (*Cornus mas* L.) namely Armuduzogal, Challakzogal, Girdazogal, Dilimlizogal, Garazogal, Sari Kahrabazogal, Irimeyvalizogal are available.

8. Lankaran-Astara region: Latitude: 38.7537311; Longitude: 48.8539286. It borders Iran to the south and west, Caspian Sea to the east and Shirvan-Salyan Economic Region to the north. In this region wild medlar (*M. germanica* L.) widely spread together with wild pomegranate (*P. granatum* L.) and quince (*C. oblonga* Mill.). Some of cultivates medlar varieties have names like 'Khan ezgili', 'Nelbeki', 'Kitil', 'Aghezgil', 'Arkivanezgili' (Akparov and Musayev, 2012.). It was reported that the medlar was domesticated by Caucasian inhabitants, especially in the Lankaran-Astara region of Azerbaijan.

In the territory of Azerbaijan: 149 species of fruit crops belonging to 39 genera and 15 families are distributed.

In forests and rural regions of Azerbaijan: Big number of genera and species of wild fruit and fruit-berry plants are available which provides the greatest diversity of fruit crops, viz., *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., *P. domestica* L., *P. spinosa* L., *Punica granatum* L., *Elaeagnus angustifolia* L., *Pyrus communis* L., *Rubus* L., *Vitis vinifera* L. subsp. *sativa* D.C., *V. vinifera* L. subsp. *sylvestris* (C. C. Gmel.) Hegi. and etc.

In river valleys and other places: many wild forms of apple (*Malus* L.) are available.

In Coastal forest area of Caspian Sea: Wild forms of quince are found. These forests represent service tree (*Sorbus* L.) with 11 species (5 of them are endemic to the Caucasus); hawthorn (*Garataegus* L.) has 9 species; plum (*Prunus* Mill.) with 3 species, almond (*Amygdalus* L.) – 2 species, cherry (*Cerasus* Juss.) – 5 species, blackberry and raspberry (*Rubus* L.) – 14 species and currant (*Ribes* L.) with 2 species. Furthermore, wild medlar (*Mespilus germanica* L.), sloe (*Prunus spinosa* L.), alycha (*Prunus divaricata* lebed.), pomegranate (*Punica granatum* L.), sweet cherry (*Cerasus avium* (L.) Moench.), dog-rose (*Rosa* sp.), sea-buckthorn (*Hippophae rhamnoides*), cornel (*Cornus mas* L.), grape (*Vitis sylvestris* Gmel.), nuts and other fruit and fruit-berry crops in the forest are available. (Akparov and Musayev, 2012; Musayev and Akparov, 2013; Asadov and Asadov, 2001; Maghradze *et al.*, 2012 and Mammadov *et al.*, 2000)

Among 27 Caucasian pear species, 19 are grown in Azerbaijan. These are *Pyrus boissieriana* Buhse., *P. hyrcana* Fed., *P. grossheimii* Fed., *P. communis* L., *P. caucasica* Fed., *P. eldarca* A.Grossh., *P. voronovii* Rubtz., *P. syriaca* Bioss., *P. salicifolia* Pall., *P. zangezura* Maleev, *P. elata* Rubtz, *P. raddeana* G.Woron, *P. serotina* Rehd., *P. nutans* Rubtz, *P. vsevolodi* Heidemann., *P. oxyprion* G.Woron., *P. complexa* Rubtz., *P. medvedevii* Rubtz. vY *P. georgica* Kuth.) with a number of spontaneous hybrids.

In Azerbaijan there were more than 400 landraces of pear and half of them were endangered (Rajabli, 1966). Some varieties of pear (*Pyrus*

communis L.) are: Abbasbeyi, Agh gulabi, Aghagormez, Bildirchin budu, Chaxma, Nurunburun, Qorxmazý, Talýbý, Kup armudu, Uzun Mustafa, Xemzeyi armud, Jirnadiri, Ispigi, Kurduku, Nargila, Qýrmýzý yanaq, Zerqava armud, Hazar armud, Letenzi, Nar armud, Nelbeki armud, Peyghambari armud, Shekeri, Sulu armud, Tir armudu, Tursh sini armud, Turshmalasi armud, Usun armud, Usun sap armud, Yag armud, etc. These varieties differ for ripening time (summer, autumn and winter), size, taste quality, productivity and different factors. For instance, Aghagormez, Bildirchin budu are early ripening, whereas Goy armud is productive (1 ton per tree) (Akparov and Musayev, 2012).

Cornelian cherry (*C. mas* L.) is widely spread in the countries and used in local cuisine. It grows in forest with other fruit species like cherry plum, sloe, hawthorn, dog-rose, apple, pear, quince, medlar, hazelnut, currant, raspberry and others.

There are variations of cornelian cherry in Azerbaijan having different color, size and shape of fruits. More than 40 forms of Cornelian cherry was reported by Mammadov and Musayev (2011).

The Common (syn. Persian, English) walnut *J. regia* L. wildy grows in Azerbaijan in lower and middle slopes of the Major and Minor Caucasus and in subtropics of Talish Mountains.

According to Safarov (1981), the total surface of walnut forests is more than 25.000 ha in Azerbaijan. Based on fossils observation, it was approved that the walnut was spread in Azerbaijan during the Tertiary Period and it is a relict plant of Cretaceous Period. The local wild forms of *J. regia* being in basis of native walnut germplasm. The Azerbaijan selective forms are ‘Kaghizi’, ‘Katankoynak’, ‘Araz’, ‘Disar’, ‘Darvishpapag’, ‘Nazikgabig’. However, ‘Evrice’ and ‘Blecmere’ cultivars had been selected from ‘Kaghizi’ cultivar (Akparov and Musayev, 2011, Ibrahimov, 2007).

Wild grapevine - *V. vinifera* L. subsp. *sylvestris* (C. C. Gmel.) Hegi., the wild ancestor of the cultivated grapevine *V. vinifera* ssp. *sativa* D.C., is a typical plant of flora in Azerbaijan, spread widely in large areas and in the banks and shores of river, lake and sea and mountain slopes. This wild grapevine together with native varieties is interesting, while the Azerbaijan - as one of the main centre of origin and domestication of

cultivated grapevine. Confirmations of this opinion are high number of autochthonous varieties with ample diversity of berry colour and technological aptitudes; historical information; linguistic and folk data; and certainly, rich palaeobotanical and archaeological findings discovered since “*Shomutapa culture*”, dated back to VI-IV millennium BC (Pipia *et al.*, 2012; Amanov *et al.*, 2012; Dong *et al.*, 2023). Wild grape spread on the whole territory of Azerbaijan is very ancient formation. In general, more than 3000 samples of wild grapes were found in expeditionary regions and phytocenotic features of their spreading areas were described. (Musayev and Akparov, 2013.) It is spread on the territory of Azerbaijan from 18 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: *typical* Negr. (with hairs) and *aberrans* Negr. (hairless). On the banks of Kondalanchayriver in Fuzuli region dark, dark red, dark purple coloured grape seed forms were observed. At the result of investigations it was determined that, different populations of wild grape in republic of Azerbaijan, spread mainly in three locations *viz.*, tugay (streamside forest), typical broad-leaved forests and coastal area of the Caspian Sea.

Utilization of native varieties

1. **Direct fresh fruit consumption:** The fruit crops like almond, pear, medlar, wild strawberry, raspberry, blackberry, barberry, hawthorn, sea-buckthorn, hazelnut, walnut, cherry plum, cornelian cherry, chestnut, mulberry, Caucasian persimmon, pomegranate and others are directly consumed as fresh.

2. **Utilization as raw materials for processing and traditional cuisine:** wild fig, mulberry, pomegranate, walnut, sloe, apple, pear, apricot, cornelian chery, persimon, oleaster, ash berry, bilberry, current, cherry plum, cherry laurel, gooseberry, hazelnut, hawthorn, Caucasian persimon, sea-buckthorn, snowball, quince, wild rose and others. These fruits are used for preparation juice, syrup (‘Behmez’, ‘Doshab’), puree, preserve (‘Muraba’), dried fruits (‘Axta’, ‘Movuc’, ‘Alana’, ‘Mianpur’), dried layers (‘Lavashana’), jam, morse, alcoholic (Wine, ‘Araki, Liqueur) and non-alcoholic (‘Limonade’) beverages, candy, species

and souces per dishes ('Lavangi', 'Abgora', 'Sujuq', 'Narsharab'), surrogates (tea, coffee), marinade, 'Kiesel', confectionery ('Badambura', 'Halva', 'Shakarbura', 'Pakhlava', 'Fasali'), others;

3. **In a food chain as a feed for domestic animals** like sea-buckthorn, mulberry, nuts and others;

4. **Utilization in breeding**, when the old autochthonous varieties took origin from the native WR of apple, pear, apricot, pomegranate, cherry plum, quince, grapevine, sweet cherry, fig, hazelnut; and when the advanced forms for cultivation were selected within cornelian cherry, cherry plum, pear, walnut, almond in the XXth century;

5. **Utilization in rootstock selection:** the Wild Relatives of pear, apple, (peach), quince, cornelian cherry, cherry plum, sloe, Caucasian persimmon, wild rose, hawthorn are used.

6. **Utilization in for live fences** - blackberry, barberry, sea-buckthorn, hawthorn, oleaster, cherry plum, sloe, *Pyrus salicifolia* and others are used.

7. **As honey, decorative and medical plants-**suitable for making anti-erosion and wind-brake line plantations; forest garden construction.

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