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PHOTOSYNTHETIC PRODUCTIVITY OF CHERRY AND SWEET CHERRY LEAVES DUE TO ROOTSTOCK AND ARTIFICIAL FORMS OF TREE CROWNS IN THE GARDEN

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ABSTRACT

In the scientific article presents the results of research on the study of varietal cherries and artificial ways of formation of the trees to the level of photosynthetic activity of leaves with the orientation of growing trees, their intensive technology. In the research, the varieties of cherries Shubinka, Podbelskaya and Shpanka Chernaya (black) zoned in the Republic, as well as sweet cherries Volovye serdtce, Revershon and Bahor, grown on a low-growing vegetatively propagated rootstock VVA-1 and VSL-2 (Krymsky-5) were used as the object of research. As a result of the conducted research, it was found that the optimal crown system for cherry and sweet cherry varieties is the five-skeletal wall. Crown formation in these forms helps to reduce the volume of the crown to an average of 25%, at which the net productivity of leaf photosynthesis in comparison with the usual crown formation – free-growing and sparse-tiered reaches a value of 34.73 grams/m² per day. When forming bushy forms of the crown of cherries and sweet cherries, the level of leafiness of leaves improves and the content of chlorophyll in them increases to 13.42 mg/g of raw leaf mass.

KEYWORDS: *cherry, sweet cherry, density, variety, leaf, area, crown, forming, photosynthesis, productivity, pruning, index, projection.*

INTRODUCTION

Currently, the main method of growing cherries and sweet cherries in Uzbekistan is grafting on seed rootstocks. When such plants are planted in the garden, strong-growing plants are formed. Planting material is put according to the scheme of 5×4 and 6×5 meters. With such planting schemes, the density of trees in the garden is 500 and 334 pcs/ha, respectively, and the gross productivity does not exceed 60-90 c/ha [2, 3].

The disadvantages of this method of placement include the irrational use of the food area, the late entry of plantings into the time of commercial fruiting, low yield, inconvenience in caring for plants due to the large size of the crowns, and others [1].

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Increasing the density of plantings can significantly improve the efficiency of land use, as well as material and labor resources. The trend towards increasing plant density is becoming more common, especially in countries with high land values. Often in the specialized literature, the definition of an intensive garden is understood as synonymous with a garden with a high density of trees on clonal rootstocks. But this definition largely characterizes only the potential intensity of the garden, and not the actual one [6, 7].

A significant increase in the productivity of the breed is unthinkable without the development of new ways of growing crops. In particular, growing plants on low-growing vegetative propagated rootstocks is accompanied by the development of new crown formation systems for them [4].

The practical implementation of these main aspects of the technology allows plants in the garden to be placed more thickly, bringing the planting density to 1000-2500 pcs/ha. The latter allows increasing the productivity of plants up to 100-150 or more centners per unit area of the garden.

Cherry and sweet cherry trees grown on low-growing vegetative propagated rootstocks, having less development of the aboveground part, have better illumination of the crown; form a well-developed leaf apparatus that effectively uses solar energy to accumulate plastic substances for the formation of generative formations and crops.

MATERIALS AND METHODS

The study was conducted in 2016-2019 at the information and consultation center (Extension center) at the Tashkent state agrarian University. The area of the experimental plot is 0.25 ha. The scheme of planting of trees is 4×4 meters.

As an object of research, the varieties of cherry Podbelskaya, Shubinka and Shpanka Chernaya (black), varieties of sweet cherry Volovye serdtce, Revershon and Bahor zoned in the Republic were used. As a rootstock for cherries, vegetatively propagated VVA-1 was used, and for sweet cherries-VSL-2.

The formation of the cherry crown was carried out according to the “fruit wall " type, with the formation of a crown with three and five skeletal branches and their departure along the row, for sweet cherries-a simple bowl, a KGB (Kim green Bush), an Austrian Bush and a V-shaped one. The Central conductor above these branches was cut out. The left branches were subordinated in height, the thickening ones were cut out.

When forming a small-sized flat crown in the crown of trees, two well-developed skeletal branches were selected, directed along the row and horizontally fixed to wooden stakes during the first two years of growing plants. All other branches were deleted. In the spring of the following year, all vertical branches formed on the two main horizontal branches were limited in length by 60-70 cm. During the study period, particularly the development of aboveground parts of trees of cherries and sweet cherries was accompanied by the following physiological tests: the definition of net productivity of photosynthesis of leaves and leaf area of individual trees on a unit area of a garden [5].

RESULTS AND DISCUSSION

The development of trees in the garden, their early fruitfulness, and stable fruiting over the years of operation in ontogenesis significantly depends on the effective activity of the assimilation apparatus of plants.

The research showed that over the years of experiments, the productivity of leaf photosynthesis in the experimental variants mostly depended on the varietal characteristics of cherries.

Of the tested cherry varieties, with all methods of crown formation, the higher net productivity of leaf photosynthesis was observed in the Shpanka Chernaya (black) variety 34.63-35.33 g/m^2 per day. Low productivity of photosynthesis during the growing season was characterized by the cherry variety Shubinka 20.81-26.17 g/m^2 per day. The Podbelskaya variety had an intermediate position in this physical indicator. In our opinion, the high characteristic of the Shpanka Chernaya (black) cherry variety in terms of photosynthetic productivity in comparison with other cherry varieties is explained by the morphological structure of the aboveground part – the shortness and large size of the leaf plates.

Of the studied crown forms, the best physiological indicators of photosynthetic activity of leaves in the cherry variety Shpanka Chernaya (black) were noted in the flat and sparse-tiered crown variants, in the Podbelskaya variety the three-skeletal and five – skeletal wall variants, Shubinka-five-skeletal wall and sparse-tiered (table 1).

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Table 1
Influence of the cherry crown formation system on the net productivity of leaf photosynthesis, g/m² per day (2016-2019)

Variety	Crown form			
	flat	Fruit wall		Sparse-tiered – cont.
		three-skeletal	five - skeletal	
Shubinka - cont.	20,81	25,73	26,01	24,17
Podbelskaya	29,87	32,49	34,73	20,15
Shpanka Chernaya (black)	34,63	33,72	32,47	32,15
LSD_{05}	2,73	1,05	1,12	2,37

Among the studied sweet cherry varieties and artificial crown formations, the highest photosynthetic activity of leaves in the experiment was shown in the varieties Volovye serdtce and Bahor, which varied in the range of 23.49-42.65 g/m². Of the tested artificial crown forms, the best results of net leaf productivity were observed in the experiment when using a V-shaped crown shape. According to the studied cherry varieties, the value of this physiological indicator of the accumulation of plastic substances in the leaves of sweet cherry varieties was 35.33-42.65 g/m² of leaves. Also, high indicators of this factor were observed when using the KGB crown form, where the value of net leaf productivity was 34.55-41.71 g/m² of leaf area. When using the crown formation of sweet cherry trees in the form of an Austrian Bush, the net productivity of photosynthesis in comparison with KGB forms and the V-shaped value of photosynthesis was lower than 5-10%. The high photosynthetic activity of the leaves of the studied cherry varieties with the above artificial crown forms is explained by the small volumes of the tree crown and the high throughput of sunlight into the inner aboveground part of the plants (Table 2).

Along with the varietal characteristics of cherries, the photosynthetic activity of the leaves is naturally influenced by the number of leaves per individual tree and the area of leaf plates.

In our experience, the largest average size of leaf plates was the cherry variety Shpanka Chernaya (black) – up to 25.7 m²/tree, the smaller 25.9 m²/tree variety Podbelskaya and the smallest size of the variety Shubinka-14.4 m²/tree.

Table 2
Influence of the sweet cherry crown formation system on the net productivity of leaf photosynthesis, g/m² per day (2016-2019)

Crown forms	Varieties		
	Revershon	Volovye serdtce	Bahor
Simple bowl – cont.	20,42	24,60	23,49
KGB	34,55	41,71	39,73
Austrian Bush	30,40	36,70	34,96
V-shaped	35,33	42,65	40,62
LSD_{05}	3,4	1,0	0,7

Of the studied crown forms for growing the breed using intensive technology, the optimal one for the cherry variety Shpanka Chernaya (black) is a five-skeleton fruit wall, in which the area of leaves formed on a separate tree was 29.2 m², respectively. For the Podbelskaya variety, such conditions were created when forming a crown of the three-and five-skeletal wall type - 27.0 and 29.2 m²/tree, and the Shubinka flat – shaped crown and five-skeletal wall varieties-13.3 and 15.7 m²/tree (Table 3).

The trend of better photosynthetic activity of leaves in trees with a sparser crown shape is also explained by the experimental data shown in table 4.

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Table 3
Influence of the cherry crown formation system on the leaf surface area of trees, m²/tree (2016-2019)

Variety	Crown forms				
	Flat	Fruit wall			Sparse-tiered – cont.
		three-skeletal	five – skeletal	Free-growing	
Shubinka	16,5	13,3	15,7	12,9	13,6
Podbelskaya	24,3	27,0	29,2	24,5	24,7
Shpanka Chernaya (black)	26,4	26,1	27,3	20,4	23,6
LSD_{05}	1,3	0,7	1,5	2,5	3,3

Table 4
Influence of the cherry crown formation system on the leaf surface area of trees, m²/tree (2016-2019)

Crown forms	Varieties		
	Revershon	Volovye serdtce	Bahor
Simple bowl – cont.	18,53	23,49	21,36
KGB	21,39	23,92	22,40
Austrian Bush	20,38	24,74	23,57
V-shaped	22,45	21,69	21,09
LSD_{05}	0,7	0,4	0,2

The data from this table show that in those variants of the experiment, where the trees had a high accumulation of plastic substances, the size of the leaf plates was higher than in the control version of the crown formation of the "simple bowl" type. So, if in this version of the experiment for the studied sweet cherry varieties, the size of the leaf area varied within 18.53-21.36 m²/tree, then with other experimental artificial ones it was 20.38-24.74 m2/tree, it means, it increased by 15.8%.

The best conditions for the formation of more developed leaf plates were noted when using such cherry varieties as Volovye serdtce and Bahor with the formation of the KGB and V-shaped crown. In these variants of the experiment, the area of leaves per individual tree to the control variant increased by 21.1%.

Along with the formation of leaves on cherry trees, a significant role is played by chlorophyll cells contained in chloroplasts, which determine the efficiency of using solar energy by leaves for the formation of spare plastic substances.

In our studies, the content of chlorophyll in the leaves of the cherry varieties used was approximately the same and ranged from 12.13-12.85 mg/g of raw material. Due to the use of various artificial forms of tree crowns, a certain increase in their content in chloroplasts was observed in the cherry variety Shpanka Chernaya (black) in variants with three- and five-skeletal branches of the crown of 13.42 and 13.25 mg/g of raw matter. We believe that this method of crown formation is most acceptable for intensive cherry gardening (Table 5).

A study on determining the content of chlorophyll in sweet cherry leaves in connection with varietal characteristics and artificial forms of the crown of trees in the garden, showed that the shape of the crown in a certain way affect the content of chlorophyll cells in chloroplasts. The quantitative presence of these organelles has a stimulating effect on the processes of photosynthesis in leaves, plant growth and development.

Table 5
Influence of cherry crown formation types on chlorophyll content in leaves "a" and "c", mg/g of raw mass (2016-2019)

Variety	Crown forms				
	Flat	Fruit wall			Sparse-tiered – cont.
		three-skeletal	five - skeletal	Free-growing	
Shubinka	12,13	11,39	12,03	11,63	12,71
Podbelskaya	12,44	11,99	11,17	11,01	9,82
Shpanka Chernaya (black)	12,85	13,42	13,25	12,32	13,13
LSD_{05}	0,24	0,41	0,63	0,32	0,70

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Table 6
Influence of types of sweet cherry crown formation on the content of chlorophyll in leaves “a” and "c", mg/g of raw mass (2016-2019)

Crown forms	Varieties		
	Revershon	Volovye serdtce	Bahor
Simple bowl – cont.	12,86	14,17	13,50
KGB	14,12	15,56	14,82
Austrian Bush	13,72	15,12	14,40
V-shaped	15,73	17,33	16,51
LSD_{05}	0,8	0,2	0,3

Our study revealed certain differences in the content of chlorophyll in the context of experimental variants. Experiments have shown that in all varieties of sweet cherries, the formation of artificial crown shapes caused an increase in the content of chlorophyll cells “a” and “c” in chloroplasts from 12.86 to 17.33 mg/g of the raw substance of the leaf mass. In particular, in the Revershon sweet cherry variety, when forming the crown according to the KGB and Austrian Bush types, the content of both types of chlorophyll in the leaves was 13.72-14.12 mg/g, Bahor 14.40-14.82 and Volovye serdtce 15.12-15.56 mg/g per raw mass of leaves, respectively. The maximum level of chlorophyll content in the leaves of the studied sweet cherry varieties was detected at the V-shaped formation of the crown of sweet cherry trees of 1.73-17.33 mg/g of raw leaf mass (Table 6).

CONCLUSION

From the studied artificial forms of the crown, the best conditions for the photosynthesis process are provided in the cherry variety flat wall, sweet cherries - in the forms of the crown of KGB trees and the Austrian Bush.

When growing cherry varieties using intensive technology in three- and five- planar skeletal forms, sweet cherries in the form of KGB and Austrian Bush, the leaf surface area of an individual tree reaches 27.3-29.2 m^2, 24.74 and 29.2 m^2/tree, respectively, which is 27.2% more than in the Republic of sparse-tiered crown formation.

When cherry trees form crowns in the form of a fruit wall, and sweet cherries of the KGB type and the Austrian Bush in leaf chloroplasts, the content of chlorophyll "a” and "c" reaches 13.42-17.33 mg/g of raw leaf mass.

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