Fruit Growing Research, Vol. XLI, 2025 DOI 10.33045/fgr.v41.2025.03
https://publications.icdp.ro/index.php

EVALUAREA UNOR PARAMETRI DE CREŞTERE LA SOIURILE DE CIREŞ ALTOITE PE PORTALTOI DIFERIŢI ÎN CONDIŢIILE ZONEI IAŞI, ROMÂNIA

ASSESSMENT OF GROWTH PARAMETERS IN CHERRY CULTIVARS GRAFTED ON DIFFERENT ROOTSTOCK UNDER THE CONDITIONS OF THE IASI AREA, ROMANIA

Iurea Elena, Gherghel Mădălina *, Mineaţă Iulia, Sîrbu Sorina, Golache Iuliana Elena, Turcu Cristina, Ungureanu Ionuţ, Perju Ionel, Chelaru Simona
Research Station for Fruit-Growing Iaşi, Romania
*Corresponding author email: ciobanica.madalina@gmail.com

Abstract

This paper aims to introduce metrics regarding the influence of environment factors and rootstock on the development of cherry cultivars under the conditions of the Iasi area, Romania. Regarding the amount of precipitation, the months of May and June, when the tree shoots growth is more accelerated, in 2022 and 2023 there was a deficit of -53.7 mm (2022) and -66.7 mm (in 2023) in comparison with 154,0 mm that is normally the multiannual amount for this period. Analysing the trunk cross-sectional area, taking into account the average over the three years of study, statistically, the cultivars 'Lapins' ('IP-C5' =7.47 cm^2 and 'IP-C7'=6.45 cm^2) and 'Kordia' ('IP-C5' =6.14 cm^2 and 'IP-C7'=7.62 cm^2) that were grafted on the two vegetative rootstocks ('IP-C5' and 'IP-C7') recorded higher significant differences followed by cultivars 'Andreiaş' ('IP-C5' =4.92 cm^2 and 'IP-C7'=5.53 cm^2) and 'Daria' ('IP-C5 =5.09 cm^2 and 'IP-C7'=6.07 cm^2) which recorded lower significant differences. In cultivars grafted on the vegetative rootstock 'IP-C5', the tree height was between 148.11 cm ('Andreiaş') and 169.67 cm ('Lapins') and in cultivars grafted on the 'IP-C7' rootstock, the tree height was between 134.56 cm ('Lapins') and 185.67 cm ('Kordia'). Considering the amount of annual shoots per tree and their average length based on the average of the three years of study, statistically, the cultivars that recorded higher significant differences were 'Kordia' ('IP-C5' =20.33 units with 40.47 cm and 'IP-C7'=23.00 units with 38.89 cm), 'Lapins' ('IP-C5' =16.00 units with 50.44 cm) and 'Daria' ('IP-C7' =18.33 units with 38.39 cm) grafted onto the two vegetative rootstocks ('IP-C5' and 'IP-C7') followed by 'Andreiaş' ('IP-C5' =13.67 units with 38.33 cm and 'IP-C7'=18.00 units with 40.44 cm), 'Lapins' ('IP-C7'=11.33 units with 41.48 cm) and 'Daria' ('IP-C5' =9.00 units with 26.19 cm) with lower significant differences.

Cuvinte cheie: portaltoi, vegetativi, soi, cireş, parametri.
Key words: rootstock, vegetative, cultivar, cherry, parameters.

1. Introduction

It is well known from the local and international specialised literature about the influence that vegetative rootstock has on the potential of growth and bearing of cherry cultivars grafted on this type of rootstock (Parnia & Mladin, 1995; Usenik et al., 2006; Quero-García et al., 2017). Moreover, vegetative rootstock is important for the growth of the orchard density, uniformity of the trees and high yields (Milatović, 2011 Ancu et al., 2016).

Water as a vegetation factor has a decisive role in the life of plants, as it is the main component in vegetal organisms. Water is the way of transport for the nutrients and the main temperature regulator (Budan & Grădinariu, 2000**;** Asănică & Hoza, 2013). During the vegetation period, the water consumption in fruit-growing plants is variable. Thus, the critical phases during the vegetation period when the water consumption is the highest are: tree shoots growth, bloom, fruit growth and buds differentiation (Toma & Robu, 2000; Ghena & Branişte, 2003).

This paper aims to introduce metrics regarding the influence of environment factors and rootstock on the development of cherry cultivars grafted onto the rootstock under the conditions of the Iasi area, Romania.

2. Material and methods

The studies were carried out between 2022-2024, using 4 cherry cultivars as research material ('Andreiaş', 'Daria', 'Kordia' and 'Lapins'), each of them grafted onto two vegetative rootstocks 'IP-C5' and 'IP-C7'.

The trees, four years since they were planted, can be found in experimental plots at the Research Station for Fruit-Growing, Iasi. The plantation is on randomised plots, in three replications of 3 trees each, at a distance of 3.5 x 4 m (714 trees per ha) and pruned to form a naturally flattened, open canopy, without support and irrigation systems.

On the row with trees, the soil was prepared with the rotary orchard tiller and between the rows the soil is grassed.

The orchard is located in the Jijia-Bahlui depression, where the multiannual average temperature is 10.2 °C, ranging during the research period between 11.4 °C in 2022 and 12.5 °C in 2024 (Table 1).

During the three years of study, meteorological factors were analysed, along with the behaviour of the cultivars grafted onto the two vegetative rootstocks in relation with the drought that occurred during the studied period.

Measurements and biometric assessments of the tree were performed for each cultivar (trunk cross-sectional area, tree height, annual twigs length and number of shoots per tree).

The height of the tree (H) and annual twig length (LCA) were determined by measuring with the graduated ruler.

Trunk cross-sectional area (TCSA) was determined by measuring with a calliper on two perpendicular directions at 30 cm from the grafting point.

The experimental data was statistically interpreted using the multiple comparisons method (Duncan test, with P 5%).

3. Results and discussions

The hereditary caracteristics of the sweet cherry species, along with the climate and technology factors act concurrently on the biological processes (Maglakelidze et al., 2015). Thus, the studied sweet cherry cultivars (grafted onto different rootstocks) showed differences in terms of behaviour under the given conditions.

From a climatic perspective, during the three years of study, the average annual temperature recorded was 11.4°C in 2022, 12.2°C in 2023 and 12.5°C in 2024 (Table 1).

In 2022 (379.0 mm) and 2023 (409.8 mm) precipitation below the multiannual limit (562.6 mm) were recorded, resulting in a deficit of 183.6 mm in 2022 and 152.8 mm in 2023 (Table 1).

The trunk cross-section area (TCSA) in the fourth year since planting (2024) in the cultivars grafted onto the vegetative rootstock 'IP-C5' was between 6.50 cm^2 ('Andreiaş') and 12.13 cm^2 ('Lapins') and in the cultivars grafted onto the 'IP-C7' rootstock were between 7.50 cm^2 ('Andreiaş') and 11.8 cm^2 ('Kordia') (Table 2). Analysing this parameter based on the average of the three years of study, statistically, the highest significant differences were recorded for the cultivars 'Lapins' ('IP-C5' =7.47 cm^2 and 'IP-C7'=6.45 cm^2) and 'Kordia' ('IP-C5' =6.14 cm^2 and 'IP-C7'=7.62 cm^2) grafted onto the two vegetative rootstocks ('IP-C5' and 'IP-C7'), followed by cultivars 'Andreiaş' ('IP-C5' =4.92 cm^2 and 'IP-C7'=5.53 cm^2) and 'Daria' ('IP-C5' =5.09 cm^2 and 'IP-C7'=6.07 cm^2) that recorded lower significant differences (Table 2, Fig. 1).

Considering the average data for tree height (H) over three years, it can be observed that the values recorded for cultivars grafted onto the 'IP-C5' rootstock are lower compared to the ones grafted onto the 'IP-C7' rootstock (table 3, fig. 2). Thus, the cultivars grafted onto the vegetative rootstock 'IP-C5' recorded a tree height between 148.11 cm ('Andreiaş') and 169.67 cm ('Lapins'), while the cultivars grafted onto the 'IP-C7' rootstock recorded a tree height between 134.56 cm ('Lapins') and 185.67 cm ('Kordia') (Table 3, Fig. 2).

Milică et al. (1982) state that the water requirements of the fruit-growing trees increase starting with April and reach their peak in May-June, when the intensive growth of shoots occurs, then by August when shoots growth ceases, followed by their thickening, while at the same time bud differentiation begins.

Regarding the amount of precipitation, during May and June (study period) when intensive growth of shoots occured, in 2022 and 2023, a deficit of -53.7 mm (2022) and -66.7 mm (2023) was recorded in comparison with 154,0 mm, representing the multiannual amount for this period; in 2024, a deficit of -17.1 mm was recorded, except for May when the rainfall quantity was sufficient (table 1). In August, when the shoots growth ceased (at the tip of the shoots, the apical bud is formed), the annual shoots on the tree were counted and their length was measured.

Analysing this parameter (length of annual shoots) through the average over the three years of study, statistically, higher significant differences were recorded for the 'Lapins cultivar' (50.44 cm) and 'Kordia' (40.47 cm) grafted onto the 'IP-C5' rootstock, followed by the cultivars 'Andreiaş' ('IP-C5' =38.33 cm) and 'Daria' ('IP-C5' =26.19 cm) (table 4, fig. 3). It can be observed that the values for the cultivars grafted onto the 'IP-C7' rootstock are not statistically significant. Therefore, the highest length for annual shoots was recorded for the cultivars 'Lapins' (41.48 cm) and 'Andreiaş' (40.44 cm) followed by 'Kordia' (38.89 cm) and 'Daria' (38.39 cm) (Table 4, Fig. 3).

The lack of water reduces the number of annual shoots growth, decreases cell turgor and reduces photosynthesis and the transport of substances within the plant (Toma & Jităreanu, 2007).

In July 2023, the rainfall amount was sufficient (136.8 mm) and the temperatures were very high (over 30°C), providing good conditions for apical bud differentiation, resulting in a high number of annual twigs per tree in 2024 (Table 5).

When assessing the number of annual shoots per tree based on the average over the three years of study, statistically, higher significant differences were recorded for cultivars 'Kordia' ('IP-C5' =20.33 shoots/tree and 'IP-C7'=23.00 shoots/tree), 'Lapins' ('IP-C5' =16.00 shoots/tree) and 'Daria' ('IP-C7' =18.33 shoots/tree) grafted onto the two vegetative rootstocks ('IP-C5' and 'IP-C7'), followed by the cultivars 'Andreiaş' ('IP-C5' =13.67 shoots/tree and 'IP-C7'=18.00 shoots/tree), 'Lapins' ('IP-C7'=11.33 shoots/tree) and 'Daria' ('IP-C5' =9.00 shoots/tree) which showed lower significant differences (Table 5, Fig. 4).

4. Conclusions

Research conducted during a period characterised by significant climatic fluctuations demonstrates that sweet cherry cultivars grafted onto the two vegetative rootstocks ('IP-C5' and 'IP-C7') exhibit different growth characteristics.

Analysing the average values recorded for all the determined parameters, it was found that the values for the sweet cherry cultivars ('Kordia', 'Andreiaş', 'Daria') grafted onto the vegetative rootstock 'IP-C5' are lower than the ones for the cultivars grafted onto the 'IP-C7' rootstock, except for 'Lapins' that recorded higher values for all the parameters in comparison with the same cultivar grafted onto the 'IP-C7' rootstock.

Under the conditions of 2022-2023, drought years, it was noticed that cultivars 'Lapins' and 'Kordia' grafted onto the vegetative rootstock 'IP-C5' were the most drought-resistant (with a high amount of annual twigs per tree and large values for their length).

Acknowledgments

This research work was carried out with the support of the Thematic Plan on the Implementation of the ‘A.S.A.S. Strategy on Research—Development—Innovation in Fruit Growing’ for the period 2021–2027, research theme:1.3.4. ″New cultivars creation with quality fruits and genetic resistance/tolerance to biotic and abiotic factors in sweet and sour cherry species″.

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DOI 10.33045/fgr.v41.2025.03

Tables and figures

Table 1. Climatic characterisation of the years 2022 – 2023 - 2024

Year/Month			January	February	March	April	May	June	July	August	September	October	November	December	Annual amount (mm)	Annual average (°C)
Rainfall monthly amount (mm)	**Multiannual average**		**35.5**	**32.1**	**71.2**	**51.4**	**71.1**	**82.9**	**64.7**	**50.8**	**36.5**	**2.4**	**33.4**	**30.6**	**562.6**	x
	2022	Monthly amount	6.6	10.4	6.0	58.0	17.4	16.2	27.8	69.0	69.6	12.6	69.2	16.2	379.0	x
		Devia - tion	-28.9	-27.7	-65.2	+6.6	-53.7	-66.7	-36.9	+18.2	+33.1	+10.2	+35.8	-14.4	**-183.6**	x
	2023	Monthly amount	12.1	23.3	5.8	88.6	18.4	29.6	136.8	16.4	10.6	19.4	42.4	6.4	409.8	x
		Devia - tion	-23.4	-8.8	-65.4	+37.2	-52.7	-53.3	+72.1	-34.4	-25.9	+17.0	+9.0	-24.2	**-152.8**	x
	2024	Monthly amount	23.0	10.6	39.2	35.8	89.8	65.8	81.0	12.0	137.0	37.4	33.8	45.8	611.2	x
		Devia - tion	-13.5	-21.5	-32.0	-15.6	+18.7	-17.1	+16.3	-38.8	100.5	+35.0	+0.4	+15.2	**+45.6**	x
Air average temperature (°C)	**Multiannual average**		**-1.9**	**-1.2**	**4.7**	**11.4**	**17.0**	**20.5**	**22.4**	**21.9**	**16.3**	**5.4**	**5.4**	**0.1**	**x**	**10.2**
	2022	Monthly amount	0.4	3.7	3.2	10.0	16.6	21.9	23.2	22.5	15.5	12.3	5.5	1.4	x	11.4
		Devia - tion	-1.5	+2.5	-1.5	-1.4	-0.4	+1.4	+0.8	+0.6	+0.8	+6.9	+0.1	+1.3	x	**+1.2**
	2023	Monthly amount	2.8	1.6	6.8	8.3	15.8	20.3	23.2	24.2	19.6	14.3	7.0	2.3	x	12.2
		Devia - tion	+0.9	+0.4	+2.1	-3.1	-1.2	-0.2	+0.8	+2.3	+3.3	+8.9	+1.6	+2.2	x	**+2.0**
	2024	Monthly amount	0.2	7.3	6.7	13.5	16.2	22.1	24.2	24.0	19.7	10.3	3.5	2.2	x	12.5
		Devia - tion	-1.7	+6.1	+2.0	+2.1	-0.8	+1.6	+1.8	+2.1	+3.4	+4.9	-1.9	+2.1	x	**+2.3**

Table 2. Trees vigour growth in sweet cherry cultivars grafted onto two vegetative rootstocks in year IV since planting (RSFG Iaşi; average of 2022 - 2024)

Cultivar	Trunk cross-section area (cm^2) in trees grafted onto the vegetative rootstock IP-C5				Trunk cross-section area (cm^2) in trees grafted onto the vegetative rootstock IP-C7			
	2022	2023	2024	Years average	2022	2023	2024	Years average
Andreiaş	2.75	5.50	6.50	4.92^{b}	3.50	5.60	7.50	5.53^{a}
Daria	2.73	4.35	8.20	5.09^{b}	2.38	6.20	9.63	6.07^{a}
Kordia	2.84	5.97	9.60	6.14^{ab}	2.95	8.10	11.8	7.62^{a}
Lapins	3.08	7.20	12.13	7.47^{a}	3.20	6.16	10.0	6.45^{a}
				DS 5% = 0.49				DS 5% = 1.61

* different letters correspond with the significant statistical difference for p ≤ 5%, Duncan test.

 DOI 10.33045/fgr.v41.2025.03

Table 3. Trees height in sweet cherry cultivars grafted onto the two vegetative rootstocks in year IV since planting (RSFG Iaşi; average of 2022 - 2024)

Cultivar	Height of the trees grafted onto the vegetative rootstock IP-C5 (cm)				Height of the trees grafted on the vegetative rootstock IP-C7 (cm)			
	2022	2023	2024	Years average	2022	2023	2024	Years average
Andreiaş	105.67	145.00	193.67	148.11[a]	133.00	180.00	222.00	178.33[a]
Daria	90.33	100.00	131.33	107.22[ab]	110.67	143.33	204.00	152.67[ab]
Kordia	118.00	153.33	212.50	161.28[a]	142.50	172.50	242.00	185.67[a]
Lapins	135.67	165.00	208.33	169.67[a]	96.00	135.00	172.67	134.56[b]
				DS 5% = 6.97				DS 5% = 4.58

*different letters correspond with the significant statistical difference for p ≤ 5%, Duncan test.

Table 4 . Average length of annual shoots in sweet cherry trees grafted onto two vegetative rootstocks in year IV since planting (RSFG Iaşi; average of 2022 - 2024)

Cultivar	Average length of annual shoots on trees grafted onto the vegetative rootstock IP-C5 (cm)				Average length of annual shoots on trees grafted onto the vegetative rootstock IP-C7 (cm)			
	2022	2023	2024	Years average	2022	2023	2024	Years average
Andreiaş	22.89	40.11	52.00	38.33[b]	22.66	40.66	58.00	40.44[a]
Daria	11.83	34.17	32.56	26.19[c]	29.00	29.28	56.89	38.39[a]
Kordia	32.22	44.87	44.33	40.47[ab]	24.50	30.83	61.33	38.89[a]
Lapins	33.33	53.00	65.00	50.44[a]	23.33	48.67	52.44	41.48[a]
				DS 5% = 2.91				DS 5% = 4.04

*different letters correspond with the significant statistical difference for p ≤ 5%, Duncan test.

Table 5. Amount of annual shoots per tree in cherry cultivars grafted onto two vegetative rootstocks in year IV since planting (RSFG Iaşi; average of 2022 - 2024)

Cultivar	Amount of annual shoots per tree grafted onto the vegetative rootstock IP-C5 (units)				Amount of annual shoots per tree grafted onto the vegetative rootstock IP-C7 (units)			
	2022	2023	2024	Years average	2022	2023	2024	Years average
Andreiaş	11	9	21	13.67[b]	10	20	24	18.00[b]
Daria	7	9	11	9.00[b]	10	15	30	18.33[ab]
Kordia	10	16	35	20.33[a]	13	17	39	23.00[a]
Lapins	9	13	26	16.00[ab]	6	10	18	11.33[b]
				DS 5% = 2.82				DS 5% = 2.48

*different letters correspond with the significant statistical difference for p ≤ 5%, Duncan test

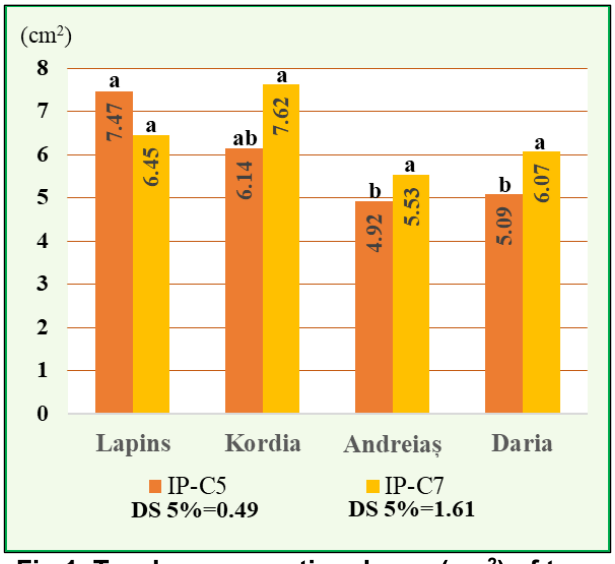

Fig 1. Trunk cross-sectional area (cm²) of trees grafted onto IP-C5 and IP-C7 vegetative rootstocks

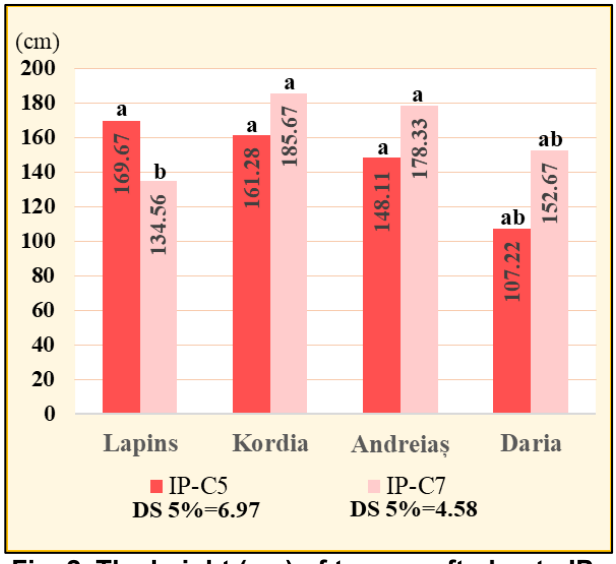

Fig. 2. The height (cm) of trees grafted onto IP-C5 and IP-C7 vegetative rootstocks

DOI 10.33045/fgr.v41.2025.03

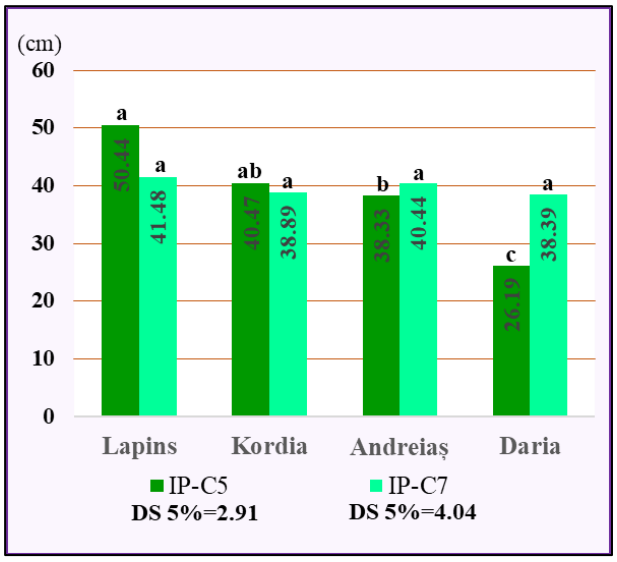

Fig. 3. Annual branch length (cm) of trees grafted onto IP-C5 and IP-C7 vegetative rootstocks

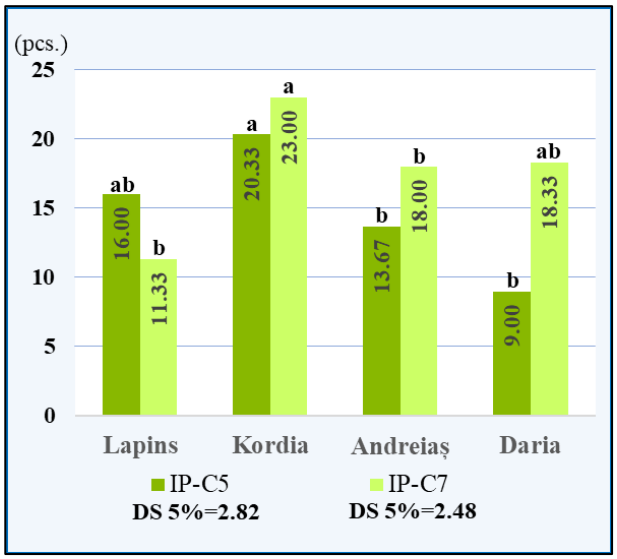

Fig. 4. Number of annual twigs (pieces) of trees grafted onto IP-C5 and IP-C7 vegetative rootstocks