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THE IMPACT OF THE PRUNING TIME ON THE BIOLOGICAL PROPERTIES OF CHERRY VARIETIES GRAFTED ON MAXMA 14

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ABSTRACT

Pruning is a basic procedure in the sweet cherry trees cultivation, which significantly affects the yield and quality of the fruit. The objective of this study was to examine the influence of the pruning time on the biological properties of sweet cherry trees (Prunus avium L.). The orchard in which the research was carried out was established in the central area of the Republic of Moldova in the fall of 2012. The Kordia and Regina sweet cherries, grafted on MaxMa 14, whose crowns had a naturally improved reduced volume, were planted at a distance of 5 x 3 m. The maintenance and fruiting pruning of the sweet cherry trees were done during the dormant and vegetation phases as follows. The flowering and fruit ripening time, the trunk cross-sectional area (TCSA), the number of fruiting buds and the fruit weight and yield were studied. The results showed that the pruning time had had a significant impact on the yield. The data on the yield of the Kordia and Regina sweet cherry varieties grafted on MaxMa 14 are promising and prove that the pruning done in the first decade of September has a positive effect on the fruit yield.

INTRODUCTION

In the Republic of Moldova, sweet cherry orchards are mainly planted with trees grafted on seed rootstocks such as Mazzard (*Prunus avium* L.) and Mahaleb (*Prunus mahaleb* L.). The trees are of great vigour, which makes it difficult to maintain the orchards, especially to perform pruning and harvesting (Donica et al., 2005, Milatović et al. 2011). In modern fruit growing, it is practically impossible to find fruit trees grafted on vigorous rootstocks (Long, Lynn E. et al. 2014, Gjamovski et al. 2016). The modernization of fruit growing processes provides for the utilization of semi dwarfing rootstocks (Gisela 5, Krymsk 6), moderate vigorous rootstocks (MaxMa 14, Piku 1, Piku 4) and semi vigorous rootstocks (Gisela 6, P HL-C, Krymsk 6), as well as the establishment of new orchards with self-fertile varieties of moderate vigour and high initial growth potential which are planted at high density (Balan 2015). Regardless of the technological procedures used in the orchards, pruning is a common practice that is applied every year in modern fruit production technology (Babuc 2012).

However, this approach may be insufficient for cultivar-rootstock associations that produce high crops of small fruit. To increase the value of cherry trees, the volume and height of trees should be reduced in order to increase labour productivity when pruning trees and picking fruit. This can be achieved by using

semi dwarfing and moderate vigour rootstocks and by applying appropriate crown shaping and pruning (Babuc 2012; Cimpoies 2018). Obviously, the pruning should be done during the maturity period in order to maintain the physiological balance between growth and fruiting, as well as to produce quality fruit (Balan et al. 2022).

The high productivity of the trees is due to the new self-fertile varieties, vegetative rootstocks and modern fruit production technologies. However, sometimes the fruit are of small size and, in some cases, the number of fruits is excessive and their quality is poor. (Long et al. 2014; Milošević et al. 2014). Climatic conditions in the Republic of Moldova are favorable for sweet cherry trees cultivation. The sweet cherry orchards occupy 3.6% of the whole orchard area in the republic.

Modern technologies for the production of sweet cherries open up new opportunities, resulting in a growing interest in sweet cherries cultivation.

The cultivation of trees grafted onto vigorous rootstocks sometimes leads to large fruit yields but smaller fruit due to reduced leaf/fruit ratio (Milatović et al. 2011). Intense orchard care is necessary to avoid large numbers of fruit, including pruning according to the cultivar and rootstock association used. Robinson et al. (2005) suggest that mature cherry trees grafted on semi dwarfing rootstocks should be pruned more intensively than the trees grafted on seed rootstocks. At the same time, with the introduction of semi-dwarf and moderate vigour rootstocks, the problem of timing of pruning arises.

Therefore, additional studies are needed regarding the pruning time, especially the pruning time of the vegetative and fruiting organs. The pruning done in early autumn, namely in the first decade of September, as compared to the conventional pruning done during the dormant phase, has a positive impact on the number of fruit and their size (Lauri P. 2005). So, maintenance and fruiting pruning of cherry trees should be applied to meet the requirements of cultivar-rootstock associations in order to optimize the balance between growth, yield, fruit size and economic value. Therefore, the aim of this study was to evaluate the influence of the time of the maintenance and fruiting pruning of the sweet cherry trees (*Prunus avium* L.), both during the dormant and the vegetation phases, on the biological properties of the Kordia and Regina varieties.

MATERIAL AND METHODS

The study was carried out during the years between 2019 and 2021, in the central area of the Republic of Moldova (the latitude 47.2544^{o}, the longitude 29.1258^{o} and altitude of 21 meters above sea level). Two cherry varieties were examined, namely the Kordia and Regina grafted on MaxMa 14. Trees with naturally improved crowns of reduced volume were planted at a distance of 5 x 3 m (666 trees/ha), and the rows were oriented from north to south (Babuc 2012). The maintenance and fruiting pruning of the cherry trees were done both during the dormant and vegetation phases as follows: G1 – during the dormant period (the control group); G2 – during the flowering period; G3 – after the harvesting (in July); G4 – in early autumn, namely the first decade of September.

The experiment was set up according to the block system, namely, 4 groups of 8 trees of the same variety each were used. The trees were selected based on the vigour and uniform development (Moiseicenco et al. 1994). The following measurements and observations were carried out during the experiment: the flowering and fruit ripening time, trunk cross-sectional area (TCSA), the number of fruiting buds per tree, fruit weight and yield.

In the spring, when the flower buds appeared, the fruit buds on 3 typical trees in each group were counted. At the stage of their maturity, fruit from 32 trees in each group were harvested. During the harvesting, the number and weight of fruit from three trees in each group were studied. The fruit mass was measured using a digital scale. Subsequently, the fruit buds and tree yield per 1 cm^2 of the cross-sectional area of the trunk was calculated.

The processed data are presented in average values per research years. The statistical data analysis was performed using analysis of variance and the LSD multiple range test at P≤0.05 to determine the significance of differences between variants. Differences between variants were compared at a significant level of 0.05 using the Tukey test (Dospehov, 1985).

RESULTS AND DISCUSSIONS

In the climatic conditions of the Republic of Moldova, the sweet cherry trees blossom in the third decade of April and at the beginning of May. It is absolutely necessary to know the timing, degree and order of flowering of different varieties in order to compile a list of pollinators, fight frosts and organize spring work in time (Budan & Gradinariu 2000; Sestras, 2004). In terms of flowering time, the studied varieties differ from each other by only 5 days (Tab.1). Earlier flowering was recorded in the Kordia variety (April 25), while the Regina variety started flowering only in 5 days. There are no differences in flowering time between the studied varieties depending on the pruning time. In both varieties, regardless of the pruning time (G1, G2, G3, G4) the beginning and end of flowering were the same.

Table 1

The phenological characteristics of sweet cherry varieties depending on the pruning time (on average, 2019-2021).

Pruning time	Flowering date		Flowering time, days	Harvesting date
	beginning	end		
Kordia variety				
Pruning during the dormant phase (control)	25.04	04.05	10	02.07
Pruning during the flowering period	25.04	04.05	10	02.07
Pruning after the harvesting	25.04	04.05	10	02.07
Pruning done in early autumn	25.04	04.05	10	02.07
Regina variety				
Pruning during the dormant phase (control)	30.04	08.05	9	16.07
Pruning during the flowering period	30.04	08.05	9	16.07
Pruning after the harvesting	30.04	08.05	9	16.07
Pruning done in early autumn	30.04	08.05	9	16.07

The average flowering time lasted 10 days in the Kordia variety and 9 days in the Regina variety. In both varieties, the pruning time did not affect the beginning, end and duration of flowering.

The results of the influence of pruning period on the number of fruiting buds, trunk cross-sectional area (TCSA), fruit weight and yield in the Kordia and Regina sweet cherry cultivars are presented in Tables 2 and 3. The number of fruiting buds varies in the Kordia variety from 143.3-161.6 pieces in 2019 to 183.6-201.8 pieces/tree in 2021. The same trend was noted in the Regina variety, i.e. the number of fruit buds increased as the trees matured. The pruning time did not

significantly affect the number of fruiting buds, because the maintenance and fruiting pruning of the cherry trees were done identically.

Table 2

The impact of the pruning time on the number of fruiting buds, trunk cross-sectional area (TCSA), fruit weight and yield of Kordia sweet cherry variety

Pruning time	Fruiting buds, pc/tree	TCSA, cm^2	Fruiting buds, pc/cm^2 TCSA	Fruit weight, g	Yield, kg/tree	Yield, t/ha	Yield, kg/cm^2 TCSA
Year 2019							
G1	147,6	10,4	14,2	10,5	30,6	20,4	2,9
G2	143,3	10,4	13,8	9,9	27,8	18,6	2,6
G3	161,6	11,0	14,7	10,1	30,6	20,4	2,7
G4	148,3	10,7	13,8	10,8	32,1	21,4	3,0
LSD, %	55,4	-	-	0,4	1,57	-	-
Year 2021							
G1	197,6	11,9	16,6	11,9	27,4	18,3	2,3
G2	183,6	11,8	15,6	10,8	29,2	19,5	2,5
G3	201,8	12,1	16,6	11,5	29,7	19,8	2,4
G4	188,7	12,0	15,7	11,4	32,0	21,3	2,7
LSD, %	34,9	-	-	0,8	1,45	-	-

The trunk cross-sectional area (TCSA) was 10.4-12.1 cm^2 in the Kordia variety, and 10.5-12.5 cm^2 in the Regina variety. The difference between the varieties was not significant, because the studied trees were selected identically and the pruning was homogeneous during the pruning time. On the other hand, while the trees were aging, the TCSA increased in both varieties. The number of the fruiting buds per TCSA differed slightly depending on the pruning period. Thus, in 2019, the Kordia variety in the G1, in which the pruning was done during the rest period (the control group), 14.2 buds/cm^2TCSA were recorded, and in G4, in which the pruning was done in early autumn, the number of buds was 13.8 pcs/cm^2 TCSA.

The same tendency was recorded in 2021, but with a higher intensity of 15.6-16.6 fruiting buds/cm^2TCSA. The Regina variety, being a self-sterile variety, recorded a density of 13.7-14.6 fruiting buds/cm^2TCSA in 2019 and 15.5-16.6 buds/cm^2TCSA in 2021. It is worth mentioning that the pruning time did not have any impact on the density of fruiting buds per TCSA.

Fruit weight, which is the main indicator of sweet cherry fruit, was 9.9-11.9 g for the Kordia variety and 10.9-13.1 g for the Regina variety. The difference in the mass of the fruit depending on the pruning time was not significant. The weight of the fruit depends more on the climatic conditions and the yield. The average fruit mass of the Regina variety in 2021 (10.9-13.1 g) was significantly higher than in 2019 (9.9-11.9). This increase was due to the low yield in 2021, the unfavourable weather conditions during the flowering period, namely low temperatures and high atmospheric humidity.

The yield of Kordia cherry orchards in 2019 was 27.8-32.1 kg/tree, and 27.4-32.0 kg/tree in 2021 (Table 2). The yield of the Kordia variety was at the optimal level for intensive cherry orchards and amounted to 18.6-21.4 t/ha in 2019 and 18.3-21.3 t/ha in 2021. The productivity level of the Kordia variety in 2019 was significantly higher (32.1 kg/tree) in G4, in which the trees were pruned in early autumn. In 2021, a higher yield was also recorded in G4, in which the pruning of the trees was carried out in the first decade of September.

Table 3

The impact of the pruning time on the number of fruiting buds, the trunk cross-sectional area (TCSA), the fruit weight and the yield of the Regina variety.

Pruning time	Fruiting buds, pc/tree	TCSA, cm^2	Fruiting buds, pc/cm^2 TCSA	Fruit weight, g	Yield, kg/tree	Yield, t/ha	Yield, kg/cm^2 TCSA
Year 2019							
G1	161,6	10,7	14,1	11,2	27,7	18,5	2,6
G2	155,3	11,0	13,7	10,9	27,5	18,3	2,6
G3	137,3	11,1	14,6	10,5	29,4	19,6	2,7
G4	140,0	10,5	13,8	11,6	31,1	20,7	2,9
LSD, 5%	44,3	-	-	0,44	1,92	-	-
Year 2021							
G1	221,6	11,9	16,6	13,0	6,3	4,2	0,52
G2	225,9	12,5	15,5	12,6	6,7	4,5	0,57
G3	197,3	12,3	16,6	13,1	8,1	5,4	0,67
G4	190,4	12,1	15,7	12,8	8,6	5,7	0,72
LSD, 5%	56,8	-	-	0,35	2,34	-	-

The yield per unit area is directly proportional to the yield per tree. Higher harvests of over 20 t/ha were recorded when the trees were pruned in early autumn, the first decade of September. The yield increased because the annual branches produced buds. The yield of Kordia variety in 2019 (2.6-3.0 kg/cm^2 TCSA) was slightly higher compared to the yield in 2021 (2.3-2.7 kg/cm2 TCDS).

The yield of the Regina variety was 27.5-31.1 kg/tree in 2019 and 6.3-8.6 kg/tree in 2021. Yields in 2019 were significantly higher for the trees pruned in early autumn. Thus, in the groups G3, in which the pruning was done after the harvesting (in July), and G4, in which the pruning was done in early autumn in the first decade of September, the harvest increased by 6.1-12.2% compared to G1, in which the pruning was performed during the rest period (the control group). The harvest in 2021 essentially decreased due to low temperatures during the flowering and fruit formation periods – the yield was only 6.3-8.6 kg/tree. The trees in G4, in which the pruning was done in early autumn, registered the highest values. That was possibly due to the differentiation of the flower buds at the base of the annual branches, when the pruning was carried out in the first decade of September. In the Regina variety, the yield per tree in 2019 was much higher (2.6-2.9 kg/cm^2TCSA) compared to 2021 (0.52-0.72 kg/cm^2TCSA). In 2019, the yield in G4, in which the pruning was done in early autumn was higher (2.6 kg/cm^2TCSA) as compared to the control group (2.9 kg/cm^2TCSA). In 2021, a low yield was recorded in all groups (Table 3).

In Serbia, Milošević et al. (2014) reported a yield of 0.029 kg/cm^2TCSA in the 5-year-old trees of the Summit variety grafted on Mazzard, and a yield of 0.041 kg/cm^2TCSA in the trees grafted on the Colt rootstock. Analysing the yield values presented in tables 2 and 3, compared to the data offered by Milošević et al. (2014), it can be said that they are large.

CONCLUSIONS

The pruning time did not have any impact on either the flowering time or the harvest time. The fruit weight of the tested sweet cherry varieties was significantly influenced by the climatic conditions. Fruit of higher weight was obtained when the yield was reduced. The yield per tree and per unit area were

influenced by the pruning time. The obtained results on the yield of sweet cherries of the Kordia and Regina varieties, grafted on MaxMa 14, are encouraging and testify to the positive effect of pruning carried out in the first ten days of September. Further research is needed to find proper pruning procedures during the growing season.

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