THE IMPACT OF THE MECHANIZED CONTOUR PRUNING OF SWEET CHERRY TREES (*PRUNUS AVIUM L.*) OF THE CV SWEET STEPHANY, GRAFTED ON THE GISELA 6 ROOTSTOCK, ON FRUIT PRODUCTION AND QUALITY

EFECTUL TĂIERII MECANIZATE DE CONTUR A POMILOR DE CIREŞ (PRUNUS AVIUM L.) SOIUL SWEET STEPHANY, ALTOIT PE PORTALTOI GISELA 6, ASUPRA PRODUCȚIEI ȘI CALITĂȚII FRUCTELOR

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Abstract.
This work is a comparative analysis of the mechanized contour pruning of sweet cherry trees carried out after fruit harvesting in an intensive cultivation system in the northern zone of the Republic of Moldova (47.9163º; 27.4587º; 160 m.) The orchard of sweet cherry trees with slender spindle-shaped crowns of the Sweet Stephany variety, grafted on the Gisela 6 rootstock and planted at a distance of 4x1 m, was established in 2018. The method and degree of contour pruning during the vegetation period of the trees was studied. The fruit quality can be improved using contour pruning without affecting the crop yield. The weight of the fruit (10.92-11.19 g), in the groups where mechanized contour pruning was used, was significantly greater than the weight of the fruit grown using annual maintenance and fruiting pruning (10.75 g). Regardless of the technique and degree of pruning, the Sweet Stephany variety has produced more than 80% of fruit larger than 26 mm in diameter.
Key words: *Prunus avium* L., fruit tree pruning, yield, fruit quality

Rezumat.
Lucrarea prezintă o analiză comparativă a tăierii mecanizate de contur, după recoltarea fructelor, a pomilor de cireș în sistem intensiv de cultură în condițiile de nord a Republicii Moldova (47.9163º; 27.4587º; 160 m.) Livada a fost înființată în anul 2018, cu pomi din soiul Sweet Stephany, altoit pe portaltoiul Gisela 6, la distanța de 4 x 1 m, conduși după coroana fus zvelt. S-a studiat modul și gradul tăierii de contur în perioada de vegetație a pomilor. Calitatea fructelor poate fi îmbunătățită, folosind tăierea de contur fără a afecta randamentul culturii. Masa fructelor (10,92-11,19 g) în variantele, unde s-a aplicat tăierea mecanizată de contur, este semnificativ mai mare comparativ cu tăierea de întreținere și de fructificare aplicate anual (10,75 g). Indiferent de modul și gradul de

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tăiere a pomilor, soiul Sweet Stephany a format peste 80 % de fructe cu diametrul mai mare de 26 mm.

Cuvinte cheie: *Prunus avium* L., tăierea pomilor, randament, calitatea fructelor

INTRODUCTION

In intensive orchards, in which there is not an interdependence of crown training system, tree pruning, planting density and fruit number regulation, trees produce high yields but small fruit [Whiting, et. al., 2005, 2006; Balan and Sarban, 2021]. Typically, fruit yield and quality are controlled by pruning during the dormant period [Babuc, 2012]. But this approach may be insufficient for intensive orchards that produce high yields of fruit which are competitive on the market [Balan and Sarban, 2021]. Therefore, the fruit size can determine the future of a sweet cherry orchard. Thus, the yield and quality of sweet cherry fruit can be regulated by the pruning carried out during the vegetative dormant period of the trees [Long et al., 2014] and the pruning done during the vegetation [Balan and Sarban, 2023]. It was decided to estimate the impact of the mechanized contour pruning of sweet cherry trees (*P. avium L.*) during the growing season on the yield and quality of the Sweet Stephany sweet cherry variety grafted on Gisela 6 rootstock.

MATERIAL AND METHOD

The study was conducted in the northern fruit-growing region of Moldova, in a sweet cherry orchard (cv. Sweet Stephany on Gisela 6 rootstock, planted in 2018 at 4×1 m spacing) belonging to Sermofarm Company, Sturzeni village, Riscani district. Orchard management followed integrated pest control principles. The study aimed to assess how varying intensities of contour pruning affect yield and fruit quality in the Sweet Stephany variety (Table 1).

Table 1.

The method and degree of the contour pruning of sweet cherry trees (*P. avium L.*)

Group	The intensity of the contour pruning
G1	Maintenance and fruiting pruning done annually (control group).
G2	Mechanized contour pruning, after harvesting the fruit, on one side of the crown one year and on the other side the following year, observing the same side every two years, which is supplemented, in early autumn, by pruning inside the crown carried out annually.
G3	Mechanized contour pruning, after harvesting the fruit, on one side of the crown one year and on the other side the following year, observing the same side every three years, which is supplemented, in early autumn, by pruning inside the crown carried out annually.
G4	Mechanized contour pruning, to limit the height and width of the crown, is carried out once every three years, after harvesting the fruit, and supplemented, in early autumn, by pruning inside the crown carried out annually.

In order to determine the angle and depth of the brunch pruning at the "blind" limitation of the height and the lateral extension of the crown, using a tree trimming

machine, namely the FL 250P model, it is necessary to establish the distance between the tree rows (L) according to the geographical latitude of the locality (φ), the height of the crown (H), the width at the bottom of the crown (B), the angle of inclination of the lateral surface of the crown to the vertical (α) following the formula proposed by V. Balan, namely **L = H tg φ – Htg α + B** (Balan, 1996, 2001).

The first contour pruning, on both sides of the crown along the row, is done at an inclination angle of 12-13°, which corresponds to the natural shape of the crown, and the second pruning is done at an angle of 4-5° in relation to the vertical plane to the top of the tree, in order to avoid the compaction of the outer part of the tree crown (Balan, 2001). The contour pruning at the base of the crown is carried out at a distance of 70-80 cm from the symmetry plane of the crown. When carrying out contour pruning, the thickness at the base of the crown is maintained at 150-180 cm

The first contour pruning, when limiting the height, is carried out at 280-300 cm, the second is reduced by 30-40 cm compared to the first pruning to avoid the compaction of the crown in its upper part.

Four randomized groups of eight trees each were used to carry out the experiment. Fruits were harvested at the stage of consumption ripeness. The fruit in each variant from the 24 trees were weighed individually and reported per hectare. The number of fruits from 3 typical trees in each group was studied during the harvest. Fruit quality indices were assessed based on fruit weight (g), diameter (mm), soluble solids content (°Bx), titratable acidity expressed as % malic acid, and fruit hardness (kg/cm^2). The fruit weight was determined by weighing 1 kg of sweet cherries in each group using a digital scale (± 0.01 g) (AS 82/220.X2) and counting them afterwards. The soluble dry matter content was measured using the digital refractometer (DR201-95, Germany). The fruit diameter and firmness were determined using 20 cherries of each variety in four identical samples (n = 80).

The statistical processing of the data was carried out using the monofactorial dispersion, correlation and regression analysis methods (Dospehov, 1985).

RESULTS AND DISCUSSIONS

Crown structure significantly influences fruit yield, quality, and the efficiency of manual pruning and harvesting, justifying the study of mechanized contour pruning (Table 2). Mechanized pruning was performed in mid-July, followed by manual inner-crown pruning in early September.

Fruit yield. The fruit yield amounted to 6.03-6.43 kg/tree. The highest yield was recorded when the maintenance and fructification pruning were done annually (G1) and when the mechanized contour pruning, to limit the height and wideness of the canopy, was carried out every three years after harvesting, which was supplemented, in early autumn, by pruning inside the crown carried out annually (G4). The mechanized contour pruning, after harvesting the fruit, on one side of the crown one year and on the other side the following year (G2, G3) caused a slight decrease in the yield (6.03-6.13 kg/tree) as compared to the control group (6.36 kg/tree). The sweet cherry yields varied slightly depending on the pruning methods, since the orchard's structural indices were maintained at an optimal level, and the orchard maintenance process was at a high level.

Table 2.

The impact of the contour pruning on the production and quality of the Sweet Stephany sweet cherry variety grafted on Gisela 6 rootstock

Group	Yield		Number of fruits per tree, pcs	Fruit weight, g	Fruit diameter, mm
	kg/tree	t/ha			
G1	6.36	15.9	592	10.75	28.66
G2	6.13	15.3	561	10.92	28.89
G3	6.03	15.1	544	11.08	29.12
G4	6.43	16.1	575	11.19	29.27
LDS, 5%	0.45	1.07	35.42	0.15	-

Effects of fruit number. The number of fruits varied from 544 pcs/tree in G3 to 592 pcs/tree in the control group. The number of fruit in the groups, where mechanized contour pruning was used on one side of the crown in one year, and on the other side in the following year (544-561 pcs/tree) decreased insignificantly compared to the number of fruit in the groups in which maintenance and fruiting pruning was carried out annually (592 pcs/tree).

Fruit weight and diameter. Fruit weight varied depending on the tree pruning system. In the second year after the utilization of the mechanized contour pruning, the weight of the sweet cherries was 10.75-11.19 g. The fruit had a greater weight when performing mechanized contour pruning on one side of the crown in one year, and on the other side in the following year (10.92-11.08 g), and also for the purpose of limiting the height and width of the crown once every 3 years (11.19 g). The weight of the fruit (10.92-11.19 g) in the groups, where mechanized contour pruning inside the crown was done annually (G2, G3, G4), was significantly greater as compared to the weight of the fruit in the groups in which maintenance and fruiting pruning was carried out annually (10.75 g).

The diameter of the fruit at the time of harvesting directly depended on the weight of the fruit and amounted to 26.66–29.27 mm. In the groups in which mechanized contour pruning was carried out (G2, G3, G4), the diameter of the fruit was larger and significantly assured, compared to the diameter of the fruit in the groups in which maintenance and fruiting pruning was done annually (G1).

Fruit quality indices. The content of soluble dry matter slightly varied depending on the pruning used and was 17.81-17.95 °Brix (Tab. 3). The titratable acidity ranged from 0.63 to 0.64 g of malic acid per 100 g^{-1}. Data in Table 3 show that the firmness of the sweet cherry fruit was 3.25-3.28 kg/cm^2. The fruit diameter and weight had a minor impact on the fruit firmness. The firmness of the fruit in the Sweet Stephany variety was insignificant in the groups in which mechanized contour pruning was carried out, namely 3.3 kg/cm^2 in G2, 3.27 kg/cm^2 in G3 and 3.25 kg/cm^2 in G4, in comparison with the firmness of the fruit in the groups in which maintenance and fruiting pruning was done annually (G1), namely 3.28 kg/cm^2. Fruit quality indices in the Sweet Stephany variety, grafted on the Gisela 6 rootstock, were constant and varied slightly depending on the tree pruning system.

Table 3.

The impact of the contour pruning on the quality of the Sweet Stephany sweet cherry variety, grafted on Gisela 6 rootstocks

Group	Soluble dry matter (° Bx)	Titratable acidity, mg of malic acid per 100 g	Fruit firmness, kg/cm²
G1	17.81	0.64	3.28
G2	17.83	0.63	3.3
G3	17.80	0.63	3.27
G4	17.85	0.64	3.25
LSD, 5%	0.54	0.21	0.48

Fruit size distribution. The size of the sweet cherries changed depending on the pruning system. The size of the fruit was assessed by its diameter and weight, but the selling price of sweet cherries was determined primarily by the size and colour of the fruit, then by its firmness, taste and aroma. For these reasons, the sweet cherries were divided into groups depending on their diameter, namely 22-26 mm, 26-30 mm, 30 mm and larger (figure 1).

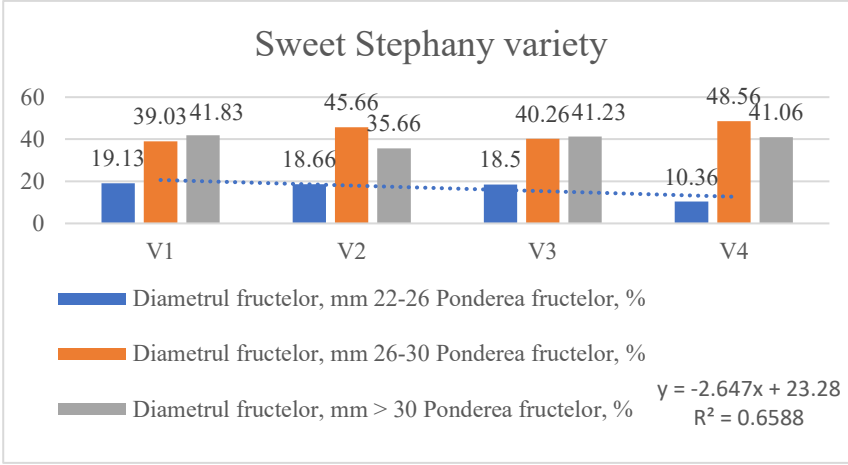

Fig. 1. The impact of the contour pruning on the distribution of fruit by diameter in the Sweet Stephany sweet cherry variety, grafted onto the Gisela 6 rootstock

The trees in the control group (G1) produced 19.3% of fruit with a diameter of 22-26 mm, 39.03% – with a diameter of 26-30 mm, and 41.83% – with a diameter of 30 mm and larger. In the groups in which mechanized contour pruning was carried out (G2, G3, G4), the fruit distribution by diameter was identical to the distribution of fruit in the groups in which the maintenance and fruiting pruning was done annually (G1), i.e. more than 80% of the fruit had a diameter larger than 26 mm and the fruit the diameter of which was less than 26 mm made up only 10.36-19.13%. The data obtained, regarding the fruit distribution by diameter in the Sweet Stephany sweet cherry variety, are significant and demonstrate a fairly high

level of reliability, where R^2 equals 0.6588.

CONCLUSIONS

The mechanized contour pruning of sweet cherry trees (*P. avium L.*) during the growing season is a practical approach aimed to improve fruit size distribution and reduce the manual labour in tree pruning. The weight of the fruit (10.92-11.19 g) in the groups, where mechanized contour pruning inside the crown (G2, G3, G4) was carried out annually, was significantly greater compared to the weight of the fruit where maintenance and fruiting pruning was done annually (10.75 g).

The method of tree pruning did not significantly affect the yield (15.1-16.1 t/ha) and the fruit quality of the Sweet Stephany variety, grafted on the Gisela 6 rootstock. The content of soluble dry matter (17.81-17.95 °Bx), the titratable acidity (0.63-0.64 mg malic acid in 100 g^{-1}) and the fruit hardness (3.25-3.28 kg/cm^2) did not depend on the method of tree pruning. Regardless of the method and degree of tree pruning, the Sweet Stephany sweet cherry variety, grafted onto the Gisela 6 rootstock, produced more than 80% of fruit with a diameter greater than 26 mm.

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