THE IMPACT OF THE TIME OF PRUNING OF SKEENA VARIETY CHERRY TREES (*PRUNUS AVIUM* L.) ON THE FRUIT QUALITY AND YIELD

EFECTUL PERIOADEI DE TĂIERE A POMILOR DE CIREŞ (*PRUNUS AVIUM* L.) DIN CV „SKEENA" ASUPRA PRODUCȚIEI ŞI CALITĂȚII FRUCTELOR

BALAN V.[1], SARBAN V.[1]*
*Corresponding author e-mail: valerianbalan@gmail.com

Abstract. *The study was carried out between 2018 and 2020, in the central area of the Republic of Moldova. The purpose of the research was to assess the effect of the pruning of Skeena variety cherry trees (Prunus avium L.), grafted on the Maxima 14 rootstocks, during the rest and vegetative phase. The pruning was done as follows: during the rest period (control group), during the flowering period; after the harvesting (in July) and in early autumn (the first decade of September). The quantity of fruit 24 mm and downwards in diameter was small in all variant. The pruning performed in early autumn reduced the amount of small fruit and increased the number of the fruit the diameter of which was 28 mm and upwards. At the same time, the expansion of the fruit size led to a slight increase in the fruit yield. The content of the soluble dry matter and titratable acidity in the fruit was almost not affected. It is necessary to conduct researches into the pruning during the vegetative phase for the purpose of the improvement of the fruit quality and the distribution of the fruit by commercial sizes, without affecting the crop yield. A long-term study, on the other hand, would be needed to assess the impact of the pruning time on harvests and, especially, on the commercial type of fruit.*
Key words: *Prunus avium L.*, tree pruning, fruit yield, fruit quality

Rezumat. *Studiul a fost realizat în perioada anilor 2018-2020 în zona de centru a Republicii Moldova pentru a evalua efectul tăierii pomilor de cireș (Prunus avium L.) din cv „Skeena", altoit pe portaltoiul Maxima 14, în perioada de repaus și în perioada de vegetație: tăierea în perioada de repaus (martor); tăierea în timpul înfloririi; tăierea după recoltare (iulie); tăierea toamna devreme (prima decadă, septembrie). Fructele care aveau diametrul de 24 mm și mai mic au fost reduse în toate variantele. Tăierea toamna devreme a redus cantitatea de fructe mici și a promovat randamentul fructelor cu diametrul de 28 mm și mai mult, iar creșterea mărimii fructelor a fost însoțită și de o ușoară creștere a randamentului fructelor. Conținutul în substanța uscată solubilă și aciditatea titrabilă în fructe nu au fost afectate în majoritatea cazurilor. Tăierile în perioada de vegetație apar ca o studiere practică pentru îmbunătățirea calității și a distribuției fructelor pe mărimi comerciale, fără a afecta randamentul culturii, dar ar trebui studiate pe termen lung să fie efectuate pentru a evalua efectele perioadei de tăiere asupra randamentului și, mai ales, a categoriei comerciale a fructelor.*
Cuvinte cheie: *Prunus avium L.*, tăierea pomilor, randament, calitatea fructelor

[1]State Agricultural University of Moldova

INTRODUCTION

The utilization of productive varieties and different-vigour rootstocks have a significant impact on the tree yield, vegetative growth, precocity and fruit quality (Whiting *et al.*, 2005; Aglar *et al.*, 2019; Bujdosó and Hrotkó, 2012). Therefore, the variety-rootstock combinations used in cherry cultivation directly determine the tree formation system, the way and time of branch pruning, the system of tillage, irrigation and fertilization in orchards (Calabro *et al.*, 2009; Long *et al.*, 2014). At the same time the yield increases a lot, but in many cases the increase of the tree productivity, without the proper management of the crown in relation to the planting distance and the regulation of the number of fruits, leads to the production of small fruit (Whiting and Ophardt, 2005; Whiting *et al.*, 2005 a, b; 2006). The fruit size is an important quality index that determines the export market, yield and the future viability of an orchard. The pruning performed during the vegetative period, as compared to conventional pruning performed during the trees' rest period, is a technological process that improves the tree physiological balance (Long *et al.*, 2014), has a good impact on the number of fruits on a tree, and leads to an increase in fruit size and colour and a decrease in the incidence of brown rot (Lauri, 2005). In the Republic of Moldova, few scientific experiments on cherry tree pruning performed at different timeshave been carried out. No works have been found which would compare the effects of the pruning performed throughout the dormant season and during the vegetative phase.

The aim of this research was to increase the productivity of cherry orchards by evaluating the impact of the pruning time on the yield and quality of cherry fruit (*Prunus avium* L.) of Skeena variety. The pruning time included the maintenance and fruiting pruning of the cherry trees both during the vegetative and the rest periods.

MATERIAL AND METHOD

Location. The study was conducted between 2018 and 2020 in the central area of the Republic of Moldova. The orchard was planted on atypical clayey black earth. Within the horizon of 20 cm, the humus content accounted for 2.94%, at a depth of 20-40 cm – 1.85%, and at a depth of 80 cm it reached 1% and downwards.

The material used. The pruning time of the cherry trees of the Skeena variety grafted on the Maxima 14 rootstock was studied. The trees were planted in the autumn of 2012 at a distance of 5x3 m; the rows were north-south directed. Naturally ameliorated reduced volume crown shapes were used (Babuc, 2012).

Research methodology. The maintenance and fruiting pruning of the cherry trees were carried out during the rest and the vegetative periods as follows: in V1 – during the rest period (the control group); in V2 – during the flowering period; in V3 – after the harvesting (in July); in V4 – in early autumn (the first decade of September).

The basic objective of the maintenance and fruiting pruning of the cherry trees, grafted on the Maxima 14 rootstock, was to maintain the crown shape at the designed parameters and the physiological balance between growth and fruiting in order to obtain high quality fruit crops.

Sampling. The experiment was conducted using 4 randomized groups of 8 trees each. The trees were selected on the basis of vigour and uniform development.

Twelve trees of uniform vigour were selected in each group taking as a basis the diameter of the trunk 20 cm below the first main branch and using a digital calliper (±0.01 mm) (*TOLSEN Tools, 35053, China*).

The diameter of the cherries during the fruit ripening periods was identified with the help of a digital calliper and a template provided with holes of 24, 26, 28, 30, 32 and 34 mm (*VOEN, Germany*).

The fruit was harvested from 32 trees in each group at the stage of its consumption maturity; the fruit yield was expressed in kilograms of fruit per tree and per hectare.

The number of fruits was studied during the fruit harvesting using 3 typical trees in each group. 100 cherries were taken on trial at random from each tree, and evaluated at room temperature.

Annually, the fruit were analysed to determine their weight and diameter, the dry matter, the total sugar content, and the titratable acidity expressed in % of malic acid. The fruit weight was measured using a digital scale (±0.01 g) (*AS 82/220.X2*).

The soluble dry matter content in the fruit was measured using the digital refractometer (*DR201-95, Germany*). The weight, diameter and firmness of the fruit were determined testing 20 cherries in four identical samples (n=80) from each group.

The differences between the groups were compared at a significant level of 0.05 using the Tukey test.

RESULTS AND DISCUSSIONS

The shape, structure and dimensions of the crown play a major role in ensuring the conversion of solar energy in fruit, its quality, as well as the productivity of manual pruning and harvesting. These aspects generated the necessity to study a long period of tree pruning in the annual cycle (tab. 1). The maintenance and fruiting pruning of cherry trees in the first decade of September were carried out between 2018 and 2019; the pruning during the rest, flowering and post-harvest periods was carried out in the years 2019 to 2020.

Table 1

The impact of tree pruning on the production, number, weight and diameter of cherry fruit of Skeena variety grafted on the Maxima 14 rootstock

Pruning period	Yield, kg/tree	Number of fruits per tree, pcs	Fruit weight, g	Fruit diameter, mm
Year 2019				
V1	13.2	1211	10.9	28.3
V2	13.5	1250	10.8	28.3
V3	13.3	1231	10.8	28.7
V4	14.9	1296	11.5	29.6
LSD, 5%	0.94	-	0.38	0.85
Year 2020				
V1	15.1	1495	10.1	27.9
V2	14.5	1479	9.8	27.2
V3	13.9	1404	9.9	27.5
V4	15.7	1467	10.7	28.4
LSD, 5%	1.4	-	0.52	0.39

Fruit yield. In the first year of the researches, the cherry yield was 13.2-14.9 kg/tree. The highest quantity of fruit was obtained in V4, in which the pruning was carried out during the vegetative period.

The pruning performed during the rest period (V1), during the flowering period (V2) and after the harvesting (V3) resulted in a significant reduction in the yield per tree. The small harvest of 13.2-14.9 kg/tree was due to the unfavourable weather conditions during the flowering period. The non-essential reduction of yield was the result of the identical tree pruning technology used during the rest and vegetative periods (Babuc, 2012).

The 2020's cherry crop amounted to 13.9-15.7 kg/tree. The decrease of the fruit yield in 2020 was due not only to low temperature during the flowering period but also to the very high temperature during the vegetative period.

The impact of pruning on the number of fruits. The reduction in the number of fruits which occurred in 2019 after the pruning done during the vegetative dormancy (V1), the flowering period (V2) and after the harvesting (V3) suggested that the supply of fruits with carbohydrates almost did not depend on the pruning period. The pruning done in autumn, namely in the first decade of September, led to a significant increase in the number of fruits per tree by 3.7-7%. In 2020, the number of fruits varied from 1404 pcs/tree in V3 up to 1495 pcs/tree in the control group.

The number of fruits in the groups in which pruning during the flowering period (V2), after the harvesting (V3) and in early autumn (V4) was performed, was lower compared to the pruning performed during the rest period (V1).

The fruit weight and diameter. The weight of the fruit was great (9.8-11.5 g) and differed depending on climatic conditions and orchard management. In 2019, the weight of the fruit was 10.8-11.5 g when the fruit harvest was 13.2-14.9 kg/tree; in 2020 the weight of the fruit decreased and constituted 9.8-10.7 g when the harvest was 13.9-15.7 kg/tree.

The unfavourable weather conditions during the flowering period, expressed by low temperature and high humidity, as well as the high temperature during the vegetative period, lowered not only the yield but also the fruit weight.

The trees which were pruned during the rest period (V1) and in autumn, namely in the first decade of September (V4), produced cherries the weight of which was greater both in 2019 (10.9-11.5 g) and in 2020 (10.1-10.7 g), as compared with the trees which were pruned during the flowering period (V2) and after the harvesting (V3), but the data were not always statistically proved. The diameter and weight are interdependent.

Thus, in 2019 the diameter of the fruit was 28.3-29.6 mm, and in 2020 – 27.2-28.4 mm. Over the years, the trees which were pruned during the rest period (V1) and in the first decade of September (V4) produced larger diameter fruit as compared to the trees which were pruned during the flowering period (V2) and after the harvesting (V3), but the data were not always statistically proved.

The impact of pruning on the fruit quality parameters. The Skeena variety produces high quality fruit. Thus, in 2019, the quantity of the soluble dry matter was 18.3-19.2°Brix; in 2020 this content remained unchanged. In 2019, the titratable acidity in fruit was 0.63-0.66 mg of malic acid/100 g^{-1}; in 2020 it amounted to 0.72-0.75 mg.

It has to be mentioned that where the Skeena variety grafted on the Maxima 14 rootstock is concerned, these indices are constant and slightly differ from year to year and slightly depend on the tree pruning period (tab. 2).

Table 2

The impact of the tree pruning on the quality parameters of the cherry fruit of Skeena variety grafted on Maxima 14 rootstock

Pruning period	Soluble dry matter (°Brix)		Titratable acidity, mg of malic acid/100 g^{-1}	
	Year 2019	Year 2020	Year 2019	Year 2020
V1	18.8	18.7	0.65	0.74
V2	18.3	18.5	0.65	0.75
V3	18.5	18.7	0.63	0.72
V4	19.2	19.1	0.66	0.74
LSD, 5%	0.47	0.59	0.33	0.82

Fruit size distribution effects. The yield and quality of cherries change depending on climatic conditions and the time of tree pruning. The commercial value of the fruit is determined, first of all, by its size and colour, and then by its firmness, taste and fragrance.

From a commercial point of view, the cherry size is determined by the fruit diameter and weight, which can be further divided into fractions with a diameter smaller than 24 mm, 24-25.9 mm, 26-27.9 mm, 28 mm and upwards (Long, 2014).

Table 3

The impact of tree pruning on the distribution of fruit of the Skeena variety, grafted on Maxima 14 rootstock, depending on its diameter

Pruning period	Yield, kg/ha	Fruit diameter, mm			
		< 24	24-25.9	26-27.9	> 28
		Fruit weight, %			
Year 2019					
V1	8791	7.2	18.5	45.7	28.6
V2	8991	5.7	20.1	47.6	26.6
V3	8857	8.1	18.6	48.4	24.9
V4	9923	4.4	15.9	45.5	34.2
LSD, 5%	956	-	-	-	-
Year 2020					
V1	10056	8.5	25.4	55.7	10.4
V2	9657	9.1	22.6	58.6	9.7
V3	9257	7.5	27.8	55.5	9.2
V4	10456	4.5	21.9	57.8	15.8
LSD, 5%	1013	-	-	-	-

In 2019, the trees which were pruned in the first decade of September (V4) produced the largest quantity of fruit as compared with the control group (V1), namely 12.9%.

The quantity of cherries produced by the trees which were pruned during the flowering period (V2) and after the harvesting (V3) was identical to the crop produced by the trees which were pruned during the rest period (V1).

The trees in the control group (V1) produced 7.2% of fruit 24 mm and downwards in diameter, 18.5% – of 24-25.9 mm, 45.7% – of 26-27.9 mm and 28.6% of fruit 28 mm and upwards in diameter.

Where the pruning was performed during the vegetative period (V2, V3, V4), the distribution of cherries, depending on their diameter, was similar to that where the pruning was performed during the rest period (the control group), in the sense that more than 70% of the fruit were larger than 26 mm in diameter, and only 4.4-8.1% were smaller than 24 mm in diameter.

The pruning done during the rest period (V1) and the pruning performed in the first decade of September (V4) led to a higher yield of fruit 28 mm and upwards in diameter (28.6-34.2%).

The fruit yield indicators over the years of research were almost identical, namely 8791-9923 kg/ha in 2019 and 9257-10456 kg/ha in 2020, but the fruit 28 mm and upwards in diameter lowered considerably in 2020 as compared to 2019.

For example, the trees in the control group (V1) produced 10056 kg/ha of fruit, of which 33.9% were smaller than 26 mm in diameter, and only 10.4% were 28 mm and upwards in diameter.

The same regularity was registered where the trees were pruned during other periods of their development (V2, V3, V4) in the sense that a large amount of fruit (26.4-35.3%) were smaller than 26 mm in diameter, and only 9.2-15.8% of the fruit exceeded the diameter of 28 mm.

In conclusion, the following should be mentioned – the pruning performed in early autumn (V4) has contributed to the lowering of the percentage (4.4-4.5%) of fruit 24 mm and downwards in diameter, and to the increase of the yield (15.8-34.2%) of fruit 28 mm and upwards, without affecting the total yield.

Analysing the yield and diameter indices of the cherries of the Skeena variety, grafted on the Maxima 14 rootstock, according to the pruning time, and comparing them with the data of other authors (Ivanov *et al.*, 2015; Bennewitz *et al.*, 2016), it may safely be said that the tree pruning performed in early autumn is very efficient, and that the pruning done during the vegetative period influences the fruit size.

CONCLUSION

It is necessary to conduct researches into the pruning performed during the vegetative phase and dormancy for the purpose of the improvement of fruit size distribution.

The pruning time has not significantly affected the yield and quality of the cherries of Skeena variety grafted on Maxima 14 rootstock.

In 2019, the largest crop (9923 kg/ha) was produced by the trees which were pruned in the first decade of September, i.e. it was by 12.9% larger than in the rest of the groups; in 2020 the harvest was 10456 kg/ha.

The fruit size has been positively affected by the pruning performed in early autumn and during the rest period.

The quantity of fruit 24 mm and downwards in diameter has lowered regardless the pruning time.

The pruning done in early autumn has reduced the amount of small fruit and increased the yield of fruit 28 mm and upwards in diameter.

The content of soluble dry matter (18.3-19.2°Brix) and the titratable acidity in fruit (0.63-0.75 mg of malic acid/100 g^{-1}) practically have not changed.

The pruning done in the first decade of September greatly reduced the number of small fruit (4.4-4.5%) and increased the yield of fruit 28 mm and upwards in diameter (15.8-34.2%) without affecting the total yield.

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