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THE INFLUENCE OF PRUNING ON VEGETATIVE GROWTH, YIELD AND QUALITY OF CHERRY FRUITS OF THE 'KORDIA' VARIETY GRAFTED ON 'MAXMA 14' (*PRUNUS AVIUM*)

Inna BÎLICI, Valerian BALAN, Vasile ȘARBAN, Corneliu BUZA, Dumitru TALPALARU

Technical University of Moldova, 168 Ștefan cel Mare şi Sfânt Blvd, Chişinău, Republic of Moldova

Corresponding author email: inna.bilici@h.utm.md

Abstract

The paper refers to the influence of tree pruning on vegetative growth, harvest and fruit quality of the Kordia cherry cultivar grafted onto the MaxMa 14 rootstock. Investigations at SRL "StarAgro Group" (Ustia village, Criuleni district) were organized in the central fruit-growing area of the Republic of Moldova, with the Kordia cultivar, grafted onto the Maxima 14 rootstock. The vegetative growth of the trees in the cherry variety under study is expressed, in quantitative terms, by the volume of vegetative growth accumulated annually through the height and width of the tree crown, through the size of the surface and volume of the crown, as well as the level of soil coverage by the vegetative ensemble of the trees. The cherry variety, Kordia, grafted on the MaxMa 14 rootstock, had yields from 18.10 kg/tree where pruning was performed during the dormant period, to 19.78 kg/tree in the variant where pruning was performed in early autumn.

Key words*: cultivar, rootstock, harvest.*

INTRODUCTION

Cherry cultivation is among the most attractive fruit crops because cherries are fruits (consumed fresh) appreciated, preferred and sought after by consumers, and the selling price is almost always high (Ivanov I. and Balan V., 2017).

The total area of the world occupied by cherries is over 440 thousand ha, and the global production of cherries is about 2.3 million tons per year, of which 35% comes from Europe. Given the favorable ecological growing conditions, in the Republic of Moldova cherries occupy approximately 4100 ha, with a fruit production of over 10 thousand tons annually, but with a fairly modest yield, below the world average (Cimpoieș Gh., 2018).

Among fruit crops, cherry has experienced the highest evolution in the last 20 years due to the new assortment of self-fertile, high-quality varieties, and the cultivar of vegetative rootstocks of low and medium vigor.

The multiple existing cultivar - rootstock associations, the numerous planting distances, as well as the diversity of biological material have required an increase in the number of researches on tree management systems (Long L. E. et al., 2014).

The pressing problems faced by fruit growers in cherry production are the efficient use of natural resources such as soil, light, slope and exposure of the land, etc. Therefore, it is appropriate to identify the biotic and abiotic factors that define the crop system, which corresponds to the biological production potential of the orchard and economic interests. Obviously, the following principles will be at the heart of the design of the orchard system: geographical conditions and the degree of natural fertility of the soil, the relative vigor of the cultivar-rootstock association, planting density, early and high yields; simple crowns easily adaptable to partial mechanization. At the moment, the cherry crop has varieties and rootstocks of different vigor, admits different forms of crown management, offers the possibility of using all crop systems, accepts the adaptation of the orchard to less fertile soils and sloping lands. (Balan V. et al., 2021).

In modern fruit growing, the cherry cultivation system provides for the introduction of rootstocks of low (Gisela 5), medium-low (Gisela 6, P-HL-C, Krymsk 6) and medium (Gisela 12, Krymsk 5, MaxMa 14, Piku 1, Piku 4) vigor, simple crown shapes, which fully utilize the nutritional space offered to the tree,

early entry of trees into fruiting, high quality and efficient harvests, mechanization of technological processes and increased labor productivity in maintenance and harvesting. At the same time, it is necessary to analyze not only biological and technological factors but also social and economic ones such as labor force, tree protection (frost, hail, rain, etc.), the use of fertilizers, irrigation and pesticides, mechanization of pruning and fruit thinning. Peșteanu A. and Șarban V., 2022).

Current scientific research shows that cherries have the role not only of satisfying the consumer with fresh fruit, but also have an opportunity as a raw material for the food industry, and due to their nutritional and therapeutic content, they are increasingly in demand on the market at a captivating price for producers. Cherry is cultivated everywhere and capitalizes on lands with varied slopes and soils, ensuring harvests every year (Peșteanu A. and Șarban V., 2022).

The improvement of pruning technology by introducing new methods obtained worldwide induces pressures on already existing cultivation technologies, and the latter must be shaped to maximize the superior biological potential of the new creations. One of the technological links that has successfully managed to maintain a reduced tree size is maintenance and fruiting pruning (Cimpoieş, 2000; Stefanco et al., 2009).

The purpose of this work is to evaluate the productivity and quality of cherry fruits of the Kordia variety depending on the types of pruning.

MATERIALS AND METHODS

Investigations at the LLC "StarAgro Group" (Ustia village, Criuleni district) were organized in the central fruit-growing area of the Republic of Moldova, with the Kordia cultivar, grafted onto the MaxMa 14 rootstock. The trees were planted in the fall of 2012 at a distance of 5 x 3 m, using the improved natural crown shape with reduced volume. Maintenance and fruiting pruning of cherry trees was carried out during the dormant period and the growing season according to the following variants: V1 - Pruning during the dormant period (control); V2 - Pruning during flowering; V3 - Pruning after harvest (July); V4 - Pruning in early autumn (first decade, September).

The experiment was organized in 4 repetitions of 8 representative trees in each.

Agrotechnical measures in the orchard are carried out in accordance with the recommendations in force. In the LLC "StarAgro Group" orchard, drip irrigation is used, and to monitor soil moisture, Watermark transducers are used, installed at 20, 40 and 60 cm depth in each plot. Water is distributed through mains with drippers fixed 40 cm from the ground in the direction of the row.

In experiments, in the first two years after planting the trees, the soil was maintained as a cultivated field, in the following years the distance between the rows remained grassed naturally or artificially. The strips between the rows are mowed as needed and remain as mulch. Herbicides or 2-3 mechanical plows are applied along the row of trees, with a rotary tiller.

RESULTS AND DISCUSSIONS

The vegetative growth of trees in the cherry cultivar under study is expressed, in quantitative terms, by the volume of vegetative growth accumulated annually through the height and width of the tree crown, the surface area and volume of the crown, as well as the level of soil coverage by the vegetative ensemble of the trees (Table 1).

After evaluating the relationships between the parameters of the structure of the fruit plantation, it was demonstrated that in the Kordia cultivar at a row spacing of 5 m, the crown height varies from 370 cm in 8-year-old trees to 400 cm in 11-year-old trees. The crown width at the base recorded maximum values of 230 cm in 8-year-old trees to 240 cm in 11-year-old trees.

The crown width at the top reached values of 92 cm in 8-year-old trees and a greater crown width at the top was recorded in 11-year-old trees.

The level of soil coverage with the vegetative ensemble receiving solar energy has values of 46.1-48.1%.

The lateral crown area varies from 16623 m^2/ha in 8-year-old trees and increased considerably in 2021, in 11-year-old trees it is 17982 m^2/ha.

Table 1. Structure of the vegetative ensemble of cherry trees (Kordia cultivar) depending on age and biological characteristics of the cultivar

Crown height, cm	Crown width, cm		Soil cover level, %	Lateral crown area, m^2/ha	The volume of the crown, m^3	
	at the base	at the top			tree	Ha
Year 2018, age of trees – 8 years						
370	230	92	46,1	16623	17.8	11902
Year 2021, age of trees – 11 years						
400	240	100	48,1	17982	20.4	13586

The crown volume, which depends on the crown area, in 8-year-old trees is 17.8 m3/tree and, respectively, 11902 m^3/ha. In 2021, the crown volume increased compared to 2018, and is 13586 m^3/ha. In the 11th year of vegetation, the Kordia cherry trees achieved an optimal crown area and volume, which characterizes the productive potential of the plantation.

Along with the growth and development of the trees, the crown height also increases. In 8-year-old trees, the height of the trees varies depending on the period of their pruning and is from 370 cm (Table 2) in trees where pruning was performed during the dormant period (control) to 400 cm in trees where pruning was performed in early autumn. In the variants where pruning was carried out during flowering and pruning after harvest, the height of the trees is 390 cm.

Table 2. Height of cherry trees (Kordia cultivar) depending on the period of tree pruning (cm)

Tree pruning period	Years			
	2018	2019	2020	2021
V1	370	380	390	400
V2	390	400	400	400
V3	390	400	400	400
V4	400	400	*395*	*415*

Trees aged 11 years (2021) have reached the optimal height, so in variants (1, 2, 3) where pruning was carried out during the dormant period, during flowering and after harvesting, the height of the trees is 400 cm. The trees reached a greater height in the variant where pruning was carried out in early autumn - 415 cm.

The growth in length of the shoots on the stem varies depending on the species, the cultivar - rootstock association, the age of the trees, the location of the branches in the crown and the agricultural techniques used (Babuc V., 2017). The growth potential is very high during the tree growth period and gradually decreases with age. Physical growth is intense in young trees, slow and prolonged in mature trees. (Cimpoieş Gh., 2020).

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The growth of branches is determined by the cultivar and age of the trees. Thus, in the orchard of SRL "Star Agro Grup", in the 8th year after planting, the average length of annual branches (Table 3) of the Kordia cherry cultivar was from 28.7 cm in the variant where pruning was performed during flowering to 42.7 cm in the variant where pruning was performed after harvesting. In the control variant, where pruning was performed during the dormant period, the average length of annual branches is 34.5 cm. In 9-year-old trees, the average length of annual branches increased compared to the previous year, so in trees where pruning was performed after harvesting this index is 50.6 cm.

Table 3. Average length of annual branches in cherry trees (Kordia cultivar) depending on the tree pruning period, cm

Tree pruning period	Years			
	2018	2019	2020	2021
V1	34.5	41.2	35.6	35.6
V2	28.7	32.5	29.6	30.7
V3	42.7	50.6	45.2	44.2
V4	38.7	42.8	45.3	44.2
DL 5%	3.48	3.74	8.26	4.16

In 2020, in 10-year-old trees, the average length of annual branches reaches higher values in the variants where pruning was performed after harvest (45.2 cm) and pruning in early autumn (45.3 cm).

In 2021, the trees grew equally well and the length of the annual branches reached 30.7-44.2 cm. The Kordia cultivar shows a greater growth of annual branches in the variants where post-harvest pruning and early autumn pruning were performed.

The cherry tree bears fruit on May bunches, medium and long branches. On average across varieties, about 75% of the flowering buds are formed on May bunches, and 25% on medium and long annual branches. On annual branches 30-45 cm long, flowering buds are located predominantly in the lower part. Most of the May bunches with higher productivity potential are located on 2-4-year-old branches.

According to Table 4, in the Kordia cultivar, the number of bouquet branches varies depending on the period of tree pruning but also depending on their location on branches of different ages. In 10-year-old trees, the number of rosettes on 2-year-old wood varies from 89.1 pcs. in the control variant (pruning during the dormant period) to 102.7 pcs. in the variant where pruning was performed during flowering.

Table 4. Number of bunch branches in cherry trees of the Kordia cultivar depending on the tree pruning period, pcs.

Tree pruning period	Rosettes on wood by:			Total, pieces
	2 years	3 years	4 years	
V1	89.1	45.5	3.0	137.6
V2	102.7	48.9	1.8	153.4
V3	99.6	54.9	6.1	160.6
V4	88.0	48.8	2.1	138.9
DL 5%	42.13	15.24	5.54	33.87

The number of bouquet branches on 3-year-old wood varies from 45.5 pcs. in the control variant to 54.9 pcs. in the trees where pruning was performed after harvesting. On 4-year-old wood, the number of rosettes is very small and varies from 1.8 pcs. in the variant with pruning during flowering to 3.0 pcs. in the control variant.

The density of cherry blossoms depends not only on the length of the branches but also on their age. In the Kordia cultivar, it is observed that the largest number of bouquet branches is formed on 2-year-old wood, followed by a smaller number on 3-year-old wood and very few rosettes on 4-year-old wood.

If we analyze this index in total, we can mention that the largest number of rosettes was recorded in variant 3 (cutting after harvest) 160.6 pcs.

The location of the buds in the cherry tree depends on the length of the branch on which they are formed (Table 5). Depending on the length of the annual branches, their diameter also differs, analyzing this index we can mention that with the increase in the length of the annual branches, their diameter will also increase, thus short branches 20-40 cm register a diameter of 5.8 mm compared to the length of the branches 20-100 cm which reached 12.8 mm in diameter.

Table 5. Distribution of buds in cherry trees of the Kordia cultivar depending on the length of annual branches, pcs.

Length of annual branches, cm	Diameter of annual branches, mm	Total number of buds, pcs.	Number of flowering buds, pcs.
20-40	5.8	17.8	7.7
20-60	7.4	21.4	5.4
20-80	9.8	28.0	4.6
20-100	12.8	36.0	3.4

The same pattern is observed if we analyze the total number of buds along the length of the annual branches, their number will increase from 17.8 pcs. on branches with a length of 20-40 cm to 36.0 pcs. on branches with a length of 20-100 cm.

In the 10th year of vegetation, 7.7 pcs. of flowering buds are found on short branches of 20-40 cm, 5.4 pcs. on branches of 20-60 cm, 4.6 pcs. on branches of 20-80 cm and 3.4 pcs. on branches of 20-100 cm.

It was found that the density of flowering buds is higher on short branches (20 cm) and decreases on medium (40 cm) and long (80-100 cm) branches.

Under favorable conditions for the development of photosynthetic processes and depending on the applied technology, high fruit yields can be obtained, which, in economic terms, would satisfy fruit producers and interest in the crop.

From the values presented (Table 6) regarding the fruit harvest, it results that the Kordia cultivar grafted on the MaxMa 14 rootstock, in the 7th year of vegetation, had a yield of 16.43 kg/tree in all the variants studied. In the 8th year of vegetation, the harvest practically doubled and is from 27.87 kg/tree in the variant where pruning was carried out during flowering to 32.13 kg/tree in the variant where pruning was carried out in early autumn. In 2020, the harvest decreased considerably in all the variants studied (9.61-10.86 kg/tree). In the following year (2021), in trees aged 11, the harvest practically tripled and recorded values of 27.47 (V1) - 32.03 (V4) kg/tree.

Table 6. Fruit yield of Kordia cherry trees depending on the period of tree pruning, kg/tree

Tree pruning period	Years							Mediate (2018-2024)
	2018	2019	2020	2021	2022	2023	2024	
V1	16.43	30.67	10.34	27.47	13.0	14.5	14.3	18.10
V2	16.43	27.87	9.81	29.27	13.7	13.2	14.3	17.79
V3	16.43	30.67	9.61	29.73	14.3	14.1	15.5	18.62
V4	16.43	32.13	10.86	32.03	15.7	15.4	15.9	19.78
DL 5%	-	0.74	0.69	2.33	1.76	2.47	1.04	-

In 2022, the harvest decreased and ranges from 13.0 kg/tree in the variant where pruning was performed in early autumn to 15.4 kg/tree in the variant where pruning was performed in early autumn. In the 12th year after planting, the fruit harvest of the Kordia cultivar reaches values of 13.2-15.4 kg per tree. Approximately the same harvest is recorded in the following year (2024) with the maximum harvest being 15.9 kg/tree in variant 4 (pruning in early autumn).

The cherry cultivar, Kordia, grafted on the MaxMa 14 rootstock, had yields from 18.10 kg/tree where pruning was performed during the dormant period, to 19.78 kg/tree in the variant where pruning was performed in early autumn.

Vegetative growth in trees is determined by biological factors (varieties, rootstocks, resistance to diseases and pests) and technological factors (fruit load, food and water supply), which condition the development of physiological processes (Balan V., Șarban V., Ivanov I., 2017).

CONCLUSIONS

The vegetative growth of trees in the cherry cultivar under study is expressed, in quantitative terms, by the volume of vegetative growth accumulated annually by the size of the height and width of the tree crown, by the size of the surface and volume of the crown, as well as the level of soil coverage by the vegetative ensemble of trees

Following the evaluation of the relationships between the parameters of the structure of the fruit plantation, it was demonstrated that in the Kordia cultivar at a row spacing of 5 m the crown height varies from 370 cm in 8-year-old trees to 400 cm in 11-year-old stands.

Along with the growth and development of the trees, the height of the crown also increases. In 8-year-old trees, the height of the trees varies depending on the period of their pruning and is from 370 cm in trees where pruning was performed during the dormant period (control) to 400 cm in trees where pruning was performed in early autumn. In the variants where pruning was performed during flowering and pruning after harvest, the height of the trees is 390 cm.

Cherry fruit on May bunches, medium and long branches. The density of May bunches in cherry depends not only on the length of the branches but also on their age. In the Kordia cultivar, it is observed that the largest number of bunch branches is formed on 2-year-old wood, followed by a smaller number on 3-year-old wood and very few rosettes on 4-year-old wood.

Under favorable conditions for the development of photosynthetic processes and depending on the technology applied, high fruit yields can be obtained, which, in economic terms, would satisfy fruit producers and interest in the crop. The cherry cultivar, Kordia, grafted on the Maxima 14 rootstock, had yields from 18.10 kg/tree where pruning was performed during the dormant period, up to 19.78 kg/tree in the variant where pruning was performed in early autumn.

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