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BIOLOGICAL AND AGRICULTURAL CHARACTERIZATION OF INTRODUCED VARIETY„WEIKI" (Actinidia arguta Planch) IN GEORGIA

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Summery. Today, the most important task of agricultural development, along with traditional crops, is to facilitate the introduction and testing of highly adaptive crops with a competitive advantage in the country, such as Kiwiberry.

The article presents the first study of the biological and agricultural properties of the "Baby Kiwi" variety (Actinidia arguta Planch.) Weiki in Georgia. It evaluates the adaptability of Kiwi plants to the environmental and climatic conditions of Eastern Georgia. The research was carried out in a collection orchard located in one of the leading fruit-growing regions of Georgia, Shida (Inner) Kartli (village Jighaura, Saguramo, Mtskheta municipality), and belongs to the LEPL Scientific-Research Center of Agriculture (SRCA) from 2019 to 2023.

Keywords: flowering; ripening; yield; fruit; size.

Introduction

In recent years, Georgia has actively begun producing exotic fruits. Exotic fruit varieties include subtropical and tropical fruits that have not had a commercial impact until now. Actinidia is one of these promising crops [1, 9].

Actinidia production in Georgia started relatively late, in the 1980s and 1990s, in the Black Sea region. The high price of the fruit and the increase in demand motivated many farmers to plant this crop. It thrives well in both western and eastern Georgia, but the main producers are in the subtropical regions of western Georgia [4 9]. The total area of actinidia plantations in Georgia is 250 hectares, with an annual yield of 1,500-1,700 tons [10].

The genus *Actinidia* (*Actinidia* Lindl.) includes more than 60 species, of which only three have been successfully cultivated worldwide: Chinese Actinidia (*A. chinensis* Planch.), *Actinidia deliciosa* (*A. deliciosa* (A. Chev.) C.F. Liang et A.R. Ferguson), and mini kiwi, or Baby kiwi that is, as it is called (A. arguta (Sieb. et Zucc.) Planch.) [8, 28].

A. arguta was discovered in the late 19th century outside East Asia, its native habitat. The species soon gained popularity. It belongs to the Leiocarpae group, is a polyploid species (2n, 3n, 4n), and consists of morphologically different variants found in geographically diverse regions. It is found in eastern Siberia, Korea, Japan, and China. In Siberia and northern China, it extends almost to sea level, and in the southern regions, up to 3,500 meters above sea level [7, 11, 14].

The limited commercial cultivation of A. arguta, in contrast to varieties of other species (A. chinensis or A. deliciosa), can be explained by its challenging care requirements, which are due to its biological characteristics. These include irregular fruit ripening, limited shelf life, and the small size of the fruit, which affects its marketability [5, 6, 12].

Currently, commercial cultivation of A. arguta takes place in the USA (mainly in Oregon), Europe, New Zealand, and South America. The global area occupied by A. arguta varieties is 200 hectares [3]. In addition to Baby (mini) kiwi, this species is also known by several popular names, including cocktail kiwi, strong kiwi, raisin, liana kiwi, tara, and waiki [27].

The fruit has a sour-sweet taste and a special aroma. It attracts attention due to its high content of vitamin C. Based on research, several authors [13, 18, 24] note that the content of vitamin C in fruits is high, averaging 45 mg/100 g.

A. arguta is classified as a superfruit, containing more than 20 essential nutrients and a number of vitamins. It is one of the products rich in vitamin C (430 mg/100 g). The fruit also contains a large amount of lutein (0.93 mg/100 g), phenols (1301.1 mg/100 g), antioxidants, organic acids, and minerals (potassium, calcium, zinc, etc.), which is very important from a commercial point of view. The fruit is used both raw and in the processing industry [19, 21]. Actinidia arguta (A. arguta) is a very rare species due to some biological features. It is characterized by good reproductive ability, high frost resistance (it is the most frost-resistant of the Actinidia genus), and good resistance to pests and diseases, which contributes to its broad development [2, 22, 23].

Materials and methods

The object of the study is the introduced variety of "Baby Kiwi" variety, Weiki. The study of the variety has been carried out in the collection plot of the Scientific - Research Center of Agriculture, East Georgia, located in the village Jighaura of Saguramo (Mtskheta municipality, Shida Kartli) during 2019-2023. The orchard has been established with 5.0 x 2.5 m planting layout in 2012. The ratio of male to female plants is 1:5. For the study, In the collection were represented with 35 plants were attached to a 3-wire horizontal trellis.

The orchard of village Jighaura is located in the eastern part of Shida Kartli, on the 630 m above sea level. The zone characterized by warm climate, moderately humid air, cold winter and hot summer is appropriate for cultivation of stone fruits. The average yearly temperature is 10.8 ^{0}C, the absolute minimum temperature is -17.8 ^{0}C. The soil was alluvial calcareous, characterized by low organic matter content (less than 3% in humus). Texture content of the soil is granular - cumulose. It is characterized by lightweight structure, good physical properties and sufficient moistness.

Phenological development of cultivars was done according to the modified version of the BBCH scale [16]. The calendar periods of the following phenological phases have been studied: swelling of bud, flowering, fruit ripening.

Pomological characteristics of cultivars were collected by instructions of UPOV (2012) harmonized descriptors for Kiwiberry.

Fruit characteristics were measured on fruits harvested in full maturity stage. The samples of 30 fruits per from each tree harvested randomly. Fruit samples were taken during harvest time for determining of physical properties (length and width of fruit, weight). Fruit length and width was measured by caliper in mm, respectively. Fruit weight was measured for each fruit in gram totally for 30 fruits and average was calculated.

Productivity characteristics of variety was studied according to Program and methods cultivar fruit, berry and nut crops [20]. Productivity were studied according to following parameters: the yield per tree and yield efficiency, were computed from the harvest date. Harvest date, the date when fruits have full (commercial) maturity stage.

Biochemical analysis of cultivars was carried out for detection of dry soluble solids, total sugars, inverse sugars and titratable acidity. The soluble solids were determined by refractmeter, (PAL-1, Atago, Tokyo Tech) and expressed as degree Brix (°Brix). Total sugar content and inverse sugars content were measured according to Luff - Schoorl method [25].

Statistical analyses. The mean values of the studied properties were determined. Statistical differences among cultivars were verified using ANOVA for each year separately. When the F-test was significant, means were compared with the LSD test at $P = 0.05$.

Results and discussions

A. arguta is a liana by its morphological structure. The liana is characterized by strong growth. The shoots are large and long, with smooth, non-wrinkled skin. The leaves are beautiful, large, dark green, and shiny, with red stalks that give the plant a decorative appearance. The flowers are sharply white and large in size [2, 12, 22].

The fruit is of medium size (weight 7-10 g) and cylindrical in shape (H 2.8 x D 2.2 cm). The skin is of medium density, green in color with a dark brown tint on the sunny side. The pulp is green with a large number of black seeds. The fruits are sweet, with a pleasant taste. Its biochemical composition is simple and as follows: soluble dry matter - 8.7-10.7% (Brix); sugar 8.8-12.1 g/100g.[15]

The variety begins to bear fruit in the third year after planting, with a high yield. According to research, the average yield per plant is determined to be 10-12 kg. It blooms in the second decade of May (under conditions of V. Jighaura). It is the best pollinator for all types of mini kiwi and is moderately resistant to harmful diseases.

The variety is an excellent dessert fruit. The fruit ripens in the first decade of October (in the conditions of V. Jighaura) and can be stored in refrigerated conditions (0-1°C) for up to 2-3 months. The results of five years (2014-2016) observations on calendar periods of phenological stages have shown that the cultivas begin vegetation (bud ripening) on average in the third decade of March. Depending on the years (2019-2023), the difference in the beginning of the vegetation period is 4-5 days. The variety starts flowering at the beginning of May (05-08.05) and lasts 8-10 days on average. The difference between the flowering of male and female flowers is 4-5 days. During the study the periods of flowering are quite variable. The mostearly flowering began in 2021 (16^{th} March) and the most lately in 2019 (3^{th} April). The sum of active temperatures during the flowering period is 86-120 ^{0}C. Intensity of flowering has been estimated together with determination of periods of flowering. The high intensities (4-5 mark) of flowering characterize the cultivar.

Yield is the most important economic characteristic of a cultivar that determines its economic value. Besides the peculiarities of cultivar and climatic conditions it depends on agronomical activities and on a rootstock [6]. The study of the period of picking and mass ripening showed that the Weiki variety reaches mass ripening in the second decade of October (12-18.10). To extend the period of fruit softening and storage, picking should be done 3-4 days before mass ripening. Defoliation begins in the third decade of October and lasts until the end of November.

The variety starts yielding quite early, in the 3rd to 4th year after planting, and reaches full productivity in the 6th year. It is characterized by regular and abundant yield. A mature plant gives an average yield of 9.2-11.4 kg.

The morphological study of the fruits showed that the fruits are large, elongated cylindrical in shape (diameter - 21-23 mm), and slightly flattened on the sides. The average weight is 7.5-10.2 grams. By biochemical analysis of the fruit, it was determined that the content of soluble dry matter varies between 19.0-21.4%, and titratable acidity is 1.03-1.25%. Under standard agrophone conditions in the garden, the study of the variety's susceptibility to diseases showed that it is less affected by pests and diseases. With Phytophthora (Phytophthora infestans), the degree of damage is on average 2.40 points. Among pests, damage by thrips and aphids is observed, which is insignificant, but for control, it is necessary to carry out plant protection measures.

As a result of the tasting evaluation of the fruits, it was found that the pulp of this variety has high taste qualities, with a sweet, balanced acidity, and is quite aromatic. The pulp texture is dense, the appearance of the product is good, and the skin is intact. The overall tasting rating is 8.7 (on a 10-point scale).

Conclusions

The first results of five- year (2019-2023) research some biological and agricultural properties of mini kiwi, Weiki, it can be concluded that this variety is among the best dessert fruits,

characterized by early maturity, regular and abundant yield, good taste qualities of the fruit, storage capacity, and resistance to fungal diseases.

According to the primary study, we can conclude that the Weiki (Actinidia arguta Planch.) cultivar can be successfully grown in Shida Kartli and other regions with similar ecological conditions in Georgia.

References

1. Agro biodiversity of Georgia (2015). (Catalog) Tbilisi, pp: 10-32.
2. Bieniek A. (2012) Yield, morphology and biological value of fruits of *Actinidia arguta* and *Actinidia purpurea* and some of their hybrid cultivars grown in north-eastern Poland. In: *Acta scientiarum Polonorum Hortorum Cultus*, 11(3):117-130.
3. Chesoniene L., (2000): Comparison of some biological features and fruiting potential of *Actinidia kolomikta* cultivars. In: *Acta Hort*. 538: 769–774.
4. Chkhaidze G. (1998) Subtropical Crops. Tbilisi, pp: 482-495.
5. Debersaques F.and Mekers O.(2003) Growing and production of kiwifruit and kiwi berry. Encyclopedia of Life Support Systems (EOLSS) Vol.II .
6. Ferguson A.R., (1999) Kiwifruit cultivars: breeding and selection. In: *Acta Hort*. 498, 43–51.
7. Ferguson, A.R. and Huang, H. (2007). Genetic Resources of Kiwifruit: Domestication and Breeding. In: *Hortic. Rev.* 33: 1-121.
8. Ferguson, A.R. and Seal, A.G. (2008). Kiwifruit. In: J. F. Hancock, ed. Temperate Fruit Crop Breeding. Chapter 8: 235-264.
9. Fruits of Georgia (catalog). (2001) F. Edited by Kvaliashvili. Tbilisi, pp: 34-44. 10.
10. Geostat (2022). Geostatic National Statistics Office of Georgia. 2022. www.geostat.ge)
11. Jo Y.S., Ma H.S., Cho H.S., Park J.O. (2007). 'Chiak', a new selection of *Actinidia arguta*. In: *Acta Horticulturæ* 753: 259–262.
12. Latocha, P. (2007). The Comparison of Some Biological Features of Actinidia arguta Cultivars Fruit Ann. Warsaw Univ. of Life Sci.- SGGW Hortic. and Landscape Architecture, 28: 105-109.
13. Latocha, P. (2008). Frost resistance and spring frost sensibility of a few cultivars of *Actinidia* grown in Central Poland. Annals of Warsaw University of Life Sciences – SGGW Horticulture and Landscape Architecture, no 29: 111–120.
14. Latocha P., Jankowski P. 2011. Genotypic difference in postharvest characteristics of hardy kiwifruit (*Actinidia arguta* and its hybrids), as a new commercial crop. Part II. Consumer acceptability and its main drivers. In: *Food Research International* 44: 1946–1955.
15. Latocha P. 2017. The Nutritional and Health Benefits of Kiwiberry (Actinidia arguta) – A Review. P*lant Foods for Human Nutrition* 72: 325-334.
16. Maghlakelidze E, Bobokashvili Z. Characterization and development perspectives of "Baby Kiwi" (*Actinidia arguta* Planch.) Culture in Georgia (2023) Georgian scientists Vol. 3.Nov 4.
17. Meier U. (2001) Growth Stages of Mono and Dicotyledonous Plants. BBCH Monograph, Federal Biological Research Centre for Agriculture and Forestry, Bonn.
18. Nishiyama I., Yamashita Y., Yamanaka M. et al. (2004): Varietal difference in vitamin C content in the fruit of kiwifruit and other *Actinidia* species. In: *J. Agric. Food Chem*. 52/17: 5472–5475.
19. Okamoto G., Goto S., (2005). Juice Constituens in *Actinidia arguta* Fruits Produced in Shinjo, Okayama. Sci. Fac. Agr. Okayama Univ. 94, 9–13.
20. Program. (1999). Program and methods Cultivar fruit, berry and nut crops. Orel, 1999. pp. 430-486. (In Russian).
21. Testolin, R. and Fergusson, A.R. (2009). Kiwifruit (Actinidia spp.): Production and Marketing in Italy. In: *New Zealand J. Crop Hortic. Sc*., 37: 1-32.
22. Tiyayon C., Strick B. (2003). Flowering and fruiting morphology of hardy kiwifruit *Actinidia arguta*. In: *Acta Hort*., 610, 171–176.
23. Stanica F., Zuccherelli G. (2007). New selections of Actinidia arguta from the romanien breeding program. In: *Acta Horticulturæ* 753: 263–268.
24. Strik B., Hummer K.E., (2006). 'Ananasnaya' hardy kiwifruit. J. Am.Pom. Sci., 60 (3), pp.106–112.

25. Shirokov E.P., Polegaev V.I. (1989) Storage and processing of fruits and vegetables. M., Agropromizdat. pp. 111-134
26. UPOV (2012). International Union the Protection of New Varieties of Plants. Actinidia UPOV Code: Actin Actinidia Lindl. TG/98/7.
27. Williams, M.H., Boyd, L.M., McNeilage, M.A. et al. (2003). Development and commercialization of baby kiwi (*Actinidia arguta* Planch.). In: *Acta Horta* (ISHS) 610: 81-86.
28. Xiao X-G. (1999). Progress of *Actinidia* selection and breeding in China. In: *Acta Horticulturæ*, 498: 25–51.