

AGRICULTURAL SCIENCES

SOME OF INTERESTING MINOR FRUIT CROPS OF GEORGIA - CONSTRAINS AND DEVELOPMENT APPROACHES

Bobokasvili Z.,

Associate Professor, PhD in Agricultural Sciences

Maglakelidze E.,

PhD in Agricultural Sciences

Kakashvili V.,

Master

Tsigriashvili L.,

Bachelor,

Vakhtangashvili M.

Master.

LEPL Scientific-Research Center of Agriculture, Division of Fruit-growing Research,
Tbilisi, Georgia

ABSTRACT

The South Caucasus, to which Georgia belongs, is one of the most distinguished centers of biodiversity, where a great diversity of fruit crops is gathered. At the modern stage of fruit development, in order to increase fruit yield and improve product quality, special importance is attached to updating and perfecting the composition of fruit crops.

The minor and underutilized crops play an important role in crop diversification and development of new agricultural products. The minor crops can make significant contribution to the life of local people through diversifying and increasing their incomes. Georgia is rich with genetic resources of minor and underutilized crops too. The surveys of minor crops of economic importance, such as quince, medlars, cornelian cherry, fig, jujube, olive, actinidia and etc. Not all varieties have been used in production.

The article presents some of minor fruits (Quince (*Cydonia oblonga*. M), Medlars (*Mespilus germanica*), Cornelian cherry (*Cornus mas* L.), Fig (*Ficus carica*) deficiently cultivated in the current time in Georgia. Of these crops Distribution and general biological-agricultural characterization, which is an important topic in terms of fruit assortment diversity.

These species can make a significant contribution to improving nutrition and health, creating conditions for the regional economy, opportunities for the development of minor agricultural and processing enterprises, conditions for the reproduction, distribution and cultivation of new plant species and the reproduction of natural resources for practical use in bioenergy, pharmaceutical, cosmetic and other purposes.

The information presented in the article will help to popularize some minor fruits in the country, which will have a positive impact on the process of adaptation-introduction of new crops and their industrial development.

Keywords: fruit quality, country, variety, crop.

1. Introduction

In recent years, climate change has been felt in all countries of Central Europe, which manifests itself in various forms: an increase in the number of humid and hot "tropical" days, a decrease and uneven amount of precipitation, and many other adverse climatic factors. The above changes affect not only living conditions, but also the cultivation of plants that provide food security. Cultivation of some basic plant species and their production becomes economically risky. Climate change has a negative impact on the economy, ensuring food security, socio-economic conditions for small and medium-sized farms. One solution to this unfavorable situation is the introduction, distribution and use of less known and new plant species. To cope with the situation, dozens of fruit and plant species that are already well studied can be used. Many of these species have already created valuable varieties and hybrids. The purpose of this publication is to present some plant species that can be used in practice in many regions (Chmielewski, *et al.*, 2004; Hedhly, *et al.*, 2009).

Georgia is one of the important centers of fruit origin. The large variety of soil and climatic conditions (49 soil types and 22 climatic zones) created excellent preconditions for the adaptation of new crops. The geographical location of the country, at the crossroads of Europe and Asia, has for centuries facilitated the influx of new genetic material into the country. This is how many fruit crops were introduced to Georgia, such as peaches, apricots, cherries, plums, pomegranates, citrus fruits, etc. Which then spread widely throughout the country (Ketskhoveli, 1957).

Over the past three decades, the production and area of major fruit crops in Georgia, as well as around the world, has grown rapidly. Nevertheless, threats continue to develop in agriculture, including fruit growing, in terms of food shortages, climate change, and a reduction in farmers' financial resources. Therefore, the most important issue is in terms of agricultural sustainability and maximum utilization and targeted use of the potential of the fruit sector for the economic development of the country (Agro biodiversity of Georgia, 2015).

Therefore, it is important to test and cultivate fruit crops that are characterized by high potential for diversification and sale, as well as the ability to adapt well to the ecological conditions of Georgia. Such a number of promising crops include some less common fruit crops in Georgia, such as quince, alfalfa, fenugreek, unabi, fig, musk. These crops are the crops of the future, they need a lot of attention in order to provide food for the population and it is desirable to include them in the agricultural production cycle of the country (Vavilov, 1935; Zhukovsky, 1971).

At present, complex, field and laboratory studies of varieties of these crops are underway to renew fruit assortment and improve diversification opportunities for local farmers.

2. Some biological properties and local varieties of culture

The quince (*Cydonia oblonga*. M) – is a fruit tree species of the Rosaceae family. Already cultivated in 2000 a.c. from the Babylonians and considered sacred by the Greeks, it is native to Asia Minor and the Caucasus area (Amiri, 2008; Bassil, *et al.*, 2011; Sykes, 1972). The fruit is called quince, distinguished in quince roundish ones and quince pears the longer ones. The center of origin of cultural quince is (P. Zhukovsky) Caucasus, including Georgia (Sharashenidze, 1973).

Quince is a favorite crop globally although it does not yet compete favorably with the likes of seed fruits are apple and pear. The top three leading countries are in Asia. Turkey (135,4 thousand tones) is at the top followed by China (125,0 thousand tones) and Uzbekistan (80.0 thousand tones) in the third place. Morocco, Iran, Argentina, Azerbaijan, Spain, Serbia, and Algeria are the other countries on the top ten in terms of the crop production (FAOSTAT 2020).

The reason why quince is less widespread in the world is that it is a heat-loving, less frost-resistant plant and its distribution area is quite limited.

The quince plants need a full sun exposure to better vegetate while it is very rustic also in relation to the climate, tolerating also the return of spring cold and particularly cold winters. The quince still requires a minimum period of vernalization of 100 hours of cold below 7 degrees during the winter, while a good flowering is required from 250 to 350 hours (Hernández, 2001; Anonymous, 2003; Roach, 1985).

Although rustic plant from the best production in medium-textured soil well-endowed with organic substance that is administered in pre-implantation with 10-12 kg of mature manure inside the individual holes. It tolerates calcareous soils that cause extensive chlorosis, poor fruiting and less fruit size, so the pH of an optimal soil should be between 5 and 6.5. As for the water supplies, even if plant able to vegetate even without artificial inputs, because of its deep and extensive root system, it is appropriate to intervene in the summer period in the early years. The use of irrigation, if necessary, must be done considering that it is necessary to prolong the hours of watering in order to be really useful to the deep root system. (Postman, 2012; Sykes, 1972; Roach, 1985).

In most regions of Georgia there are favorable conditions for growing quince. Quince orchards are cultivated both in the eastern and western regions of Georgia, their area is within 3 thousand hectares, and the average annual production is 1.4-1.7 thousand tons (2020-2021). Regions such as Kakheti (Lagodekhi, Kvareli, Akhmeta), Shida Kartli (Gori, Kareli, Khashuri), Imereti (Sachkhere, Chiatura, Vani, Samtredia), Racha-Lechkhumi and Svaneti (Oni, Ambrolauri, Lentekhi) etc. are especially famous for quince production. Georgia is rich in local gene pool. Several types of local varieties are known in “Vashlakomsa”, “Georgian sour” and “Malachini”. Also known as the summer, autumn and suffocating quince group, and others. Currently, 12-16 local and introduced varieties are mainly distributed in the industrial gardens of Georgia. (GEOSTAT, 2020, Agro biodiversity of Georgia, 2015).

Kartuli Mzhave - a variety of local origin, the tree has strong growth, is characterized by mesquite leaves and rounded shape. The fruits are harvested in late October and stored until spring. The fruit is of medium thickness, rounded apple-shaped, the skin is weakly scaly, the pulp is light yellow, dense, slightly juicy, the taste is sour, characterized by a strong aroma. It is a canned variety. Distributed in Eastern Georgia

Sakompote - a variety of local origin, the tree is of medium growth, characterized by a rounded shape. The fruits are harvested at the end of September and consumed immediately. Stored for 1-1.5 months. The fruit is of medium thickness, rounded in shape, skin - of medium thickness, yellow in color, very oily and plump, pulp - whitish-yellowish, juicy, taste - sweet, characterized by aroma. It is a canned variety. Distributed in Eastern Georgia

Malachina - a variety of local origin, the tree is of medium growth, the fruits are harvested in late September and stored until mid-January. The fruit is medium-sized, rounded-pear-shaped, the skin is thick, dense, yellowish (slightly greenish in color). The surface is greasy, less coated. The pulp is whitish-yellowish, dense, juicy, the taste is extremely sweet, characterized by a good aroma. Consumed both raw and canned. Distributed in Eastern Georgia.

Shilduri - a variety of local origin, the tree is of medium growth, the fruits are harvested in late October and stored until February. The fruit is large, rounded, pulp - whitish-yellowish, dense, juicy, sweet-sour taste, characterized by good aroma. It is a canned variety. Survived only in collectible plantations.

Medlars (*Mespilus germanica*) is a plant with a long history. It is known to have been around for over 3000 years and the fruit was commonly eaten from Roman through to Medieval times when it was quite popular. *Mespilus germanica* might have been cultivated in the Caspian Sea region of Northern Iran and the Black Sea. Among them, the Caucasus is considered to be the beginning of culture, where plant remains were found during geological excavations. (Schaefer, 2015; Voaides, *et al.*, 2021)

Many cultural forms of ryegrass are widespread in Georgia, however, the medlar culture in Georgia did not have a significant industrial significance. Due to its

low prevalence, we do not have statistical information about the area. Although marjoram is an old crop, the variety has few (several dozen). Common in Georgia: small, cylindrical and large forms. As a fruit crop, ryegrass deserves more attention. (Abramishvili, 1973; Fruits of Georgia, 2001).

This plant is cultivated for its medicinal and nutritional properties. Medlar has been recently cultivated due to good potential for diversification of fruit production among the minor pome fruits. The species is subjected to high risk of erosion, since it is characterized by low genetic diversity (Baird and Thieret 1989).

The Medlar has successfully spread to regions as diverse as south-east Asia to north-west Europe. Black Sea, Caucasus, Western Asia. Cultivated as a fruit tree and widely introduced in European and Mediterranean countries, where it is frequently naturalized. Also introduced locally in North and South America. That plant will not produce fruit in tropical climates as it requires winter chill (similar to apples) to flower. They grow well, crop well and produce good quality fruit in nearly all parts of Europe. They should always be planted in full sun for optimal fruit production but will produce good quantities of fruit in partial shade (4-6 hrs of direct sunlight a day) (Atay, 2013).

Mespilus germanica requires temperate and sub-mediterranean climate conditions with warm summers and mild winters. Air temperatures of 18 to 20 °C are mentioned as favourable for growth, cold of as low as -20 °C is tolerated and late frosts hardly cause any damage. Medlars like to be out in the sunshine, so choose an open, sunny site. If they are in light or dappled shade the fruit crop will be reduced and you won't get that lovely, golden autumn colour. For optimum fruit production plant in a sunny position. Young trees planted out in the spring or autumn need regular watering while establishing. The soil should be free draining as the plants will not grow well in waterlogged soils and will tolerate a wide range of soils except for very alkali or chalky soils. Free drainage is essential, as they dislike waterlogging (Akbulut *et al.*, 2016)

The wild form was observed in dry areas with annual precipitation of 700 mm and at altitudes from 0 to 1,100 m. The species grows in a wide range of soil types and prefers fresh, well-drained loamy soils with a pH that is between 6 and 8.

Mespilus germanica requires temperate and sub-mediterranean climate conditions with warm summers and mild winters. Air temperatures of 18 to 20 °C are mentioned as favourable for growth, cold of as low as -20 °C is tolerated and late frosts hardly cause any damage. Medlars like to be out in the sunshine, so choose an open, sunny site. If they are in light or dappled shade the fruit crop will be reduced and you won't get that lovely, golden autumn colour (Atay, E.2013).

Cornelian cherry (*Cornus mas L.*), is a species, of flowering plant in the dogwood family Cornaceae, native to Southern Europe and Southwestern Asia. (Ercisli, 2004)

It is reliably known that already in Ancient Rome and Ancient Greece, dogwood was grown precisely as

a cultivated plant, even the first breeding work was carried out there, which consisted in the banal selection of the most large-fruited plants from among the seedlings and their subsequent reproduction. The generic name 'mas' comes from the Latin for 'man' (masculus). This may refer to the hard wood, which was used to make spears (Da Ronch and *et al.*, 2016; Brindza and *et al.*, 2007; Klimenko, 1990; Schaefer and *et al.*, 2015).

Cornelian cherry (*Cornus mas L.*) is a widely spread species. .) Distributed from France to Central Europe to the Black Sea. Introduced in the UK and Eastern US. There are about 65 species of dogwood (*Cornus*) representing a morphologically diverse. It can also be commonly found all over Europe outside its natural range, as it has been exported for centuries first as a fruit and pharmaceutical plant, then as an ornamental shrub, and is now naturalised in some countries⁴. Although its natural northern limits are Belgium and Germany, it has been planted in colder regions: e.g. in Oslo, Cornelian cherry trees in parks and gardens ripen every year (Meusel and *et al.*1998; Klimenko, 2004). It has also been exported to North America as a landscape ornamental (Sargent, 1961; Mmbaga and Nnodu, 2006) and to China as an ornamental tree and for medical uses (Xiang and Boufford, 2005).

Various forms and varieties of Cornelian cherry grow in the Caucasus. Shind has been known in Georgia since time immemorial. The climatic conditions in Georgia are favorable for the proper growth and yielding of this long-lived plant. Even the early flowering period does not limit the quantity of the cornelian cherry yield. Nevertheless, industrial plantations are not found in Georgia. Cornelian cherry practically does not require chemical treatment. Cultivation in combination with an integrated farming system makes it possible to minimize the use of pesticides and obtain environmentally friendly products. The study of biological features makes it possible to reveal the potential of species in new soil-climatic conditions and develop a set of measures for the creation of industrial plantations (Agro biodiversity of Georgia, 2015).

Unlike many fruit crops, Cornelian cherry prefers a neutral and slightly acidic soil solution, feels great on slightly alkaline soils. Therefore, it is often referred to as a calciophil. At the same time, it grows well on slightly acidic soils. Cornelian cherry generally prefers warm and dry climates and can occur at altitudes from sea level up to 1500 m. Cornelian cherry is classified as a frost-resistant plant that tolerates temperatures as low as -30 °C. However, it is negatively affected by winter thaws and the early onset of spring with the return of cold weather. Rains and fogs during flowering have an adverse effect on the fruiting of the dogwood, preventing the normal flight of the bee, and therefore, pollination and fertilization. Dogwood is a drought-resistant plant, a powerful fibrous root system, located in the upper soil horizon, is able to use even slight rainfall, but during a long dry period, its leaves curl, sometimes the fruits dry out, and flower buds may not form (Dokoupil and Řezníček 2012).

In the forests of Georgia, fennel is spread in both the eastern and western parts, in the forests of the lower and middle mountain belt up to 1350 m above sea level.

From the forms of the Shindi forest, as a result of folk selection, varieties with high agricultural characteristics were selected, which are mainly propagated on homestead plots (Sanadze and Shatirisvili 1978). These varieties are: Mereti Round, Okroshinda, Black Early, Black Late, Red Early.

Bottle shaped Cornel. The fruits reach technical and consumer maturity in late October and mid-October. At full maturity it takes on a dark cherry color.

The fruit is oblong-bottled, with 7 stems well depicted at the end. The "bottle neck" is quite bent and slightly flattened. The concave side of the fruit is almost always exposed to the touch of the sun's rays. It is the best samurai variety.

Meretuli mrgvali. The fruit ripens in the third decade of September. The fruit is barrel-shaped, slightly oval towards the stalk, and sharply cut towards the tip. It is the best samurai variety.

It was golden. The fruit ripens by 15 September. The fruit is cylindrical in shape, more strongly pointed towards the beard, yellow-amber. It is the best samurai variety.

Shavi Adreuli. The fruits ripen in mid-August. At full and technical maturity, the fruit is dark cherry, almost black. The crest is elliptical, truncated on the side of the stalk, pointed towards the beard. It is a samurai variety.

Shavi Sagviano. The fruit ripens by October 20th. The fruit is dark cherry-black in technical and consumer ripeness. It is the best sa-jam variety.

Fig (*Ficus carica*) – plant of the mulberry family (Moraceae) and its edible fruit is one of the first cultivated trees in the world, is grown in many parts of the world with moderate climates. The history of the fig can be traced back to 5000 B.C., and some historians consider figs to be one of the first domesticated crops (Gozlekci, 2011).

The East Greece, Italy Mediterranean region is considered to be the area of the common fig domestication (Ercisli *et al.*, 2012), and from there the cultivation spread to the West Mediterranean area, where fig populations were already present in natural habitats before domestication. The process of domestication resulted in sweeter and bigger fruits (Falistocco, 2009; Duron and *et al.*, 1989).

The world production of figs is next to 1 million tons. Approximately 90% of this production comes from the countries of the Mediterranean basin and the Middle East. The most important producers are in the Turkey, (278 thousand tones) Algeria (69 thousand tones), Spain (60 thousand tones); Greece, Italy (35 thousand tones) and the United States (42 thousand tones) mainly California, are also important.

Three other varieties of *Ficus carica* are: **Capri-fig** (*Ficus carica sylvestris*). They're not useful as fruit producers on their own, caprifigs are indispensable as pollinators of other types of fig trees. **Smyrna fig** requires cross-pollination by Caprifigs in order to develop fruit. **San Pedro fig** produces two crops of fruit each season. The first crop grows on old branches and fruit develops without cross-pollination. Later in the season, the trees produce a second crop of fruit on new growth, but this crop will usually drop from the tree before it matures if cross-pollination hasn't occurred (Aksoy and *et al.* 2003).

Figs require full sun to grow and need a dry climate with light early spring rains. A wet season during

fruit ripening will hurt the crop, causing the fruits to split and spoil. Semi-arid climates with warm temperatures are perfect for growing figs if irrigation is available. Fig tree grows in a wide range of soils from light sands to richly organic loams and heavy clays, if there is adequate drainage. Highly acidic soils are not recommended and are not tolerated. The pH should be between 6.0 and 6.5. Figs can handle some moderate salinity, making them suitable for coastal planting but not shorefront landscapes. Fig trees are quite drought tolerant and do not require much water for most of the year. However, they will prefer consistently moist soil when there is fruit on the tree. Inadequate moisture will affect the fruit quality and size (Lianju and *et al.*, 2003; Aksoy and *et al.*, 2003; Veberic and *et al.*, 2016).

Fig cultivation has been practiced in Georgia since time immemorial. It is especially common in western Georgia (Imereti) and eastern Georgia (Kakheti) as well as in the suburbs of Tbilisi.

Some local fig varieties in Georgia give two crops. The fruits of the first crop are called gouda figs. The following local varieties are widespread: Kakhetian white, Arabic, Chumlakuri green, Kakhetian black, Kadota, etc. (Sanadze and Shatirisvili, 1978; Chkhaidze, 1998). Although the industrial purpose of fig culture is limited in Georgia, the following varieties can still be found:

Abkhazian Violet is widespread on the Black Sea coast, the tree is strong growing, ripens in late August, the fruit is pear-shaped or rounded, large, pulp dark red-dish pink, the best table variety.

Smena- is an introduced variety, ripening in late August, the duration of ripening does not exceed one month, the fruit is large, rounded oval in shape, with a short stalk. The skin is yellowish in color, the pulp is pink, with a gentle and pleasant taste. Included in the recommended assortment.

Chafila - Turkish variety, ripens in mid-August, the fruit is medium-sized, yellowish-brown, the skin is medium-thick, rounded oval, the fruit of the second crop is elongated, slightly convex, a good table variety.

Kakhetis TeTri fig is a Georgian variety, it has two crops, the first harvest is in spring, the second harvest is in July, the fruit is of medium thickness, rounded, the skin is of medium thickness, the pulp is yellowish, fragrant, the best dried fruit is made from it. Included in the recommended assortment.

Conclusion:

Climate change has a negative impact on the economy, ensuring food security, socio-economic conditions for small and medium-sized farms. One solution to this unfavorable situation is the introduction, distribution and use of less known and new plant species. To cope with the situation, dozens of fruit and plant species that are already well studied can be used. Many of these species have already created valuable varieties and hybrids. The purpose of this publication is to present some plant species that can be used in practice in many regions.

References

1. Abramishvili M., (1973). The Medlar. In: Khomizurashvili, N. (Ed), Fruit Growing. In four volumes. Volume 3 – pome fruits. Tbilisi, pp:607- 621 (In Georgian, Russian, English).
2. Agro biodiversity of Georgia (2015). (Catalog) Tbilisi, pp: 10-32.
3. Akbulut M., Ercisli S., Jurikova T., Mlcek J., Gozlekci S. (2016). Phenotypic and Bioactive Diversity on Medlar Fruits (*Mespilus germanica* L.) Erwerbs-Obstbau. 3. pp: 185–191.
4. Aksoy U., Balci, B., Can, H., Hepaksoy, S. (2003). Some significant results of the research-work in Turkey on. *Acta Hort.* 605. pp: 173-181.
5. Amiri, M. (2008). The status of genetic resources of deciduous, tropical, and subtropical fruit species in Iran. *Acta Horticulturae* 769 pp: 159–167.
6. Anonymous (2003). Guidelines for the conduct of tests for distinctness, uniformity and stability of quince (*Cydonia* Mill.). International Union for the Protection of New Varieties of Plants, Geneva, Switzerland. 25.
7. Atay, E. (2013). Phenological stages of medlar (*Mespilus germanica* L. ‘İstanbul’) according to the BBCH scale. *Journal of Biological & Environmental Sciences* 7(20). pp: 103-107
8. Baird J., Thieret J. (1989). The Medlar (*Mespilus germanica*, Rosaceae) from antiquity to obscurity. *Economic Botany*. 43(3). pp: 328–372.
9. Bassil N., Postman J., Hummer K., Mota J., Sugar D. (2011). Quince (*Cydonia oblonga*) genetic relationships determined using microsatellite markers. *Acta Hort.* 909, pp: 75-84.
10. Brindza P., Brindza J., Tóth D., Klimenko S., Grigorieva O. (2007). Slovakian Cornelian Cherry (*Cornus mas* L.) Potential for Cultivation Proc. XXVII IHC-S1 Plant Gen. Resources. *Acta Hort.* 760, ISHS.
11. Chkhaidze G. (1998) Subtropical Crops. Tbilisi, pp:212-355
12. Chmielewski, F., Müller, A., Bruns, E. (2004). Climate changes and trends in phenology of fruit trees and field crops in Germany, 1961–2000. *Agricultural and Forest Meteorology* 121(1-2), pp: 69-78
13. Da Ronch F., Caudullo G., Houston Durrant T., De Rigo D. (2016). *Cornus mas* in Europe: distribution, habitat, usage and threats. *European Atlas of Forest Tree Species*. Publ. Off. EU, Luxembourg, pp: 82-83
14. Ercisli S. (2004). A short review of the fruit germplasm resources of Turkey. *Genet Resour Crop Evolution* 51(4), pp: 419-435.
15. GEOSTAT (2020). Geostatic National Statistics Office of Georgia. www.geostat.ge
16. Gozlekci S. (2011). Pomological traits of fig (*Ficus carica* L) genotypes collected in the west Mediterranean region in Turkey. *The Journal of Animal and Plant Sciences* 21, pp: 646–652.
17. FAOSTAT 2020. FAOSTAT. Food and agricultural organization of the United Nations. Available at: <http://faostat.fao.org>
18. Fruits of Georgia (catalog). (2001) F. Edited by Kvaliashvili. Tbilisi, pp:34-44. 10.
19. Hernández, F.C.A. (2001): Phenological stages of the quince tree (*Cydonia oblonga*). *Annals of Applied Biology* 139(2): 189-192.
20. Hartmann, H.T., and Panetsos C. (1961). Effect of soil moisture deficiency during floral development on fruitfulness in the olive. *P. Am. Soc. Hort. Sci.* 78, pp: 209-217.
21. Hedhly, A., Hormaza, J.I., Herrero, M. (2009): Global warming and sexual plant reproduction. *Trends in Plant Science* 14(1), pp: 30-36.
22. Ketskhoveli N. (1957). Zones of Cultivate3d plants in Georgia (in Russian). Tbilisi, pp: 92- 120.
23. Klimenko, S (1990). *Kizil na Ukrajine* (Cornelian cherry in Ukraine). Kyjev: Naukova Dumka, pp: 174.
24. Klimenko S. (2004). The cornelian cherry (*Cornus mas* L.) Collection, preservation and utilization of genetic resources. *Fruit Ornament Plant Res (Spec Ed)* 12, pp: 93–98.
25. Lianju W. Weibin, J. Kai M. Zhifeng, L. Yelin, W. (2003). The production and research of Fig (*FICUS CARICA* L.) in China. *Acta Hort.* 605, pp: 191-196
26. Meusel H, Jäger E, eds (1998). *Vergleichende Chorologie der Zentraleuropäischen Flora - Band I, II, III* (Gustav Fischer Verlag, Jena).
27. Mmbaga M, Nnodu E. (2006) *HortScience* 41, PP.721
28. Postman, J. (2012). Quince (*Cydonia oblonga* Mill.) center of origin provides sources of disease resistance. *Acta Hort. (ISHS)* 948, pp: 229-234.
29. Roach F. (1985). Quinces. In: *Cultivated Fruits of Britain: Their Origin and History*. Blackwell, London pp: 220–225.
30. Sanadze K., Shatirisvili L. (1978). Cornel (*Cornus mas* L.). In: Khomizurashvili, N. (Ed), Fruit Growing. In four volumes. Volume 4 – stone fruits. Tbilisi, pp. 386-496 (In Georgian, Russian, English).
31. Sanadze K. Shatirisvili L (1978). The Fig. In: Khomizurashvili, N. (Ed), Fruit Growing. In four volumes. Volume 4 – stone fruits. Tbilisi, pp: 768-802-496 (In Georgian, Russian, English).
32. Sargent C. (1961). *Manual of the Trees of North America (exclusive of Mexico)*, vol. 2 (Dover Publications, New York, second edn.
33. Schaefer K., Nyberg A., Postman, N., Bassil (2015). Genetic Diversity of Medlar (*mespilus germanica*) germplasm using microsatellite markers *ISHS Acta Horticulturae* 1094. 3.
34. Sharashenidze D. (1973). The Queens. In: Khomizurashvili, N. (Ed), Fruit Growing. In four volumes. Volume 3 – pome fruits. Tbilisi, pp: 507-597 (In Georgian, Russian, English).
35. Sykes, J. (1972)., A description of some quince cultivars from western Turkey. *Economic Botany* 26. pp:21–31.
36. Vavilov N. (1935). Theoretical basis of plant breeding. Volume I, (in Russian). Moscow, pp:26-79.
37. Xiang O., Boufford D. (2005). *Flora of China*. Text Volume 14, Apiaceae through Ericaceae, F. of China Editorial Committee, ed. (Missouri Botanical Garden), pp: 206–221.
38. Zhukovsky P. (1971). *Cultivated plants and their relatives*. Moscow. Kolos publishing house, pp: 481-565 (in Russian).