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The article was received at editors 25.06.2015.

Tankevich V.V., Sotnik A.I., Popov A.I., Chakalov T.S. Horticulture nursery of the Crimea – Intensive bases // Bull. of the State Nikit. Botan. Gard. – 2015. – № 116. – P. 29-35.

The article presents summery and results of long-term investigations in the field of stocks, cultivar-stock combinations and methods for cultivation of competitive pruned plant material of fruit-bearing cultures. This research covers work of scientists of the Crimean experimental horticulture station for last 50 years. It brings up necessity to transform Crimean horticulture to virus-free work way and the main aspects of the Crimean horticulture nursery as well.

Key words: *horticulture nursery; stock; provine; maternal plant; the Crimea.*

UDC 634.11:632.421.12

ASSESSMENT OF ECONOMICAL AND BIOLOGICAL CHARACTERISTICS OF WINTER APPLE CULTIVARS

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Introduction

Crimean peninsula has got quite favorable soil and climatic conditions for horticulture development. Fruits, cultivated in the region, are characterized by high taste and dietic properties. They are in great demand and could be an important item for export and economy stabilization of the Republic. Reduction of sanitary standard for fruit consumption has a negative effect on human body and causes oncolytic diseases. That`s why foundation of new intensive perennial fruit plantations takes a big role in development of the Crimean agriculture. Planting of new gardens in the region is realized allowing for scientifically grounded zonality of fruit cultures, as natural and climatic conditions has a big range.

Apple is the key fruit culture being in a structure of the Crimean plantations. Soon its part in the gardens will make 65-70%. The Peninsula attracts tourists all year round, and during this period guests and inhabitants of the region must be supplied by fresh fruit production completely. Apple trees, in particular winter cultivars which provide consumers in winter-spring, are of great importance to solve this task. Hereafter this cultivar group will make 80-85% from the total value cultivated in the Crimea. It should be noted these climatic conditions are favorable for growing winter apple cultivars.

Objects and methods of the research

Branch "Crimean experimental station of horticulture" was involved in studying the economical and biological peculiarities of apple cultivars with winter ripening, its own breeding: Aurora Krymskaya, Kimmeriya, Krymskoye, Krymskoye Zimneye, Predgornoye,

Tavriya, 1-8th, 3-2-11-79, 10-99-78, 2-1-18-79, 75-74; and foreign selection: Aidared, Brebern, Golden Delicious, Champion, Florina.

An experimental area was founded in 2000. Plantation consisted of seedlings grafted on stock MM-106 with insertion-9 using scheme 3,5 x 1,75 m. Area soils are heavy loamy, alluvium meadow-chernozyom-like. Humic horizon is massive, humic content isn`t considerable.

Area climate is semiarid and warm with changeable winter weather with significant range of snow cover. Average annual air temperature makes 10°C, in the warmest month it`s 20°C, the coldest month – January – 1,4°C below zero. Average annual temperature minimum is -20°C, absolute minimum - 31°C below zero. Spring is the most arid and windy season with frequent recurrent frosts. The latest frosts occur in early May, in the end of April this phenomena is possible ones per 4 years only. Precipitations are not even along the year. Maximum point is reached in June-July, considerable amount falls in autumn. Autumn frosts come on 16th of October on average. Ones per 20 years they happen in middle of September.

Investigations were based on program and methodic of fruit, baccate and nut-bearing cultures [11], using methodic of field studies with fruit cultures. Fruit chemical composition was assessed using methodic of fruit-baccate production merit-rating [7]. Fruits were stored under conditions of standard gaseous medium at 0-2°C and relative air humidity 86-90%. Statistical processing of data was carried out by methodic of field experiment [4].

Results and discussion

Crop capacity is the major economic and biological characteristic of apple cultivars, as it provides cost-efficiency of cultivation. Principal tasks of culture species study is to mark out cultivars with high yielding [9]. Crop capacity of 17 apple cultivars belonging to domestic breeding were investigated in comparison with intensive cultivar from foreign breeding – Golden Delicious, taken as a control. In this way maximum values of parameters were registered for the following cultivars from own selection: Aurora Krymskaya (31,2), Kimmeriya (32,1), Tavriya (34,1), 10-99-78 (30,3), 2-1-18-79 (38,6), 75-74 (33,8) and foreign cultivar Champion (30,7 ton/ha. The following station cultivars presented approximately the same crop capacity as control variant: Krymskoye (28,3), 1-8th, (28,1), 3-2-11-79 (28,5); minimal value of this parameter was registered for cultivar Florina (18,1 ton/ha), foreign breeding.

Apple fruits with high commercial qualities, that is large size, attractive appearance, high tasty properties, are in great demand. As researchers suppose, average weight of an apple fruit, cultivated in southern zone, should be 160-170g [12]. Most cultivars and forms had a fruit weight reaching 130-150 g: Golden Delicious, Aurora Krymskaya, Aidared, Brebern, Krymskoye, Krymskoye Zimneye, Reinette Simirenko, Tavriya, Champion, Florina, 2-1-18-79, 10-99-78; 155-170 g was typical for Kimmeriya, Predgornoye and 1-8th, 3-2-11-79. The largest fruits (210 g) characterized form of the station own breeding 75-74 (table 1).

Nowadays apple cultivars with rounded, oval and rounded-conic fruit shape, smooth surface, bright red color all over the whole fruit, without rusty spots gain the great demand. Demad for fruits without induviate color goes up considerably [8].

Table 1

Economical and biological parameters of apple winter cultivars

Cultivar	Average crop capacity 2011-2014, ton/ha	Fruit rating			Storage capacity, days
		Appearance, points	Weight, g	Taste, points	
Golden Delicious	26,4	4,3	140	4,7	150

(Control)					
Aurora Krymskaya	31,2	4,6	150	4,6	120
Aidared	22,8	4,5	150	4,2	200
Brebern	22,6	4,3	140	4,4	210
Kimmeriya	32,1	4,4	155	4,1	190
Krymskoye	28,3	4,5	140	4,6	200
Krymskoye Zimneye	23,2	4,4	135	4,6	240
Predgornoye	21,4	4,7	165	4,7	110
Reinette Simirenko	26,8	4,3	130	4,6	120
Tavriya	34,1	4,6	145	4,6	240
Champion	30,7	4,5	140	4,6	170
Florina	18,1	4,6	140	4,6	190
1-8th	28,1	4,5	150	4,5	160
2-1-18-79	38,6	4,6	150	4,5	190
3-2-11-79	28,5	4,7	160	4,6	170
10-99-78	30,3	4,4	130	4,5	160
75-74	33,8	4,7	210	4,4	100
HCP_{05}	2,7				

High parameters of fruit appearance (4,6-4,7 points) were registered for the following cultivars and forms: Aurora Krymskaya, Predgornoye, Tavriya, Florina, 2-1-18-79, 3-2-11-79, 75-74. Attractiveness of these fruits appearance is mainly based on their regular shape and bright induviate color with stripes or diffused color over the most part of surface. There is an exclusion, form 2-1-18-79, its fruits have got flat-rounded and regular shape with smooth surface and delicate pink erubescence spread over less fruit surface; they are attractive as well. Fruits of Kimmeriya cultivar and form 10-99-78 possess induviate color spread over less surface or absent at all, what makes it possible to include them into clinical nutrition and baby food.

According to taste properties of apple fruites, cultivars are classified into dessert (4,5-5,0), table (3,0-4,4) and industrial (3,8 points and lower) [8]. Taking into account organoleptic rating of fruit taste majority of study cases belongs to dessert (4,5-4,7 points).

Storage period of fruits depends upon concentration of solid, what is a positive correlation, but the principal influence is made by genotype [2]. Winter ripening apple cultivars are characterized by long-term preservation of fruits, late winter cultivars are possible to store fruits till the next yield. Maximum storage period (240 days) is typical for late-winter cultivars such as Krymskoye Zimneye and Tavriya. 170-210 days is the preservation period for cultivars of station own breeding, Kimmeriya, Krymskoye, 2-1-18-79, 3-2-11-79, 10-99-78, and foreign one – Aidared, Brebern, Champion, Florina.

Biosynthesis of ascorbic acid is determined by many factors. Vitamin “C” concentration depends to a large degree upon cultivar biological characteristics [8]. Apples, cultivated in the Crimea, don`t have a high content of ascorbic acid, what is typical for fruits grown in regions with colder climate. Maximum content of vitamin “C” was fixed in fuits of Reinette Simirenko (12,1) and Krymskoye Zimneye (12,8 mg%) (table 2). According to other studies, vitamin “C” content in Reinette Simirenko made 11,4 mg% [9].

Table 2

Biochemical composition of apple fruits (average factor for long-term study)

Cultivar	Vitamin “C” mg %	Titratable acidity, %	Sugars, %		Solid, %	Sugar-acid coefficient
			mono	Total sugar		
Golden Delicious	4,2	0,33	11,7	15,1	16,4	45,8

Reinette Simirenko	12,1	0,76	12,4	14,9	17,7	19,6
Aurora Krymskaya	9,8	0,94	9,8	14,2	18,5	15,1
Brebern	6,0	0,99	9,0	12,7	16,6	12,8
Kimmeriya	8,9	0,96	7,5	10,4	14,3	10,8
Krymskoye	7,2	0,52	12,1	17,0	19,6	32,7
Krymskoye Zimneye	12,8	0,55	10,0	16,1	18,4	29,3
Predgorrnoye	8,8	0,46	12,8	14,9	16,8	32,4
Tavriya	5,8	0,29	8,9	11,0	17,0	28,2
Champion	6,7	0,50	10,5	12,9	15,8	25,8
Florina	6,2	0,42	12,2	15,5	17,2	36,9
1-8th	6,0	0,28	11,1	14,6	16,1	52,1
2-1-18-79	5,0	0,47	11,5	13,7	15,8	29,2
3-2-11-79	4,9	0,65	10,4	12,5	15,1	19,2
10-99-78	6,8	0,49	12,1	14,5	16,5	25,6
75-74	6,7	0,44	12,3	14,5	16,8	32,9

Availability of organic acids in apple fruits is determined by soil-climatic conditions and cultivar biological characteristics. There is an opinion that maximum acidity is typical for winter cultivars [3]. In terms of our researches we could mark out the following apple cultivars and form according to organic acids in fruits (0,76-0,99%): Reinette Simirenko, Aurora Krymskaya, Brebern, Kimmeriya and 3-2-11-79.

Carbohydrates are an essential part of apple fruits. They suppose that winter cultivars contain more sugars in comparison with summer and autumn ones [1]. According to our researches a high concentration of monosaccharide (12,1-12,8%) was fixed for Reinette Simirenko, Krymskoye, Predgornoye, Florina and forms 10-99-78, 75-74. Level of total sugar ranged from 11,1 in fruits of Tavriya till 17,0% of Krymskoye.

A number of scientists suppose fruit taste is determined by sugar-acid coefficient. It is 15-27 for cultivars with dessert taste [5]. Allowing for this coefficient almost all study cultivars are classified as dessert (15,1-52,1), besides Brebern and Kimmeriya (12,8 and 10,8 relatively) that have lower taste properties of course. Golden Delicious and forms – 1-8th having sugar-acid coefficient 45,8 and 52,1 relatively are identified as the cultivars with the sweetest fruits.

Concentration of solids considerably effects on apple fruit storage, but cultivar genotype has the key influence [10]. In our researches cultivars with long-term fruit preservation had a high content of solids: Brebern (16,6), Krymskoye (19,6), Krymskoye Zimneye (18,4), Tavriya (17,00%).

Conclusions

Maximum value of average crop for 4-years research (more than 30 ton/ha) was received from station own breeding: Aurora Krymskaya, Kimmeriya, Tavriya, 2-1-18-79, 10-99-78, 75-74 and foreign cultivar Champion.

Cultivars Aurora Krymskaya, Predgornoye, Tavriya, Florina and forms 2-1-18-97, 3-2-11-79, 75-74 had attractive fruits (4,6-4,7 points).

The longest storage period (240 days) was fixed for late winter cultivars: Krymskoye Zimneye and Tavriya. Cultivars with prolonged storage capacity of fruits were characterized by high content of solid (16,6-19,6%).

As to ascorbic acid concentration the following cultivars were marked out: Reinette Simirenko (12,1) and Krymskoye Zimneye (12,8 mg%).

Concerning sugar-acid coefficient (15,1-52,1) majority of cultivars, besides Brebern and Kimmeriya, are rated as dessert.

Taking into consideration economical and biological parameters almost all study apple cultivars are applicable for cultivation in industrial gardens of the Crimea, though Florina needs further investigation.

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The article was received at editors 29.06.2015

Litchenko N.A., Gorb N.N. Assessment of economical and biological characteristics of winter apple cultivars // Bull. of the State Nikit. Botan. Gard. – 2015. – № 116. – P. 35-39.

This article presents study results of economical and biological characteristics of 17 winter apple cultivars of native and foreign breedings. Maximum crop capacity was registered for “Aurora Krymskaya”, “Kimmeriya”, “Tavriya”, 2-1-18-79, 75-74 and cultivar of foreign selection “Champion”. Attractive fruits were marked for “Aurora Krymskaya”, “Predgornoye”, “Tavriya”, “Florina” and forms 2-1-18-79, 3-2-11-79, 75-74. Fruits of “Tavriya” and “Crymsky Zimny” cultivars had the longest period of storage. A high concentration of ascorbic acid was typical for fruits of “Reinette Simirenko” and “Krymskoye Zimneye”. Assessment of fruit taste properties was carried out according to sugar-acid coefficient.

Key words: *apple; winter cultivar; crop capacity; fruit keeping capacity; sugars; solids; ascorbic acid; sugar-acid coefficient; the Crimea.*