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INFLUENCE OF PLANTING DISTANCE AND CROWN SHAPE ON THE GROWTH, PRODUCTIVITY AND QUALITY OF CHERRY FRUITS, GRAFTED ON GISEALA 6

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Abstract. *The study on the influence of planting distance and crown shape on cherry fruits in the pedoclimatic conditions of the central and northern areas of the Republic of Moldova in the period 2018-2024 aimed at assessing the impact of these factors on the growth, productivity and quality of the fruits. In the research, trees of the Early Star and Samba varieties were grafted onto the Gisela 6 rootstock and managed under the Thin Spindle, Cupă and Kym Green Bush crown forms, planted at a density of 1250 trees/ha. The Kordia and Sweet Stefany varieties were grafted onto the same rootstock, but managed according to the Thin Spindle, Structured Vertical Axis and Improved Thin Spindle crown systems, planted at a distance of 4x1 m, with a density of 2500 trees/ha. For all variants, parameters such as total yield, diameter and mass of cherries, as well as soluble dry matter content and titratable acidity of the fruits were determined. The Early Star variety achieved the highest yield in 2022 when the trees were managed according to the Thin Spindle crown shape, with an average of 8.8 kg/tree. The Kordia variety recorded the highest yield (9.64 kg/tree) when the trees were managed according to the Structured Thin Spindle crown shape. Although the Sweet Stefany variety has a lower yield overall, the highest production was obtained in the variant with management according to the Structured Vertical Axis system, with a yield of 7.11 kg/tree.*

Keywords: cherry variety, crown shape, harvest, fruit quality.

INTRODUCTION

According to data presented by FAO, in 2020 cherry was cultivated in 64 countries of the world. The estimated area for the last 10 years is 400-450 thousand ha,

with a small increase in the last two years. And the evolution of world cherry production, in the last 30 years, increased by 1.8 times. The average global harvest, in the last 10 years, was 5.3-6.2 t/ha [1, 2, 3].

The climatic conditions of the Republic of Moldova are favorable for cherry cultivation, which occupies 3.6% of the area of orchards. Modern technologies for cherry production offer new opportunities on the international market and, as a result, there has been a greater interest in cherry cultivation.

Currently, in the Republic, the wild cherry (Cerasus avium, L.) and Mahaleb (Cerasus mahaleb, L.) rootstocks are still used in cherry cultivation. Rootstocks of low (Gisela 5), medium-low (Gisela 6, Krymsk 6) and medium vigor (Maxima 14, Krymsk 5, Piku 1, Piku 4) are not fully used and there are still few studies on this subject in our country. Taking this situation into account, the Early Star, Samba, Kordia, Sweet Stefanny varieties grafted onto Gisela 6, at different planting distances and crown shapes, were studied [4].

In modern orchards, cherry tree pruning is applied every year, in order to maintain the balance between growth and fruiting, as well as to produce high yields of quality fruits [5, 6, 7]. In order to make cherry cultivation more efficient, it is necessary to reduce the volume and height of the trees when pruning trees and harvesting fruits. This goal can be achieved by using rootstocks of low and medium vigor, but also by applying pruning appropriate to the variety-rootstock association [8, 9, 10].

Cherry cultivation in modern orchards requires simplicity in the process of crown formation, pruning and maintenance, relatively free forms with reduced volume with a central axis and cup-shaped, early and stable quality harvests. [11, 12, 113, 14]. Small-volume, narrow fusiform crowns with a thickness of no more than 3 m, associated with small planting distances ensure the efficient use of solar energy in the formation of large harvests of qualitative fruits, labor productivity in manual work on pruning and harvesting fruits and a high degree of mechanization of technological work [15, 7,16]. Formation and pruning are important procedures for cherry trees, as they ensure the formation of an airy and balanced crown in space, early harvests, maintaining the final parameters of trees according to the reserved space [17, 18].

The issues addressed are aimed at promoting sustainable cropping systems that ensure early entry of cherry trees into economic fruiting, produce quality and healthy fruits, demanded and competitive on the market by identifying planting distances, the system of tree formation and pruning, as well as maintaining a balance between growth and fruiting. Currently, all sustainable, integrated cropping systems are being successfully introduced, based on geographical conditions, the degree of natural soil fertility, the relative vigor of the variety-rootstock association, planting density, simple crown shapes, early, high-quality and efficient harvests.

MATERIAL AND METHODS

The experiments were organized in 4 repetitions of 8 representative trees in each. The interaction of planting distance and crown shape was monitored, as basic factors that determine the entry of trees into fruit, the harvest and the quality of the fruits. Agrotechnical measures in orchards are carried out in accordance with the recommendations in force. In the orchards of SRL "StarAgro Group" in Dubăsari district and in the northern area, in Sturzeni, Rîșcani district, 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 the 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, 2–2.5 m wide, with weeds that grow naturally and artificially, are mowed as necessary and remain as mulch. Herbicides or 2–3 mechanical plows are applied along the row of trees, with a rotary tiller with a feeler.

Experiment 1 was established in the central orchard area in the fall of 2015 with the cherry varieties Early Star, and Samba, grafted on the Gisela 6 rootstock, with trees planted at a distance of 4x2 m, 1250 trees/ha. The rows of trees are located in the north-south direction. The following crown shapes with reduced volume were studied: C1 - Thin spindle; C2 - Cup; C3 - Kym Green Bush.

Experiment 2 is carried out in the northern fruit growing area with the varieties Kordia and Sweet Stefanny, grafted on Gisela 6, planted in 2018 at a distance of 4 x 1 m, 2500 trees/ha. Crown shapes are used: V1- Thin spindle; V2 - Structured vertical axis; V3 - Improved thin spindle.

RESULTS AND DISCUSSION

Cherry trees grafted onto Gisela 6 rootstock at the age of 6-7 years reached the optimum height, width and crown length for such orchards with trees planted at a distance of 4x2 m (tab. 1). In 6-year-old trees, higher values of tree height were recorded for the Early Star variety (400 cm) where the trees were trained according to the Cup crown shape. In 7-year-old trees, this index recorded higher values for trees trained according to the Thin Fus and Cup crown shapes in the Samba variety (400 cm). Crown width differs depending on the variety, the age of the trees and the crown shape. Therefore, in 6-year-old trees this index varies from 230 cm in the Samba variety with the Cup crown shape and Kym Green Bush to 250 cm in the Early Star variety with the Thin Fusiform crown shape. In the following year, an increase in crown width is observed in both varieties, but the Early Star variety records higher values compared to the Samba variety and this index varies from 243

cm in trees formed according to the Cup crown shape to 255 cm in trees formed according to the Kim Greem Bush crown shape.

Table 1. Phytometric indicators of cherry trees depending on the tree management system

(Gisela 6 rootstock, planting distance 4x2 m, tree age 6-7 years, SRL "StarAgroGroop")

Crown shape	Tree height, cm		Tree height, cm		Tree height, cm	
	The year 2020	The year 2021	The year 2020	The year 2021	The year 2020	The year 2021
Variety Early Star						
Slim Waist	369	385	250	244	211	240
Cup	400	375	236	243	220	251
Kym Green Bush	392	397	262	255	232	240
Variety Soiul Samba						
Slim Waist	397	400	236	253	200	250
Cup	385	400	230	246	234	245
Kym Green Bush	380	397	230	251	230	250

The crown length also varies from one variety to another and depending on the crown shape. In 6-year-old trees managed according to the Thin Fus crown shape, a crown length of 200 cm is recorded for the Samba variety to 211 cm for the Early Star variety. A greater crown length is observed in varieties formed according to the Cup crown shape 220-234 cm. Trees with the Kym Green Bush crown shape have a greater crown length compared to trees managed according to the other crown shapes 230-232 cm.

Research on the length and width of the crown of cherry trees in intensive cultivation systems demonstrates that the crown parameters depend on the variety and crown shape.

The growth of branches is determined by the variety and age of the trees. Thus, in the orchard of SRL "StarAgroGroop", in the 6th year after planting, the average length of annual branches (tab. 2) in the studied trees was 35.8-54.2 cm. In 7-year-old trees, the average length of annual branches varies from one variety to another and depending on the crown shape studied. The Early Star variety is characterized by a greater length of annual branches compared to the Samba variety.

Therefore, the average length of annual branches in the Samba variety is from 32.5 cm in trees managed according to the Cupă crown shape, up to 34.8 cm in trees managed according to the Thin Shaft and Kym Green Bush crown shapes. The average length of annual branches in the Early Star variety varies from 45.2-49.5 cm.

Analyzing the total length of annual branches, it is observed that the Early Star variety registers higher values compared to the Samba variety.

Table 2. Average and total length of annual branches of cherry trees depending on variety and crown shape, cm

(Gisela 6 rootstock, planting distance 4x2 m, tree age 6-7 years, SRL "StarAgroGroop")

Crown shape	Average length, cm		Total length, m	
	2018	*2019*	*2020*	*2021*
Variety Early Star				
Slim Waist	53,6	48,9	50,2	48,2
Cup	49,6	45,2	45,2	42,2
Kym Green Bush	54,2	49,5	47,4	45,4
DL 5%	*8,9*	*16,4*	*4,12*	*7,24*
Variety Samba				
Slim Waist	42,7	34,8	37,5	35,5
Cup	35,8	32,5	42,3	32,3
Kym Green Bush	40,5	34,8	35,1	33,1
DL 5%	*8,9*	*16,4*	*4,12*	*7,24*

In 6-year-old trees, in the Early Star variety, the total length of annual branches varies depending on the crown shape and varies from 45.2 m in trees trained according to the Cup crown shape to 50.2 m in trees trained according to the Thin Spine crown shape. In 7-year-old trees, this index decreased slightly, in all studied crown shapes and the largest total length of annual branches is recorded in trees trained according to the Thin Spine – 48.2 m. The Samba variety is characterized by shorter growth compared to the Early Star variety. In 7-year-old trees, the total length of annual branches varies from 32.3 m in the variant where the trees were trained according to the Cup crown shape, to 35.5 m in trees trained according to the Thin Spine crown shape. Regarding the harvest of the Early Star variety (Fig. 1) depending on the crown formation system, the highest average yield was obtained in 2022 in the case of the thin spindle crown form – 8.8 kg/tree. In the case of the Cup and Kym Green Bush crown forms in all the years of study, there are no large differences between the harvests.

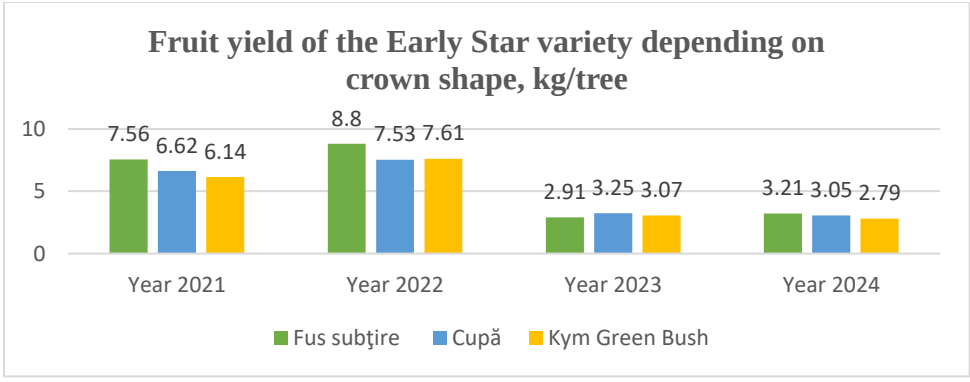


Figure 1. Fruit yield of the Early Star cherry variety depending on the crown shape *(Gisela 6 rootstock, planting distance 4x2 m, tree age 4-10 years, SRL "StarAgroGroop")*

In 2022, the Early Star variety recorded maximum yields in all crown shapes studied, but trees managed according to the Thin Spine crown shape are highlighted by a higher yield of 8.8 kg/tree compared to the Cup crown shape (7.53 kg/tree) and Kym Green Bush (7.61 kg/tree). In 7-year-old trees, the yield varies depending on the variety and crown shape (tab. 3).

The Kordia variety recorded a higher yield in the variant where the trees were managed according to the Thin Spine Structured crown shape (9.64 kg/tree) followed by the variant where the trees were managed according to the Thin Spine crown shape (9.32 kg/tree), and a lower yield in variant 3, the trees being managed according to the Improved Thin Spine shape (9.25 kg/tree).

The Sweet Stefanny variety is characterized by a lower yield compared to the Kordia variety, but we can mention that a higher yield is recorded in the variant where the trees were trained according to the Structured Vertical Axis (7.11 kg/tree). We note that the biological particularities of the variety, the crown shape and the planting distance greatly influence the fruit harvest.

Table 3. Fruit yield of cherry trees depending on variety and crown shape
(Gisela 6 rootstock, planting distance 4x1 m, year 2024)

Crown shape	Variety Kordia		Variety Sweet Stefanny	
	Kg/tree	t/ha	Kg/tree	t/ha
Submachine gun	9,32	23,30	6,55	16,37
Same vertical structuret	9,64	24,10	7,11	17,77
Upgraded sub-spindle.	9,25	23,12	6,66	16,65
DL 5%	1,39	1,85	1,39	1,85

All registered sunflowers in the study were harvested in a variant where apples had a fusiform crown shape, with a minimum planting distance (4x1 m) of crown shape. și Kym Green Bush (4x2 m).

Fruit yield shows that, similar to the majority of soybeans, the surplus unit remains an essential factor in assessing the technological efficiencies of cultivating its shareholder value. adaptability to modern cultivation technology, in varied natural conditions.

Fruit quality is genetic in nature, give this pubertal influence of action factor of technological means, is interested in obtaining higher fruit with ridiculous commercial value representing a greater representative pomology and soiului (tab.4). The variability of the maximum diameter of the masses around this sea depends on its shape, crown shape, period of harvest and the climatic conditions of the annuli. The threshold studied registered a diameter at the fruit of 28.41 mm the Kordia threshold to 30.82 mm the Sweet Stefanny threshold. Luate sun in studio produces high quality fruit.

Table 4. Influence of soil on cherry fruit quality

(Gisela 6, plant distance 4x1 m, submerged spindle crown, apple green 7 years, year 2024)

Vsriety	Screw diameter, mm	The target mass, g	Soluble extracted substance, Brix%	The firmness of cherries, kg/cm^2	Acidity of cherries, g malic acid/100 g fresh fruit
Kordia	28,41	10,21	18,65	3,04	0,67
Sweet Stefanny	30,82	12,11	19,05	3,26	0,65
DL 5%	1,25	0,45	1,13	0,12	0,12

Thus, the firmness of the fruits was 3.04-3.26 kg/cm2, the soluble dry matter was 18.65-19.05 °Brix, and the titratable acidity in the fruits was 0.65-0.67 g malic acid/100 g fresh fruit. We note that these results for the Kordia and Sweet Stefanny varieties, grafted on the Gisela 6 rootstock, are constant values and differ little from climatic conditions.

CONCLUSIONS

The study confirms that the crown shape and planting distance significantly influence the production and quality of cherry fruits, being essential for optimizing cultivation technologies in the specific conditions of the studied area.

The crown width differs depending on the variety, the age of the trees and the crown shape. Thus, in 6-year-old trees this index varies from 230 cm in the Samba variety with the Cup crown shape and Kym Green Bush to 250 cm in the Early Star variety with the Thin Spindle crown shape.

The crown length also varies from one variety to another and depending on the crown shape. In 6-year-old trees managed according to the Thin Spindle crown shape, a crown length of 200 cm is recorded in the Samba variety to 211 cm in the Early Star variety. A greater crown length is observed in varieties formed according to the Cup crown shape 220-234 cm.

In 2022, the Early Star variety recorded maximum yields in all crown shapes studied, but trees managed according to the Thin Spindle crown shape are highlighted by a higher yield of 8.8 kg/tree compared to the Cup crown shape (7.53 kg/tree) and Kym Green Bush (7.61 kg/tree).

The Kordia variety recorded a higher yield in the variant where the trees were managed according to the Thin Spindle structured crown shape (9.64 kg/tree) followed by the variant where the trees were managed according to the Thin Spindle crown shape (9.32 kg/tree), and a lower yield in variant 3, the trees being managed according to the Improved Thin Spindle shape (9.25 kg/tree).

The Sweet Stefanny variety is manifested by a lower yield compared to the Kordia variety, but we can mention that a higher yield is recorded in the variant where the trees were managed according to the Vertical Structured Axis (7.11

kg/tree). The variability in the size, diameter and mass of cherries is large and depends on the variety, crown shape, fruit harvest period and climatic conditions of the year. The studied varieties recorded a fruit diameter from 28.41 mm in the Kordia variety to 30.82 mm in the Sweet Stefanny variety.

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