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YIELD AND QUALITY OF CHERRY FRUITS (*PRUNUS AVIUM* L.) DEPENDING ON TREE FORMATION AND PRUNING

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ABSTRACT

The objective of this study was to evaluate the effect of pruning during the dormant and growing periods on the production and quality of cherry fruits of the varieties "Record" and "Valerii Cikalov", grafted on Mahaleb rootstock, planted in 2003, at a distance of 6x5 m, and "Skeena" and "Stella", grafted on MaxMa 14, planted in 2012, at a distance of 5x3 m. Pruning applied on 3 – 5 year old wood led to an increase in fruit yield by up to 6.7 – 8.9 % for the varieties "Valerii Cikalov" and "Record". In the varieties "Skeena" and "Stella", pruning performed during the growing period had a major positive effect on quality. This practice stimulated the production of fruits with a diameter greater than 28 mm, registering an increase of up to 15.8 – 34.2 % compared to pruning performed on dry (dormant) wood. Pruning during the growing season has proven to be a practical method for improving fruit quality and size.

INTRODUCTION

The introduction of low and medium vigor vegetative rootstocks, the selection of self-fertile varieties, the use of fusiform crowns with reduced volume and high tree densities have had a positive impact on the production and marketing of high-quality fruit in cherry (Prunus avium L.) cultivation (Balan et al. 2017). In modern fruit cultivation, the chosen rootstock must meet several essential requirements: to ensure high and constant fruit yields with a quality accepted by consumers (Neilsen et al. 2007); to induce moderate tree growth; and to guarantee adaptability to adverse environmental conditions (pH, drought, low temperatures, drainage, salinity, diseases, insects) and stress factors (Ghena et al. 2004).

Although cherry quality depends mainly on the variety, it is also significantly influenced by the rootstock (Whiting et al. 2005), the cropping system (Babuc, 2012; Balan, 2015), the correct tree formation and pruning (Balan, 2015; Cimpoieș, 2018; Long et al. 2014), as well as by climatic and soil conditions. For this reason, evaluating the influence of the rootstock, the formation and pruning method on productivity (Balan et al. 2023) and fruit quality (Pești eanu et al. 2018) is particularly important. Numerous studies have shown that the rootstock can modify both the yield and earliness of the grafted variety, as well as the quality parameters of the fruit (size, firmness, soluble substance content, acidity, color and taste) (Claverie and Lauri, 2005a; Whiting et al. 2005), along with the growth vigor of the trees (Babuc,

2012; Claverie & Lauri, 2005b). Thus, both the regulation of yield and the improvement of the quality of cherry fruits can be achieved through pruning practices carried out during the vegetative dormancy period and during the growing season (Pește anu et al. 2018), with fruit size being considered an essential parameter for the future of a cherry orchard (Long et al. 2014; Neilsen et al. 2007).

Given the importance of the training and pruning method for each variety-rootstock combination in obtaining high yields and quality fruits, the aim of this study was to evaluate the effect of pruning during the dormant and growing periods on the production and quality of cherry fruits (Prunus avium L.) from: The variety 'Valerii Cikalov', grafted on the Mahaleb rootstock (P. mahaleb). The varieties 'Skeena' and 'Stella', grafted on the Maxima 14 rootstock (P. mahaleb x P. avium).

MATERIAL AND METHODS

The study evaluated the plantation planted in 2003, with a distance of 6 x 5 m between trees, with the varieties Valerii Cikalov and Record, grafted on seedling rootstock (P. mahaleb). The research also included a cherry plantation planted in 2012, with the varieties Skeena and Stella, grafted on the vegetative rootstock of average vigor Maxima 14 (P. mahaleb x P. avium), at a distance of 5 m between rows and 3 m per row.

The following pruning systems were investigated for the varieties Valerii Cikalov and Record:S1 – pruning for crown maintenance and fruiting, during the dormant period (control); S2 – pruning for crown maintenance and fruiting, during the vegetative period; S3 – successive pruning of semi-skeletal branches, in 3-5 year old wood, during the dormant period; S4 – successive pruning of semi-skeletal branches, in 3-5 year old wood, during the vegetation period.

Also, crown maintenance and fruiting pruning of cherry trees, of the Skeena and Stella varieties, was carried out during the dormant period and during the vegetation period, 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 of September).

Sampling was carried out both in the field and in the laboratory, to ensure a complete assessment of the characteristics of cherry trees and fruits. In the field, biometric measurements were carried out to highlight the influence of crown maintenance pruning on cherry growth and fruiting. In the laboratory, physiological and biochemical analyses were carried out to determine specific fruit parameters.

To perform the measurements, a digital caliper with an accuracy of ± 0.01 mm (TOLSEN Tools, 35053) was used, as well as a template equipped with cavities of diameters of 24, 26, 28, 30, 32 and 34 mm (VOEN). The fruit harvest was carried out at the stage of consumption maturity, from 32 trees for each variant studied. The fruit yield was expressed in kg per tree and reported to the area of one hectare. During the harvest, the position of the fruits was evaluated both inside the crown and on different branches, on three representative trees for each variant. For the analyses, 100 fruits were randomly harvested from 32 trees, which were evaluated at room temperature.

The samples were analyzed according to the mass and diameter of the cherries, dry matter content, firmness, total sugar content and acidity in %. Fruit mass was determined by weighing with an accuracy of ± 0.01 g (AS 82/220.X2). Fruit soluble dry matter was measured with the DR201-95 digital refractometer, expressed in Brix %. Firmness was assessed with the FT 327 penetrometer, which

measures the resistance of the pulp to the penetration of a 3 mm² piston, according to OECD guidelines. Fruit weight, diameter and firmness were determined per variety in 80 cherries (20 cherries x 4 samples).

Statistical analysis of the data was performed using analysis, synthesis, tabular, comparative and graphical methods. Means were compared using the Tukey test, at a significance level of 0.05 (Доспехов, 1985).

RESULTS AND DISCUSSIONS

Crown maintenance and fruiting prunings performed during the dormant period (S1) and the growing season (S2) led to lower yields compared to pruning performed by gradually rejuvenating 3 – 5 year old semi-skeletal branches during the dormant period (S3) and the growing season (S4). The results obtained highlight that the pruning method had a significant effect on fruit production in the case of the cherry varieties Valerii Cikalov and Record, grafted on the seed stock. In the 17th year after planting, the highest yield was recorded, with values of 21.8 – 23.9 t/ha for cv Valerii Cikalov and 28.6 – 31.4 t/ha for cv Record. In conclusion, the pruning method has a significant impact on the yield of cherry trees grafted on Mahaleb, influencing both the quantity and quality of the fruits. Applying appropriate and periodic pruning techniques contributes to obtaining optimal, healthy and high-quality harvests.

In the case of the cherry varieties Skeena and Stella, grafted on Maxima 14 rootstock, average yields were recorded between 12.01 – 13.71 t/ha for Skeena and 10.88-12.49 t/ha for Stella (Table 1). The highest yields, clearly significant, were observed for Skeena (13.72 t/ha) and Stella (12.85 t/ha) in the early autumn pruning variant. In 2021, record yields of 17.9 – 19.9 t/ha for Skeena and 17.2 – 20.3 t/ha for Stella were obtained. The lowest yields were recorded for trees pruned during the dormant period.

Table 1

Influence of pruning period on the yield of cherry trees grafted on MahMa 14, t/ha

Pruning period	Years						Average
	2019	**2020**	**2021**	**2022**	**2023**	**2024**	
Cv Skeena							
V1	8,79	10,05	17,9	11,27	10,79	16,1	12,48
V2	8,99	9,65	18,8	12,03	10,66	15,7	12,64
V3	8,85	9,25	18,2	13,38	11,05	17,7	13,07
V4	9,92	10,45	19,9	14,52	11,45	16,1	13,72
DL 5%	0,94	1,41	1,28	0,85	2,33	1,87	-
Cv Stella							
V1	8,5	5,4	17,2	12,41	10,79	13,0	11,21
V2	8,1	5,9	19,8	12,92	10,59	14,3	11,93
V3	9,1	4,6	19,3	13,87	10,59	14,1	11,93
V4	8,9	5,8	20,3	14,94	11,45	15,7	12,85
DL 5%	1,84	1,03	1,61	1,54	2,15	1,32	-

The yield of cv Skeena was 8.79 – 9.92 t/ha in 2019 and 9.25 – 10.45 t/ha in 2020, while for cv Stella, the yield was 8.1-9.1 t/ha in 2019 and 4.6-5.8 t/ha. The decrease in yield in 2019 – 2020 was caused by lower temperatures during flowering, and the pruning period did not influence this index. In 2021, the values were higher compared to previous years, and the highest production, 19.9 t/ha for Skeena and

20.3 t/ha for Stella, was recorded in the V4 variant, where pruning was applied in September. This period favored fruit growth and the deposition of fruit buds at the base of annual branches.

In 2022, the fruit yield decreased compared to 2021, being 11.28 – 14.52 t/ha for Skeena and 12.41 – 14.94 t/ha for Stella, with particularly significant values in the early autumn pruning variant. In 2023, the yield decreased again, being 10.66 – 11.45 t/ha for Skeena and 10.59 – 11.45 t/ha for Stella. In contrast, in 2024, the yield increased for both varieties, being significant in the case of early autumn pruning, with 16.1 t/ha for Skeena and 15.7 t/ha for Stella.

Effects on fruit weight by diameter. In the context of assessing the quality of cherries, given the variability determined by climatic conditions and maintenance technology, as well as the evaluation criteria based on diameter or weight, it was decided to analyze the distribution of cherries in fractions defined by diameter. Thus, fractions were established for cherries with a diameter of 24 mm and above, divided into 2 mm intervals (e.g. 24 – 25.9 mm, 26 – 27.9 mm, etc.). This method allows a more precise assessment of the size and, implicitly, the quality of the fruits depending on the orchard management and the techniques applied at the time of pruning the trees, according to the data in Table 2.

Table 2

Influence of the pruning period of cherry trees of cv Skeena, grafted on MaxMa 14, on the distribution of cherries according to their diameter.

Pruning period	Yield, t/ha	Distribution of cherries (%) according to their diameter (mm)				
		< 24	**24-25,9**	**26-27,9**	**28-29,9**	**> 30**
Year 2019						
V1 (m)	8,79	7,2	18,5	45,7	20.3	8,3
V2	8,99	5,7	20,1	47,6	19.0	7,6
V3	8,85	8,1	18,6	48,4	19,1	5,8
V4	9,92	4,4	15,9	45,5	20,1	14,1
LSD, 5%	0,96	-	-	-	-	
Year 2021						
V1 (m)	10,06	8,5	25,4	55,7	7,0	3,4
V2	9,66	9,1	22,6	58,6	6,2	3,5
V3	9,26	7,5	27,8	55,5	6,2	3,0
V4	10,46	4,5	21,9	57,8	9,4	6,4
LSD, 5%	1,01	-	-	-	-	

In 2019, trees pruned in the first ten days of September (V4) had the highest clearly significant yields – 12.9 % compared to the control (V1). In the control (V1) trees, 7.2 % of the fruits were 24 mm or less in diameter, 18.5 % – 24-25.9 mm, 45.7 % – 26-27.9 mm and 28.6 % of the fruits were 28 mm or more in diameter.

According to the observations, both pruning carried out during the vegetation period of the trees (V2, V3, V4) and that carried out during the dormant period (control) have a similar impact on the distribution of fruits in terms of their diameter. In both cases, 68.3 – 79.7 % of the fruits have a diameter greater than 26 mm, and the percentage of fruits with a diameter smaller than 24 mm varies between 4.4 % and 9.1 %. Also, pruning during the vegetative rest period (V1) and that carried out in the first ten days of autumn (V4) are characterized by a greater amount of fruits with a diameter of 28 mm and more, with percentages ranging between 28.6 % and

34.2 %. This indicates that these pruning periods favor the development of larger fruits compared to the other periods analyzed.

In 2020, the crop showed a yield of 9.26 – 10.46 tons per hectare, given that fruits with a diameter below 26 mm in the variant (V1) represented 33.9 % of the total. Fruits with a diameter of 28 mm and more constituted only 10.4 %. The same trends were observed during the growing season, where fruits with a diameter greater than 28 mm represented between 9.2 % and 15.8 % of the total.

Pruning trees in early autumn had a strong effect in reducing the share of small fruits to only 4.4 – 9.1 % of the total fruits and also promoted the production of high-quality fruits with a diameter > 28 mm to 15.8 – 34.2 % of the total fruits, achieving effects without affecting the total yield.

CONCLUSIONS

Crown maintenance and fruiting prunings performed during the dormant (S1) and growing (S2) periods led to lower yields, between 13.3 and 14.9 t/ha. In contrast, fruiting pruning by gradually rejuvenating semi-skeletal branches (3 – 5 years old) led to higher yields, between 14.2 and 16.1 t/ha, both during the dormant (S3) and growing season (S4). Pruning performed in early autumn led to an increase of over 70 % in fruit with a diameter of over 26 mm and reduced the percentage of small cherries (24 mm or less) by between 4.4 % and 9.1 %, while maintaining the final yield. The pruning method for branch renewal has a positive impact on cherry production, compared to maintenance and fruiting pruning performed during the dormant and growing periods.

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