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THE ADAPTATION CAPACITY OF THE NEW APRICOT VARIETIES IN SOUTHERN CLIMATE CONDITIONS OF REPUBLIC OF MOLDOVA

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Abstract

The experimental plot is placed in fruit-growing orchard of 'Agroparc Management' Ltd., during the 2020 year. The object of the research was the trees of the apricot varieties of 'Wonder Cot', 'Spring Blush', 'Magic Cot', 'Lilly Cot', 'Pinkcot', 'Perle Cot', 'Orange Red', 'Sweet Cot', 'Big Red', 'Kyoto', 'Faralia' and 'Farbaly', grafted on the 'Mirobalan 29C' rootstock. Planting distance was 5.0 x 3.0 m. The planting of apricot trees was carried out in spring of 2015. During the researches was studied the period of beginning of flowering and the ripening of fruit harvesting phases, the period between these two phases on different varieties of apricots, morphological parameters of fruits and kernels, shape index and redistribution of fruits in various quality of classes. It has been established that the biological particularities of the variety influence on the period of beginning of the flowering and the ripening of the apricot fruits, the period between these two phases, the morphological parameters, the shape index and the redistribution of the fruits in different quality classes.

Key words*: apricot, blooming, ripening, medium weight, shape index, quality.*

INTRODUCTION

Apricots are in high demand among consumers and therefore apricot is one of the main fruit species grown in the world (Chira et al., 2005; Cociu et al., 1993). The largest production of apricots in the world comes from Asian countries and those in the Mediterranean basin (Balan et al. 2008; Cociu, 1993).

The Republic of Moldova is located in a temperate zone, where there is a great potential to cultivate many fruit species as a result of a great variety of soil and environmental conditions.

Apricot is one of them with an annual production that varies in the last 4-5 years from 9.50 to 21.50 thousand tons (Peşteanu et al., 2018).

Large apricot areas in the Republic of Moldova are located in the southern and central part of the country, but due to climate change in the last 10-15 years; apricot cultivation is planted on large areas in the northern area (Peşteanu et al., 2018; Pîntea, 2018).

However, the main factors limiting the wider spread of apricot cultivation among fruit growers is: the disease of the generative organs of low temperatures at the end of the rest period and late spring (Abbas et al., 2016; Cociu et al., 1993), premature wilting of trees (apoplexy), infection with viruses (Balan et al., 2008; Cociu et al., 1993), the absence of a wide assortment of modern varieties and rootstocks that would allow to intensify the culture, to obtain productions high, constant and competitive (Balan et al., 2008; Cociu et al., 1993; Maria & Sosna, 2006; Peşteanu et al., 2018).

The primary task of fruit growers is to replace the old varieties, less corresponding to the requirements in force, with new ones, more suitable for the conditions of our country, more productive and already known by consumers in the markets we want to penetrate.

This replacement may be possible based on the introduction of new modern varieties from the global range, which based on testing over 4-5 years on their adaptation to climatic, edaphic, biotic, and abiotic and agrotechnical conditions in various areas of the country recommended in production. (Cociu et al., 1993; Milatovic et al., 2016; Pîntea, 2019).

Among the varieties cultivated with apricots in the Republic of Moldova, there is an acute lack of valuable varieties with maturity from very early to very late.

This would allow completing the assortment of varieties, ensuring a harvesting conveyor, the consumption of these fresh fruits and their

industrial capitalization for a period of 50-60 days or even more (Negru, 2018; Pîntea, 2019).
Apricots being mostly intended for fresh consumption, they must meet certain requirements submitted by consumers, which are very difficult to achieve due to biological and technological features of the species (Cociu et al., 1993; Peşteanu et al., 2018).
In order to satisfy the consumer's necessities regarding the quality of the fruits and to penetrate new markets, the organoleptic apricots must be homogeneous in size, with specific color to the variety, but priority is given to varieties where 60-80% of the fruit surface is red, medium weight, pulp firm, dry detachment, relatively small pips, attractive appearance and valuable nutritional biochemical composition (Balan et al., 2008; Cociu et al., 1993; Milatovic et al., 2013; Pîntea, 2019; Souty et al., 1990).
The practical argumentation of some phenophases of fruit development in apricots, the morphological characteristic and quality indices of fruits in various apricot varieties were the main objectives of the research in question.

MATERIALS AND METHODS

The research was carried out during the year 2020 by setting up an experience in field conditions at the company SRL "Agroparc Management". The orchard was planted in the spring of 2015, with trees "Certificate" category twigs produced in the "Battistini Vivai" fruit nursery, Italy.
The object of research was the trees of apricot varieties introduced from the world selection (Cot International, Escande, International Plant Selection, etc.), which, due to a preliminary theoretical study showed to be prospective for the Republic of Moldova as: 'Wonder Cot', 'Spring Blush', 'Magic Cot', 'Lilly Cot', 'Pinkcot', 'Perle Cot', 'Orange Red', 'Sweet Cot', 'Big Red', 'Kyoto', 'Faralia' and 'Farbaly'. The 'Kyoto' variety, which has the same maturation period as the native 'Nadejda' apricot variety, was taken as a control variant. The 'Mirobalan 29C' biotype was used as the rootstock. The trees were guided according to the usual vessel crown system. Planting distance is 5.0 x 3.0 m.
Methodological principles and approved methods in genetic improvement and the study of fruit species were used for the research.
The study of biological, phenological and production properties was carried out based on observations, determinations and analyses regarding the development of apricot trees and fruits.
Observations on the onset of early-flowering phenophases and harvest maturity were made taking into account the apricot landmark stages described by Baggiolini (1952).
The average weight of the fruits and kernels was calculated by the weighing method, and the height, small and large diameter of the fruits by the measuring method. The shape of the fruits was expressed on the basis of the shape index, which was the correlation between the height of the fruit and the large diameter of the fruit.
The quality of apricots was determined by the method of measuring the large diameter in the equatorial area of the fruits. Apricots with a diameter of 30-35 mm are assigned to quality category I and II fruits, or are marked with the letter C, and those with a diameter greater than 35 mm to the extra quality category. Apricots of extra quality category are divided into the following classes: B - diameter 35-40 mm; A - diameter 40-45 mm; 2A - diameter 45-50 mm; 3A - diameter 50-55 mm and 4A - diameter 55 mm and larger.
The average value of the index under study was calculated at the main morphological parameters.

RESULTS AND DISCUSSIONS

The requirements of apricot against heat are very dynamic and therefore each development phase has a certain optimum temperature and travel time.
The data in Table 1 show that flowering in the early maturing varieties 'Wonder Cot' and 'Magic Cot' began on March 9. On March 11, the 'Perle Cot' variety began to bloom, on March 12, the 'Pinkcot' variety. One day later, the flowering of 'Spring Blush' and 'Sweet Cot' varieties started. Next, in the next row, the 'Lilly Cot' variety - March 14, the 'Orange Red' variety - March 16, the 'Big Red' variety - March 17, the 'Faralia' variety - March 18,

the ‘Farbaly’ variety - March 19 and the Kyoto variety - March 20, blossomed. Basically, during 12 days, the phenophase started flowering in the studied varieties.

The study performed on the degree of flowering, we record that in the varieties studied with different precocity, 50% of the flowers were flowering at different stages. The flowering rate of 50% of flowers in the crown of apricot trees in the ‘Wonder Cot’ and ‘Magic Cot’ varieties started on March 11, in the ‘Pinkcot’ and ‘Perle Cot’ varieties on March 13, and in the ‘Spring Blush’ and ‘Sweet Cot’ varieties on of March 15. Next, in the next row, the ‘Lilly Cot’ variety - March 17, the ‘Orange Red’ variety - March 18, the ‘Big Red’ variety - March 19, the ‘Faralia’ variety - March 19, the ‘Farbaly’ variety - March 20 and the ‘Kyoto’ variety - March 21.

Table 1. The influence of the biological particularities of apricot varieties on the triggering of the flowering phases of the trees in the southern part of the country

Variety	The start of the beginning of the flowering phase of the trees			
	The start of flowering	Flowering 50%	Full flowering	Falling petals
Wonder Cot	09.03	11.03	13.03	19.03
Spring Blush	13.03	15.03	17.03	21.03
Magic Cot	09.03	11.03	13.03	18.03
Pinkcot	12.03	13.03	15.03	19.03
Perle Cot	11.03	13.03	15.03	21.03
Orange Red	16.03	18.03	20.03	24.03
Sweet Cot	13.03	15.03	19.03	23.03
Lilly Cot	14.03	17.03	20.03	23.03
Big Red	17.03	19.03	21.03	25.03
Kioto (c)	20.03	21.03	23.03	26.03
Faralia	18.03	19.03	21.03	25.03
Farbaly	19.03	20.03	22.03	26.03

That is, the period between the beginning of flowering and the 50% flowering phenophase lasted about 2-3 days depending on the biological characteristics of the variety and the air temperature in that period.

The end of flowering is considered when 100% of the flowers in the multiannual wood and annual branches in the first wave of growth have fully flowered. For the varieties studied, the end period coincided with 13.03-23.03, which lasted 11 days.

The duration between the phenophase from the beginning of flowering and full flowering (100%) in the apricot varieties studied was from 4 to 7 days depending on the biological characteristics of the variety. In the case of varieties with early ripening this period was 5-7 days, but for varieties with late fruit ripening period of 4 days.

Depending on when 100% flowering was recorded, the varieties studied can be placed in the following sequence: ‘Wonder Cot’ variety - March 13, ‘Spring Blush’ variety - March 17, ‘Magic Cot’ variety - March 13, ‘Lilly Cot’ variety - March 20, variety ‘Pinkcot’ - March 15, ‘Perle Cot’ variety - March 15, ‘Orange Red’ variety - March 20, ‘Sweet Cot’ variety - March 19, ‘Big Red’ variety - March 21, ‘Faralia’ variety - March 21, ‘Farbaly’ variety - March 22 and ‘Kyoto’ variety - March 23 .

The fall of the petals invokes the period when the fruits have just been formed and it is necessary not to allow their condition to be affected by the abiotic and biotic factors. They are quite sensitive to various biotic and abiotic hazards. The obtained results show that the fall of the petals in the apricot varieties studied in the southern area took place from March 18 to March 26, starting with the varieties with earlier age (‘Wonder Cot’, ‘Spring Blush’, ‘Magic Cot’, ‘Lilly Cot’, ‘Pinkcot’), continuing with those with medium maturation (‘Perle Cot’, ‘Orange Red’, ‘Sweet Cot’, ‘Big Red’) and ending with late maturing varieties (‘Faralia’, ‘Farbaly’, ‘Kyoto’).

Further studying the sequence of fruits ripening of apricot varieties studied in the southern part of the country during the research, we notice that large deviations from the harvest period that each variety possesses has not been recorded.

The study carried out on the period of fruits set in the apricot varieties studied shows that this phenophase began on average 88 days after flowering with the ‘Spring Blush’ variety and ended after the 129-day period with the ‘Farbaly’ variety. If we compare the ripening period of apricot fruits with the ‘Kyoto’ variety, considered as a control, we record that all the varieties studied can be divided into 4 groups (Figure 1).

The group ‘Wonder Cot’ and ‘Spring Blush’ are attributed to the group of extra-early ripening varieties, whose fruits harvesting started 12-14 days earlier compared to the control variety. The group of varieties with early maturation is assigned the varieties ‘Magic Cot’, ‘Pinkcot’, ‘Sweet Cot’, ‘Lilly Cot’ and ‘Orange Red’, whose difference in terms of triggering the harvest period compared to the control variant was 6-8 days. The varieties with medium maturation include the varieties ‘Perle Cot’, ‘Sweet Cot’, ‘Big Red’ and ‘Kyoto’ (0-4 days), and the group of late maturing varieties ‘Faralia’ and ‘Farbaly’ varieties, which recorded a retention of the beginning of the harvest period compared to the variant witness with 16 and 27 days, respectively.

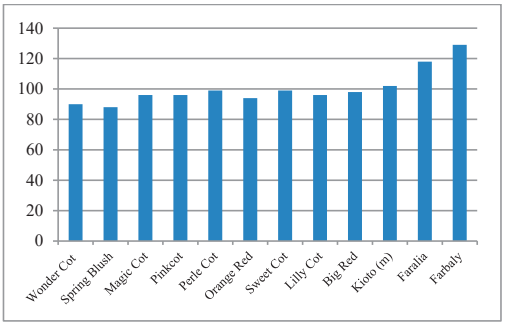

Figure 1. The influence of the biological particularities of apricot varieties on the period from the beginning of the flowering of the trees to the ripening of the fruits harvest

The size and shape of the fruits influence the market value and are important indicators in the study of varieties, because they are directly related to the quality of the product obtained, productivity in sorting and packaging of fruits.

The study carried out in 2020, in the apricot plantation shows that the biological particularities of the varieties influenced the average weight of the fruits. After average weight, the apricot varieties studied can be divided into the following groups. To the group of very small varieties, weighing between 20-30 g, is assigned the ‘Big Red’ variety, which has borne fruits in anticipated branches and for the future in order to obtain competitive productions it will be necessary to regulate the fruits load from the tree crown by manual thinning. ‘Lilly Cot’ and ‘Wonder Cot’ varieties are assigned to the group of those with small fruits whose average weight is 31-40 g. To the group of varieties with medium fruits are placed the varieties ‘Spring Blush’, ‘Orange Red’, ‘Kyoto’ and ‘Farbaly’, whose average weight of the fruits was 41-50 g. The varieties ‘Sweet Cot’ and ‘Faralia’, according to the average weight of the fruits belong to the group of varieties with large fruits (50-60 g), and the variety ‘Magic Cot’ and ‘Pinkcot’ to the group of varieties with very large fruits, whose value was greater than 60 g (Table 2).

Table 2. Morphological parameters of apricot fruits according to the biological particularities of the variety

Variety	The average weight, g	Height, mm	Large diameter, mm	Small diameter, mm	The shape index
Wonder Cot	38.4	46.0	40.5	38.7	114
Spring Blush	47.3	44.2	43.2	41.8	1.02
Magic Cot	61.7	50.9	46.2	45.3	1.10
Lilly Cot	32.8	41.0	38.2	33.3	1.05
Pinkcot	62.4	49.3	47.3	44.9	1.04
Perle Cot	51.6	46.2	46.0	41.7	1.00
Orange Red	44.7	47.2	46.0	40.5	1.03
Sweet Cot	50.8	47.9	46.6	41.0	1.03
Big Red	38.6	38.9	37.6	34.7	1.03
Kioto (c)	49.3	45.5	45.6	43.1	1.00
Faralia	56.4	48.9	47.6	42.5	1.04
Farbaly	46.7	47.0	44.7	34.7	1.06
Average	47.6	46.1	44.1	40.2	1.04

The shape of the fruit is in strict accordance with the biological characteristics of the variety and can be from spherical, ovate to ellipsoidal. Deviations from the fruit form indicate an incomplete development due to water insufficiency during fruit development (Mitrea V. 2007; Piagnani M. C., 2013).

The height and large diameter of the apricots are the characteristics that define the shape of the fruit. Differences in fruits height are genetic in nature. The lowest fruit heights were recorded in the ‘Big Red’ variety (38.9 mm), and the highest in the ‘Faralia’, ‘Pinkcot’ and ‘Magic Cot’ varieties, where the index under study was 48.9; 49.3 and 50.9 mm, respectively. In general, all apricot varieties studied can be divided according to the height of the fruits into 3 groups. That is, varieties with a fruit height of up to 40 mm are assigned

the ‘Big Red’ variety, varieties with a height of 40-50 mm where most of the studied varieties include ‘Wonder Cot’, ‘Spring Blush’, ‘Lilly Cot’, ‘Pinkcot’, ‘Perle Cot’, ‘Orange Red’, ‘Big Red’, ‘Kyoto’, ‘Faralia’ and ‘Farbaly’. The ‘Magic Cot’ variety recorded values greater than 50 mm.

The large diameter and small diameter of the varieties studied were influenced by the biological characteristics of the variety. If, for example, values of more than 40 mm were recorded for most apricot varieties after large diameter, then ‘Lilly Cot’ and ‘Big Red’ varieties had a diameter between 37.6-38.2 mm. According to the values of the small diameter we register diametrically opposite correlations. In this case only for the varieties ‘Spring Blush’, ‘Magic Cot’, ‘Pinkcot’, ‘Perle Cot’, ‘Orange Red’, ‘Sweet Cot’, ‘Kyoto’ and ‘Faralia’ the diameter of apricot fruits had values greater than 40 mm, and for varieties taken ‘Wonder Cot’, ‘Lilly Cot’, ‘Big Red’ and ‘Farbaly’ index in the study recorded values between 33.3-38.7 mm.

The study performed on the shape of the fruit through the shape index, it is highlighted that in all the studied varieties values higher than 1.0 were registered. If in the varieties ‘Spring’ ‘Blush’, ‘Lilly Cot’, ‘Pinkcot’, ‘Perle Cot’, ‘Orange Red’, ‘Sweet Cot’, ‘Big Red’, ‘Kyoto’, ‘Faralia’ and ‘Farbaly’ the shape index varied from 1.00 to 1.06, which highlights the spherical shape of the fruit. In the ‘Wonder Cot’ and ‘Magic Cot’ varieties, this index registered values of 1.1-1.26, meaning the fruits had an elongated spherical and cordiform shape.

The stone/fruit ratio and their morphological parameters are important indicators in the study of varieties, because they are directly related to the quality of the product obtained and how the consumer will perceive the importance of the variety.

The biological particularities of the varieties also influenced the share of the pit in the fruit (Table 3). According to the weight of the pit in the fruit, the apricot varieties studied can be divided into the following groups. ‘Wonder Cot’ (3.0%), ‘Magic Cot’ (4.4%), ‘Perle Cot’ (4.2%) and ‘Kyoto’ (4%) are assigned to the group of varieties with a weight of fruit pit 3.0-5.0%. The varieties ‘Spring Blush’, ‘Lilly Cot’, ‘Pinkcot’, ‘Orange Red’, ‘Sweet Cot’, ‘Big Red’ and ‘Faralia’, the share of seed in the fruit varied from 5.1 to 7.0% and for the varieties mentioned above it was 5.9; 5.7; 6.0; 5.1; 6.5 and 5.7, respectively. The ‘Farbaly’ variety (8.9%) is placed in the group of varieties with a share of seed in the fruit higher than 7.0%.

The heights, large and small diameter of the apricot pit are hereditary characteristics of the variety. All apricot varieties according to the height of the pit studied can be divided into 3 groups. That is, varieties with a seed height of 20-25 mm, varieties with a height of 25.1-30 mm and varieties with values greater than 30 mm. The lowest pit heights were recorded for the ‘Kyoto’ (21.1 mm), ‘Lilly Cot’ (23.1 mm) and ‘Big Red’ (24.3 mm) varieties, and the highest for the ‘Magic Cot’ (30.5 mm), ‘Farbaly’ (31.2 mm) and ‘Faralia’ (33.4 mm) varieties. The varieties ‘Wonder Cot’, ‘Spring Blush’, ‘Pinkcot’, ‘Perle Cot’, ‘Orange Red’ and ‘Sweet Cot’ recorded average values between 25.3-27.5 mm.

Table 3. The morphological parameters of apricot kernels according to the biological particularities of the variety

Variety	The share of pit in fruit, %	Height, mm	Large diameter, mm	Small diameter, mm	The shape index
Wonder Cot	3.0	266	18.9	9.4	1.40
Spring Blush	5.9	25..3	21.4	13.5	1.18
Magic Cot	4.4	30.5	21.6	11.0	1.41
Lilly Cot	5.7	23.1	18.0	9,.	1.28
Pinkcot	5.2	27.5	21.8	11.6	1.26
Perle Cot	4.2	26.1	19.3	11.6	1.35
Orange Red	6.0	28.0	21.8	11.6	1.28
Sweet Cot	5.1	27.4	20.4	11.8	1.34
Big Red	6.5	24.3	17.8	10.9	1.36
Kioto (c)	4.4	21.1	19.3	11.2	1.10
Faralia	5.7	33.4	24.1	14.4	1.37
Farbaly	8.9	31.2	21.8	12.0	1.43
Average	-	27.0	20.5	11.6	1.31

The large diameter and small diameter of the seed in the varieties studied were influenced by the biological particularities of the variety. If, for example, values of 17-20 mm were recorded for the apricot varieties ‘Wonder Cot’ (18.9 mm), ‘Lilly Cot’ (18.0 mm), ‘Big Red’

(17.8 mm), after the large diameter of the stone, 'Pearls Cot' (19.3 mm) and 'Kyoto' (19.3 mm), then value greater than 23 mm was entered by the variety 'Faralia' (24.1 mm). The varieties 'Spring Blush', 'Magic Cot', 'Pinkcot', 'Orange Red', 'Sweet Cot' and 'Farbaly', according to the large diameter of the stone, recorded average values, ranging from 20.4 to 21.8 mm.

All apricot varieties according to the small diameter of the pit can be divided into 3 groups. That is, varieties with a small diameter of 8-10 mm, registered in the varieties 'Wonder Cot' (9.4 mm) and 'Lilly Cot' (9.8 mm), varieties with values of 10.1-12.0 mm to which it is assigned most varieties studied as: 'Magic Cot', 'Pinkcot', 'Perle Cot', 'Orange Red', 'Sweet Cot', 'Big Red', 'Kyoto' and 'Farbaly' with values of the studied index between 10.9-12.0 mm. In the third group can be attributed to the varieties 'Spring Blush' and 'Faralia' whose small core diameter was 13.5 and 14.4 mm, respectively.

In addition to the indicators studied previously, the biological particularities of the variety also influence the pit shape index. Lower pit shape index values were recorded for the 'Kyoto' (1.10) and 'Spring Blush' (1.18) varieties and higher for the 'Wonder Cot' (1.40), 'Magic Cot' (1.41) and 'Farbaly' varieties. (1.43). In the case of 'Lilly Cot', 'Pinkcot', 'Perle Cot', 'Orange Red', 'Sweet Cot', 'Big Red' and 'Faralia' varieties, the pit shape index registered average values, between 1.26-1.37.

The dimensions of the fruits are of special importance because depending on them, they are redistributed on different quality classes, on which then depends the selling price, so implicitly the economic efficiency. Particularly important is the diameter of the fruit in the equatorial plane, which is a very important quality element, which apart from hereditary influences is strongly conditioned by environmental and cultural factors (Table 4).

The carried out investigations show that from the studied varieties, fruits of quality category I and II (class C) are not registered, because due to the low temperatures in the spring, a large part of the harvest was compromised. In the varieties studied, fruits with a diameter greater than 35 mm were recorded in the 'Lilly Cot' (100.0%) and 'Big Red' (100.0%) varieties.

Table 4. The influence of biological characteristics of apricot varieties on fruit quality by diameter and weight, %

Variety	By diameter			
	B	A	2A	3A
Wonder Cot	-	100.0	-	-
Spring Blush	-	65.9	34,1	-
Magic Cot	-	30.6	69.4	-
Lilly Cot	34.5	65.5	-	-
Pinkcot	-	-	83.9	16.1
Perle Cot	-	34.2	65.8	-
Orange Red	-	16.1	83.9	-
Sweet Cot	-	48,2	51,8	-
Big Red	9.5	87.7	2.8	-
Kioto (c)	-	83.4	16.6	-
Faralia	-	7.0	80.2	12.8
Farbaly	-	100.0	-	-

In quality class A, a higher share of fruits belonged to the 'Wonder Cot' (100.0%) and 'Farbaly' (100.0%) varieties, average values to the varieties 'Spring Blush' (65.9%), 'Kyoto' (83.4%), sub-averages for the varieties 'Sweet Cot' (48.2%) and 'Perle Cot' (34.2%), and a lower share formed the varieties 'Orange Red' (16.1%) and 'Faralia' (7.0%).

Apricot fruits with a diameter of 45-50 mm are attributed to class 2A, and those with values of 50-55 mm to category 3A, which are the most requested among consumers. In quality class 2A, a higher share of fruits belonged to the varieties 'Pinkcot' (83.9%), 'Orange Red' (83.9%) and 'Faralia' (80.2%), and lower values, to the varieties 'Kyoto' (16.5%), 'Spring Blush' (34.1%). The varieties 'Magic Cot' (69.4%), 'Perle Cot' (65.8%) and 'Sweet Cot' (51.8%), registered average values in terms of quality of apricot fruits in the respective class.

Further research has shown that quality of 3A fruits has been obtained in a limited amount of fruits, only in the case of 'Pinkcot' (16.1%) and 'Faralia' (12.8%).

CONCLUSIONS

The flowering period of apricot in the spring of 2020 with different maturation period was staggered over 12 days, and in the northern part of 7 days.

The morphological parameters are a valuable tool in assessing fruits quality, which is valuable information for fruit growers, who need to pay more attention to technological elements in order for cultivated fruits to be successful among consumers.

Most of the studied apricot varieties have a spherical fruit shape and only in the 'Wonder Cot', 'Magic Cot', 'Faralia' and 'Farbaly' varieties the fruits had an elongated spherical and cordiform shape.

Of the varieties studied in the southern part of the country, a higher share of quality class A and 2A fruits was registered for the varieties 'Spring Blush', 'Magic Cot', 'Pinkcot', 'Big Red', 'Orange Red', 'Kyoto', 'Faralia' and 'Farbaly'.

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