

Breeding of subtropical (*Diospyros kaki* L., *Feijoa sellowiana* Berg) and citrus crops (*Citrus reticulata* Blan. var. *unchiu* Tan.) in FRC SSC of RAS

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Abstract. This paper presents the results of the breeding work carried out by the Subtropical Scientific Centre of the Russian Academy of Sciences. The purpose of the research is to improve the assortment of subtropical and citrus crops. The objects of research were 230 hybrid forms, of which citrus - 138 hybrids, persimmons - 56, feijoa - 36. Currently, the breeders of the FRC SSC of RAS are working hard to develop new winter-hardy, high yielding, and high-quality cultivars resistant to growing conditions. The sources of priority traits have been identified, which are included in hybridization for the development of new cultivars with improved economic and biological traits. Over the past 5 years, the State Register of Breeding Achievements of the Russian Federation has included 3 cultivars of feijoa and 1 cultivar of kaki persimmon created in the Centre. On the test are 3 promising forms of tangerine, 2 feijoa and 1 form of kaki persimmon.

1 Introduction

Breeding of subtropical (kaki persimmon, feijoa) and citrus crops is a long-term and continuous process, its main tasks are determined by the increasing requirements of intensive horticulture, the main ones are: early ripeness, early maturity, stable fruiting, restrained tree growth, resistance to biotic and abiotic stressors, as well as high quality fruits. Fruits are of great value as rich in sugars, acids, vitamins, pectin and bioactive substances [4; 10]. It is possible to speed up the breeding process by involving the sources of biologically and economically significant traits of persimmon, feijoa and citrus crops from different growing zones [2; 3; 5]. Genetic collections of many crops, including citrus fruits, kaki persimmon and feijoa have been created on the basis of FRC SSC of RAS, where cultivated plant species and cultivars, as well as their wild relatives, which are carriers of valuable traits for breeding work, are kept alive [9]. Deciphering the impurities of the germ plasm in modern cultivars (citrus, kaki persimmon) is important for the effective use of the collection biodiversity in breeding schemes for the new cultivars' development [6; 7;8]. The zone of humid subtropics of the Black Sea coast of the Krasnodar Territory provides cultivation of many subtropical

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crops; it is the only one in Russia for cultivating citrus crops and tea [1]. With the development and popularization of indoor, greenhouse and office gardening, the demand for many evergreen fruit plants is growing. Breeding work in this direction is carried out for restrained growth, remontant qualities, early maturity, leaf variegation and for many other decorative features.

The aim of the work is to analyze the main collection samples and create on their basis new high-yielding, low-growing, early-ripening forms, with high taste qualities of fruits and cultivars for the humid subtropics of Russia. The task of the research is to study the qualitative and quantitative indicators of fruits, forms and hybrids of the tangerine group, kaki persimmon and feijoa.

2 Materials and methods

Currently, the collection of citrus fruits includes 148 cultivars, kaki persimmon 24 - and feijoa - 34 samples. On their basis, 138 forms of citrus fruits were bred by the method of intervarietal and interspecific crosses, clonal selection and by breeding on a nucellar basis, of which 50 are promising, 24 are elite forms, 56 are resistant to biotic and abiotic factors forms of kaki persimmon and 36 are promising forms of feijoa, of which 7 are elite with high fruit quality and yield (Fig. 1)

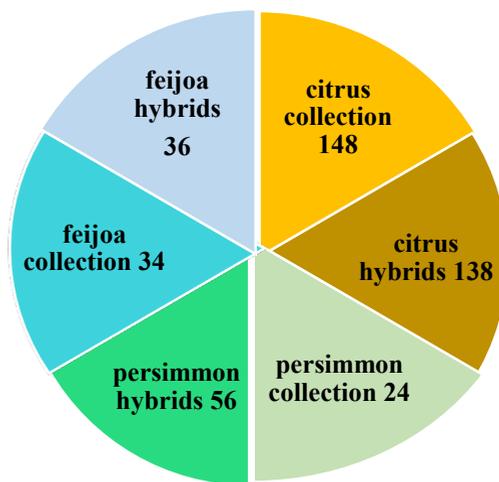


Fig. 1. Collection and hybrid fund of FRC SSC of RAS for crops, pcs.

In the course of research, a comprehensive phenotypic assessment of cultivar samples was carried out according to the UPOV protocol.

3 Results and discussion

As a result of previous studies, 28 most important sources of economically valuable traits were identified from the collections for use in breeding programs for the development of new forms and cultivars.

An analysis of the results of using various methods in breeding has shown that interspecific, intergeneric hybridization, clonal selection and the use of nucellar

polyembryony is an effective method for creating new forms of tangerine, and intervarietal hybridization and selection from free pollination is effective for kaki persimmon and feijoa.

The breeding program of citrus crops is aimed at creating winter-hardy forms using distant hybridization; *Citrus trifoliata* L. (= *Poncirus trifoliata* (L.) Raf.), *Citrus japonica* Thunb. (= *Fortunella margarita* (Lour.) Swingle), *Citrus cavaleriei* H.Lév. ex Cavalerie (= *Citrus ichangensis* Swingle), *C. × insitorum* Mabb. were used as donors of cold resistance. Semi-deciduous, low-growing (2.0 m.) hybrids have been obtained. The creation of cultivars with high fruit quality (large fruit, uniformity, sugar content, seedlessness) is the leading direction and is based on interspecific crosses (*C. reticulata* × *C. sinensis*; *C. reticulata* × *C. paradise*; *C. reticulata* × *C. maxima*). A wide variety of hybrids and nucellar forms with different levels of trait expression has been obtained. Variegated forms are gaining great popularity among lovers and collectors of citrus fruits. Variegated hybrids have been obtained from combinations of *C. reticulata* Blan. var. *unchiu* 'Miyagawa Wase' × *C. leiocarpa* and *C. reticulata* Blan. var. *unchiu* 'Kowano-Wase' × *Citrus limon* (= *Citrus* × *bergamia*). On the basis of the tangerine genetic collection of FRC SSC of RAS, 138 forms have been bred, of which 50 are promising, 24 are elite; bud mutations clone 22 and clone 33 have been selected, which have important economically valuable traits - high yield, low-growth, early ripeness. An early ripening high winter-hardy hybrid 10 has been obtained from cross combination (*C. reticulata* Blan. var. *unchiu* 'Kowano Wase' × hybrid 3252). Table 1 shows the basic characteristics of the obtained cultivars and hybrids.

Kaki persimmon (*Diospyros kaki* L.) is one of the most frost-resistant among subtropical crops, withstanding low temperatures down to -12-15 °C. The Centre's collection includes 24 cultivars. 16 intervarietal and 5 interspecific crossing combinations were carried out, the best ones have been identified: 'Djiro' × 'Geili', 'Djiro' × 'Zenji-Maru' and 'Hiakume' × 'Fuyu', 'Djiro' × *D. virginiana* L., of which 56 most promising hybrids have been identified. A new cultivar 'MVG Omarova' with high winter hardiness and hybrid 39 with large, evened fruits of high quality have been created (Table 1).

Among the evergreen fruit plants, a significant place is occupied by a subtropical fruit crop - feijoa (*Feijoa sellowiana* Berg), which is of great economic importance in the region. To date, in the humid subtropics of the Russian Federation, industrial plantings of feijoa are about 70 hectares. The collection includes 34 cultivars, mainly of hybrid origin, on its basis 36 forms have been bred with different ripening terms, high yields and good fruit quality (without stony inclusions). The result of the breeding work is the creation of 3 new cultivars 'Dachnaya', 'Dagomysskaya', 'Sentyabrskaya' (Table 1).

Table 1. Characteristics of cultivars and forms.

Signs	Cultivar/hybrid, species
<i>Diospyros kaki</i> L.	
Yield - 80 c/ha	'MVG Omarova'
Short - (2.5m)	
Fruit quality: ascorbic acid 20mg%; sum of sugars 25%; fruit weight - 40-60 g	
Resistance to low temperatures (-18oC)	
Yield - 120 c/ha	Hybrid 39
Average height - (3.5 - 4.0m)	
Fruit quality: ascorbic acid 22mg%; sum of sugars 16%; fruit weight - 80 g	
Resistance to low temperatures (-15oC)	
<i>Feijoa sellowiana</i> Berg	
Yield - 130 c/ha	'Dagomysskaya'
Fruit quality: total acidity up to 1.50%;	

the sum of sugars is 6.0 or more; fruit weight - from 50 - 60 g	
Ripening term - late (mid-late October - early November)	
Yield 110 q/ha	
Fruit quality: total acidity up to 1.30%; the sum of sugars is 6.5 or more; fetal weight - up to 40 g	‘Sentyabrskaya’
Ripening term - early (mid-late September - early October)	
Yield - 120 c/ha	
Fruit quality: total acidity up to 1.50%; the amount of sugars 6.0 and more; fruit weight - 40 -50 g	‘Dachnaya’
Maturation period - the middle (early- late oOctober)	
<i>Citrus reticulata</i> Blanco	
Yield - 220 c / ha	
Short - up to 3.0 m	
Fruit quality: sugar acid index - 6.5%; vitamin C - 30-35 mg%; average weight of a fruit - from 59	Clone 22
Maturation period is early (late September - early October)	
Yield - 250 c/ha	
Medium height - 3.0 - 3.5 m	
Fruit quality: sugar acid index - 7.0%; vitamin C - 35 mg% average weight of a fruit - from 80-85 g	Clone 33
Maturation period is early (late September - early October)	
Yield - 250 c / ha	
Medium height - 3.0 - 3.5 m	
Fruit quality: sugar acid index - 7.0%; vitamin C - 35 mg%; average weight of a fruit - from 80-85 g	Hybrid 10
Maturation period is early (early- mid oOctober)	
Resistance to low temperatures (-11oC)	

4 Findings

Created new cultivars and hybrid forms of *Diospyros kaki* L., *Feijoa sellowiana* Berg. *Citrus reticulata* Tan. bred by FRC SSC of RAS are more adapted to the peculiar natural and climatic conditions of the humid subtropics of Russia, which distinguishes them from many introduced cultivars and allows replenishing and updating the zoned assortment.

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