Fruit Growing Research, Vol. XXXIX, 2023 DOI 10.33045/fgr.v39.2023.12
https://publications.icdp.ro/index.php

CERCETĂRI PRIVIND INFLUENȚA TĂIERILOR ASUPRA MUGURILOR DE ROD ȘI A PRODUCȚIEI DE FRUCTE LA CAIS

RESEARCH ON THE INFLUENCE OF PRUNING ON FRUIT BUDS AND FRUIT YIELDS IN APRICOT TREES

Lămureanu Gheorghe[1], Tudor Marian[2], Gavăt Corina[1], Opriță Alexandru Vlăduț[1], Moale Cristina[1], Caplan Ion[1]
[1]Research Station for Fruit Growing Constanța, Romania
[2]Ovidius University Constanța, Romania

Abstract

The apricot (*Prunus armeniaca* L.) is one of the most appreciated species of fruit trees in Romania, due to its high-quality fruits, which can be valued at a high price. In recent years we have been experiencing very low temperatures during spring time, with severe frosts and hoarfrosts that negatively influence the production of this species. The study was carried out at Research Station for Fruit Growing Constanța from 2018 to 2022 in a plot of apricots in the period of maximum fructification on three varieties with different fruit ripening periods - early, middle and late, in order to establish a connection between the times of application of pruning and the number of fruit buds differentiated on perennial and annual branches. In the apricot cultivars studied, the obtained results indicate that pruning at the beginning of the dormancy period (November) is beneficial within the years without climatic accidents, obtaining yields of 25 t/ha.

Cuvinte cheie: soiuri, tăieri, producție, greutate fruct.
Key words: cultivars, pruning, yields, fruit weight.

1. Introduction

The apricot finds optimal growing and fruiting conditions in the South-Eastern part of Romania, where it provides important productions with a high selling price. Consumers appreciate the quality of the fruit, the special flavor, the fineness of the orange flesh and the fact that they can be eaten fresh from the first decade of June until the second decade of August. Apricots can be used as compote, jam, comfiture or candied, etc. (Cociu, 1993; Bălan, 2008). Current climatic conditions, characterized by dry summers, winters with predominantly positive temperatures and springs with late frosts and returning mists, require a reorientation of certain technological sequences in apricot growing, including tree pruning. Thinning and fruiting pruning in apricot considerably improves branch regeneration and reduces crown size and height, thus forcing the fruit to remain close to the main skeleton branches (Demirtas et al., 2010; Szklarz et al., 2011). Green pruning of apricot (Ghiță and Drăgănescu, 2008) results in a much more vigorous growth of greedy shoots, which still requires a land intervention and considerable effort during the fruit harvesting season as well as during dormancy. How to cut the apricot trees: remove most of the greedy shoots that form an umbrella at the top of the crown that keeps out light and air. Depending on the vigor of the tree, choose between 4-6 greedy shoots which are shortened to 60-80 cm and which will be garnished with fruit buds. Remove dry, diseased and mechanically damaged branches. Two- to three-year-old half-islet branches are shortened by a third, above a well-developed branch and in a position that favors the resumption of growth and fruiting. Branches older than four years are removed and replaced by new annual branches in their vicinity.

2. Material and methods

The study was carried out at Research Station for Fruit Growing (RSFG) Constanța during 2018-2022 period, in an apricot lot planted in 2011, in its peak fruiting period. Three varieties with different fruit ripening periods -early ('Elmar' cv.), middle ('Mamaia' cv.) and late ('Sulmona' cv.) were followed. The rootstock used for grafting is 'Constanta 14'. Planting distance is 4m/4m and tree density is 625 trees/ha. Trees are trained as improved pot; each variant/timing of pruning was carried out on a number of 15 trees linearly arranged as follows: after fruit harvesting (V1), when entering dormancy in November (V2), when entering vegetation in March (V3).

The study aimed to establish a link between the timing of pruning and the number of differentiated fruiting shoots on multiannual and annual branches, the influence on fruit production and fruit quality under current climate change.

The following observations and determinations were made:

- Taking into account the variety and the time of pruning application, flowers were counted at different tree heights (50-120 cm; 120- 190 cm; 190-260 cm).

- Fruit yield was assessed by weighing the fruit from each tree in the experiment by variants and average yields were calculated for the years of the study (2018-2022).

- Percentage of stone was calculated and determinations of average dry matter content (%) and acidity (% malic acid) were made.

SPSS Statistics 29.0.1.0 software was used for statistical calculation. Climatic data were monitored using the IMT300 weather station at the RSFG Constanța.

3. Results and discussions

Climate data recorded at SCDP Constanta during 2018-2022

In apricot, the onset and progression of the fruiting phenophase is conditioned by the emergence from dormancy, which can occur in early spring, when after a period of 7-10 days temperatures of 5-6 ºC are recorded; in the white button phenophase it resists up to -4.4 ºC, and apricot flowers resist up to -2.2 ºC, the bound fruits are destroyed at a temperature of -1.0 ºC. Climate data for the period January-April 2018-2022 are shown in table 1. Temperature ranges between 29.9ºC (April, 2019) and 32.4ºC (March, 2022), but also late fogs (April 2019, March and April 2021) were recorded, which influenced fruit production. With climate change, lower yields were recorded in early varieties of apricot due to return frosts and late mists in March and April.

Influence of the timing of pruning on fruit buds and fruit production

From the study in apricot, it was found that fruit bud differentiation also depends on the time of pruning, Table 2. In all varieties studied, most flowers were counted in the variant of applying pruning at the trees' dormant entry (November), because, by removing greedy shoots, apricot uses the nutrient resources for the carefully preserved multiannual fruiting branches following thinning and fruiting pruning.

The presence of flowering buds in the crown is different in all the varieties of apricot studied, most flowers were counted, also in the variant of applying cuttings in the resting period (November) in the upper part of the crown, at the height of 190-260 cm: 'Elmar' and 'Sulmona' cvs. were noted with percentages of 58% and 62% respectively, and in the lower part of 16%-17%. The trees fruited more in the upper part of the crown due to the occurrence of the polarity process, but also due to frosts and low temperatures in certain periods which are more intense near the ground and affect the flowers positioned in the lower part of the crown.

In all three times of pruning application, 'Elmar' cv. early apricot variety formed the most flowers, between 243 and 277 respectively, possibly because the trees have a longer growing period without fruit, Table 2.

The same trend was observed for fruit production, which was higher in the variant of applying the cuttings at the time of entering the dormant period in November, Table 3. The 'Elmar' cv. (with early fruit ripening) responded best to this technological work, but only in years without climatic accidents (2018, 2021), when average yields of 28 - 29 kg/tree were recorded. On the other hand, the 'Sulmona' cv. had good yields, ranging from 15-28 kg/apple in all years of the study, due to the fact that it flowers later which helps it to escape from the return frosts and late fogs.

In all three varieties studied, the highest average fruit weight was recorded in the variant applying cuttings at the beginning of the dormant period, 63 -75 g (Table 4).

Analysis of the statistical significance of the results obtained

In order to better evaluate the effect of the treatments applied to the trees of the three varieties, the results were statistically analyzed. The confidence interval chosen for the analyses was the standard 95% (p=0.05). Hence, the main descriptive parameters and the results of the ANOVA tests can be seen in Tables 5 to 10. As can be seen, the p-value in all cases is well above the 95% confidence interval ($p>0.05$), leading to the conclusion that the way in which the pruning were made played a secondary role in determining the number of flowers.

In terms of fruit yield, the effect of the three pruning variants seems however to be strongly significant for 'Elmar' and 'Sulmona' cvs. ($p<0.05$) for all five years of experimentation, while for 'Mamaia' cv. only for 2020 and 2022 (tables 11 - 16).

4. Conclusions

Current climatic conditions in recent years, with long autumns and mild winters, are forcing a change in pruning season for this species;

The shrub rots on long second-year branches and best on May clusters that are on multi-year fruiting branches. By pruning we help the tree send the nutrient resources to the branches we want, thus we will have a higher quality and higher yield.

Post-harvest pruning causes the tree to form a large number of greedy shoots to the detriment of the fruiting branches; in addition, shoot blight occurs.

In the study, the option of pruning after harvesting the fruit was found to be the least beneficial, as the tree continues to vegetate, many greedy shoots are formed, which die back.

When the tree starts to vegetate in March, we cut back the greedy shoots but it is already late because almost all the tree's resources have been exhausted by the greedy shoots, which form an umbrella over the tree and no more light penetrates to the multiannual fruiting branches and May bunches. As a result, the tree withers and premature decline occurs.

References

1. Bălan V., 2008. Caisul și caisele. Ed. Ceres, București, pag. 686.
2. Cociu V., 1993. Caisul. Ed. Ceres, București, pag. 438.
3. Ghiță Alina, Drăgănescu E., 2008. Cercetări privind influenţa tăierilor în verde asupra formaţiunilor de rod şi diferenţierii mugurilor la cais.
4. Naim Demirtas M., Ibrahim Bolat, Sezai Ercisli, Ali Ikinci, Handan A. Olmez, Mustafa Sahin, Mustafa Altindag, Belgin Celik, 2010. The effects of different pruning treatments on the growth, fruit quality and yield of 'hacihaliloglu' apricot. Acta Sci. Pol., Hortorum Cultus 9(4): 183-192.
5. Szklarz M., Radajewska B., Klak T., 2011. Effect of tree pruning and crown formation in young apricot (*Armenica vulgaris* Lam.) trees on their growth and yielding. Acta Sci. Pol., Hortorum Cultus 10(3): 63-73.

Tables and Figures

Table 1.Evolution of average and extreme air temperatures and rainfall regime in the period January-April, 2018-2022 at RSFG Constanţa

Year	Month	Average air temperature (ºC)	Absolute minimum (ºC)	Absolute maximum (ºC)	Rainfall (mm)
2018	January	2.1	-9.7	15.3	33.8
	February	1.9	-10.6	17.2	0.5
	March	4.7	-15.3	20.2	1.4
	April	13.7	-0.1	29.8	3.7
2019	January	1.3	-13.2	14.2	0.5
	February	3.5	-7.6	18.2	0.9
	March	8.8	-6.2	25.2	2.2
	April	10.3	-5.1	24.8	2.7
2020	January	1.65	-7.31	11.23	2.6
	February	5.1	-8.2	20.7	66.9
	March	8.12	-5.6	24.8	19.0
	April	10.3	-4.6	24.7	7.2
2021	January	3.4	-9.3	15.7	86.0
	February	3.2	-13.4	19.7	19.0
	March	4.7	-5.52	19.7	65.9
	April	9.2	-1.37	28.1	66.8
2022	January	1.9	-10.0	17.1	13.6
	February	4.5	-4.1	18.7	26.4
	March	2.7	-7.53	24.9	10.4
	April	11.4	-0.36	25.5	30.8

Table 2. Multi-year data on average number of flowering shoots differentiated by time of cut application and crown height (50-120 cm; 120- 190 cm; 190-260 cm), Valu lui Traian, 2018-2022

No.	Variety	Variant/ Time of cutting application	Average number of flower buds						
			Total number of flowers	At the bottom of the crown		In the middle		At the top	
				No. flowers	%	No. flowers	%	No. flowers	%
1	Elmar	After harvesting	250	50	20	68	27	132	53
		At the beginning of the dormant period -November	277	44	16	72	26	161	58
		When they start growing -March	243	46	19	70	29	127	52
2	Mamaia	After harvesting	199	41	21	66	33	92	46
		At the beginning of the dormant period -November	235	50	21	80	34	105	45
		When they start growing- March	188	37	20	52	28	99	52
3	Sulmona	After harvesting	222	38	17	47	21	137	60
		At the beginning of the dormant period -November	235	41	17	55	23	139	62
		When they start growing -March	199	37	19	42	21	120	60

Table 3. Annual data on fruit production (kg/tree) by time of application of pruning Valu lui Traian, 2018-2022

No.	Variety	Pruning variants	Fruit production kg/tree					
			2018	2019	2020	2021	2022	Average
1	Elmar	After harvesting	22	13	21	12	21	17.8
		At the beginning of the dormant period (November)	28	24	26	29	27	26.8
		When they start growing (March)	23	17	22	14	24	20
2	Mamaia	After harvesting	18	17	1	20	20	15,2
		At the beginning of the dormant period (November)	22	21	7	23	27	20
		When they start growing (March)	19	20	5	21	20	17
3	Sulmona	After harvesting	21	13	5	17	9	13
		At the beginning of the dormant period (November)	27	25	15	28	23	23.6
		When they start growing (March)	22	14	7	18	11	14.4

DOI 10.33045/fgr.v39.2023.12

Table 4. Multi-annual data on fruit characteristics according to the time of pruning, Valu lui Traian, 2018-2022

No.	Variety	Pruning variants	Average years of study				
			Fruit weight (g)	Kernel weight (g)	Percentage of pulp (%)	S.U (%)	Acidity (%malic acid)
1	Elmar	After harvesting	57	4	53	12.1	0.91
		At the beginning of the dormant period - November	63	5	58	13.4	1.2
		When they start growing - March	58	4	54	13.7	0.95
2	Mamaia	After harvesting	63	4	59	13.2	1.54
		At the beginning of the dormant period - November	65	5	60	14.0	2.1
		When they start growing - March	64	4	60	12,0	1.7
3	Sulmona	After harvesting	71	5	66	12.3	0.8
		At the beginning of the dormant period - November	75	4	71	13.2	0.68
		When they start growing - March	72	5	67	13.5	1.0

Table 5.Main descriptive parameters for the number of flowers resulting from the three pruning options for Elmar variety

		N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
50-120 cm	V1	15	20.47	7.698	1.988	8	35
	V2	15	16.47	6.512	1.681	8	30
	V3	15	19.00	6.824	1.762	10	36
	Total	45	18.64	7.068	1.054	8	36
120- 190 cm	V1	15	27.00	10.128	2.615	10	44
	V2	15	26.00	9.008	2.326	10	43
	V3	15	29.00	6.279	1.621	20	44
	Total	45	27.33	8.520	1.270	10	44
190-260 cm	V1	15	53.00	13.617	3.516	32	82
	V2	15	58.00	9.863	2.547	42	82
	V3	15	52.00	5.438	1.404	42	60
	Total	45	54.33	10.315	1.538	32	82

Table 6. ANOVA test results for the number of flowers resulting from the three pruning options for Elmar variety

Sum of Squares		df	Mean Square	F	Sig. (*p*)	Sum of Squares
50-120 cm	Between Groups	122.844	2	61.422	1.243	0.299
	Within Groups	2075.467	42	49.416		
	Total	2198.311	44			
120- 190 cm	Between Groups	70.000	2	35.000	0.471	0.628
	Within Groups	3124.000	42	74.381		
	Total	3194.000	44			
190-260 cm	Between Groups	310.000	2	155.000	1.489	0.237
	Within Groups	4372.000	42	104.095		
	Total	4682.000	44			

Table 7. Main descriptive parameters for the number of flowers resulting from the three pruning options for Mamaia variety

	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum	
50-120 cm	Between Groups	15	21.00	9.509	2.455	8	45
	Within Groups	15	21.00	7.081	1.828	9	36
	Total	15	21.00	6.719	1.735	7	32
	Between Groups	45	21.00	7.687	1.146	7	45
120- 190 cm	Within Groups	15	33.00	9.335	2.410	20	49
	Total	15	34.00	8.775	2.266	23	49
	Between Groups	15	28.00	5.682	1.467	20	43
	Within Groups	45	31.67	8.339	1.243	20	49
190-260 cm	Total	15	46.00	9.957	2.571	16	56
	Between Groups	15	45.00	10.177	2.628	15	58
	Within Groups	15	52.00	9.079	2.344	34	66
	Total	45	47.67	10.025	1.494	15	66

Table 8. ANOVA test results for the number of flowers resulting from the three pruning options for Mamaia variety

		Sum of Squares	df	Mean Square	F	Sig. (*p*)
50-120 cm	Between Groups	.000	2	.000	0.000	1.000
	Within Groups	2600.000	42	61.905		
	Total	2600.000	44			
120- 190 cm	Between Groups	310.000	2	155.000	2.367	0.106
	Within Groups	2750.000	42	65.476		
	Total	3060.000	44			
190-260 cm	Between Groups	430.000	2	215.000	2.262	0.117
	Within Groups	3992.000	42	95.048		
	Total	4422.000	44			

Table 9. Main descriptive parameters for the number of flowers resulting from the three pruning options for Sulmona variety

		N	Mean	Std. deviation	Std. erros	Minimum	Maximum
50-120 cm	V1	15	17.00	3.928	1.014	11	24
	V2	15	17.00	5.043	1.302	9	25
	V3	15	19.00	3.684	.951	14	26
	Total	45	17.67	4.269	.636	9	26
120- 190 cm	V1	15	21.00	4.914	1.269	13	34
	V2	15	23.00	5.412	1.397	14	33
	V3	15	21.00	2.777	.717	15	25
	Total	45	21.67	4.513	.673	13	34
190-260 cm	V1	15	60.00	9.914	2.560	43	81
	V2	15	62.00	3.964	1.024	55	69
	V3	15	60.00	9.914	2.560	43	81
	Total	45	60.67	8.274	1.233	43	81

Table 10. ANOVA test results for the number of flowers resulting from the three pruning options for Sulmona variety

		Sum of Squares	df	Mean Square	F	Sig. (*p*)
50-120 cm	Between Groups	40.000	2	20.000	1.102	0.342
	Within Groups	762.000	42	18.143		
	Total	802.000	44			
120- 190 cm	Between Groups	40.000	2	20.000	0.981	0.383
	Within Groups	856.000	42	20.381		
	Total	896.000	44			
190-260 cm	Between Groups	40.000	2	20.000	0.283	0.755
	Within Groups	2972.000	42	70.762		
	Total	3012.000	44			

Table 11. The main descriptive parameters for the quantity of fruit resulting from the three pruning variants of Elmar

		N	Mean	Std. deviation	Std. erros	Minimum	Maximum
2018	V1	15	22.00	5.000	1.291	12	30
	V2	15	28.00	4.690	1.211	22	35
	V3	15	23.00	3.817	0.986	14	28
	Total	45	24.33	5.161	0.769	12	35
2019	V1	15	13.000	3.2950	0.8508	8.0	19.0
	V2	15	24.040	3.8522	0.9946	18.5	31.5
	V3	15	17.000	6.7718	1.7485	7.0	26.0
	Total	45	18.013	6.6383	0.9896	7.0	31.5
2020	V1	15	21.00	4.106	1.060	12	27
	V2	15	26.00	3.525	0.910	21	32
	V3	15	22.00	4.583	1.183	12	28
	Total	45	23.00	4.558	0.679	12	32
2021	V1	15	12.006667	3.0936494	0.7987768	7.3000	17.3000
	V2	15	29.006667	4.2794303	1.1049442	21.5000	34.7000
	V3	15	14.006667	3.4615163	0.8937597	9.0000	22.0000
	Total	45	18.340000	8.4586266	1.2609376	7.3000	34.7000
2022	V1	15	21.000000	4.6297177	1.1953880	12.2000	28.0000
	V2	15	27.000000	3.6051550	0.9308470	21.4000	33.7000
	V3	15	24.013333	4.9225235	1.2709901	13.0000	30.0000
	Total	45	24.004444	4.9801404	0.7423955	12.2000	33.7000

Table 12. ANOVA test results for the quantity of fruit resulting from the three pruning options for Elmar variety

		Sum of Squares	df	Mean Square	F	Sig. (*p*)
2018	Between Groups	310.000	2	155.000	7.552	0.002
	Within Groups	862.000	42	20.524		
	Total	1172.000	44			
2019	Between Groups	937.216	2	468.608	19.647	0.000
	Within Groups	1001.756	42	23.851		
	Total	1938.972	44			
2020	Between Groups	210.000	2	105.000	6.264	0.004
	Within Groups	704.000	42	16.762		
	Total	914.000	44			
2021	Between Groups	2590.000	2	1295.000	97.451	0.000
	Within Groups	558.128	42	13.289		
	Total	3148.128	44			
2022	Between Groups	270.002	2	135.001	6.904	0.003
	Within Groups	821.277	42	19.554		
	Total	1091.279	44			

Table 13.The main descriptive parameters for the quantity of fruit resulting from the three pruning variants of Mamaia cv.

		N	Mean	Std. deviation	Std. erros	Minimum	Maximum
2018	V1	15	18.00	7.121	1.839	5	27
	V2	15	22.00	6.425	1.659	9	29
	V3	15	19.00	6.036	1.558	8	27
	Total	45	19.67	6.620	0.987	5	29
2019	V1	15	17.00	6.845	1.767	6	26
	V2	15	21.00	7.020	1.813	8	29
	V3	15	20.00	6.897	1.781	7	28
	Total	45	19.33	6.977	1.040	6	29
2020	V1	15	1.000	1.0576	0.2731	0.1	3.5
	V2	15	7.000	1.5584	0.4024	5.0	10.0
	V3	15	5.000	2.0000	0.5164	2.0	9.0
	Total	45	4.333	2.9606	0.4413	0.1	10.0
2021	V1	15	20.00	6.492	1.676	7	27
	V2	15	23.00	5.964	1.540	9	31
	V3	15	21.00	7.020	1.813	8	29
	Total	45	21.33	6.481	0.966	7	31
2022	V1	15	20.00	6.601	1.704	8	28
	V2	15	27.00	3.645	0.941	16	31
	V3	15	20.00	6.601	1.704	8	28
	Total	45	22.33	6.564	0.979	8	31

Table 14. ANOVA test results for the quantity of fruit resulting from the three pruning options for Mamaia cv.

		Sum of Squares	df	Mean Square	F	Sig. (*p*)
2018	Between Groups	130.000	2	65.000	1.518	0.231
	Within Groups	1798.000	42	42.810		
	Total	1928.000	44			
2019	Between Groups	130.000	2	65.000	1.357	0.269
	Within Groups	2012.000	42	47.905		
	Total	2142.000	44			
2020	Between Groups	280.000	2	140.000	55.650	0.000
	Within Groups	105.660	42	2.516		
	Total	385.660	44			
2021	Between Groups	70.000	2	35.000	0.827	0.444
	Within Groups	1778.000	42	42.333		
	Total	1848.000	44			
2022	Between Groups	490.000	2	245.000	7.319	0.002
	Within Groups	1406.000	42	33.476		
	Total	1896.000	44			

Table 15.The main descriptive parameters for the quantity of fruit resulting from the three pruning variants of Sulmona cv.

		N	Mean	Std. deviation	Std. erros	Minimum	Maximum
2018	V1	15	21.00	4.309	1.113	16	29
	V2	15	27.00	2.777	0.717	23	31
	V3	15	22.00	7.280	1.880	10	31
	Total	45	23.33	5.681	0.847	10	31
2019	V1	15	12.93	3.788	0.978	7	19
	V2	15	25.00	4.123	1.065	17	31
	V3	15	14.00	4.811	1.242	6	23
	Total	45	17.31	6.911	1.030	6	31
2020	V1	15	5.00	2.878	0.743	1	12
	V2	15	15.00	5.529	1.428	6	23
	V3	15	7.00	2.854	0.737	3	13
	Total	45	9.00	5.835	0.870	1	23
2021	V1	15	17.00	4.175	1.078	7	24
	V2	15	28.00	3.024	0.781	21	33
	V3	15	18.00	5.782	1.493	10	27
	Total	45	21.00	6.657	0.992	7	33
2022	V1	15	9.00	4.567	1.179	2	20
	V2	15	23.00	2.420	0.625	20	27
	V3	15	11.00	4.243	1.095	6	20
	Total	45	14.33	7.302	1.089	2	27

Table 16. ANOVA test results for the quantity of fruit resulting from the three pruning options for Sulmona cv.

		Sum of Squares	df	Mean Square	F	Sig. (*p*)
2018	Between Groups	310.000	2	155.000	5.865	0.006
	Within Groups	1110.000	42	26.429		
	Total	1420.000	44			
2019	Between Groups	1338.711	2	669.356	36.848	0.000
	Within Groups	762.933	42	18.165		
	Total	2101.644	44			
2020	Between Groups	840.000	2	420.000	26.809	0.000
	Within Groups	658.000	42	15.667		
	Total	1498.000	44			
2021	Between Groups	1110.000	2	555.000	27.750	0.000
	Within Groups	840.000	42	20.000		
	Total	1950.000	44			
2022	Between Groups	1720.000	2	860.000	57.700	0.000
	Within Groups	626.000	42	14.905		
	Total	2346.000	44			