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## **THE INFLUENCE OF THE PLANTING DISTANCE ON THE DEVELOPMENT OF THE CHERRY ROOT SYSTEM**

Ivanov I., Balan V., Balan P.

Agrarian State University of Moldavia

Correspondence author. E-mail: v.balan@uasm.mdmailto:cameliapopescu@yahoo.com

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### **ABSTRACT**

*This study presents the distribution of roots in the soil in commercial cherry orchards (*Prunus avium* L.) depending on the planting distance. The study was carried out in the southern fruit tree area of the Republic of Moldova on the Ferrovía cherry variety, aged 3 years, grafted on Gisela 6, planted at the distance of 5x1.5 m, 5x2 m and 5x2.5 m and crowns after the Crown naturally ameliorated with low volume. The weight and length of the roots were determined on horizontal sections at 0-25 cm, 26-50 cm, 51-75 cm, 76-100 cm, 101-125 cm and 126-150 cm from the trunk, at 0-20 cm, 21-40 cm, 41-60 cm and 61-80 cm. Each soil layer has been rooted, washed, dried, and distributed in size categories: below 1 mm, 1-3 mm, 3-5 mm, over 5 mm. The length of roots is determined by fibrous roots (95.4-95.8%), and mass - by skeletal roots (65.6-69.3%). Most roots after length (69.8-82.9%) and after meal (88.8-92.8%) are distributed on a depth of 0-60 cm.*

### **INTRODUCTION**

The density of cherry trees in modern orchards is constantly changing due to vegetal rootstocks, new varieties and new tree management systems. (Whiting & Ophardt 2005, Calabro et al., 2009, Balan 2015). Considering that the planting distance of cherry trees is determined by the vigor of the variety and of the rootstock, the crown shape, the soil fertility and the equipment, it has been felt that it is necessary to study the development of the root system and the distribution of the roots in the soil at different planting distances of cherry trees. (Long et al., 2014; Musacchi & Serra, 2015).

### **MATERIAL AND METHODS**

The experience was organized in the southern fruit tree area of the Republic of Moldova in the spring of 2009 at S.R.L. Terra Vitis in the village of Burlacu Cahul district with cherry rootstock Gisela 6 grafted with cherry varieties Bigarreau Burlat, Ferrovía, Lapins. Planting distances were 5x1.5 m, 5x2 m, 5x2.5 m. The low crown shape was used: Crown naturally ameliorated with low volume, and Slender Spindle.

The root system development study was carried out on the Ferrovía variety formed after the reduced-volume natural crown. Three trees were chosen for the study, in each variant, with uniform increases, after the diameter of the trunk, the height and diameter of the crown.

The root mass and form were studied at the end of vegetation (1/4 of the tree nutrition surface was dug) in terms of their spreading in the soil layers vertically and horizontally. The weight and length of the roots were determined on horizontal sections at 0-25 cm, 26-50 cm, 51-75 cm, 76-100 cm, 101-125 cm and 126-150 cm from the trunk, at 0-20 cm, 21-40 cm,

41-60 cm and 61-80 cm. In each layer of soil, the roots were selected, washed, dried, and distributed in size categories: below 1 mm, 1-3 mm, 3-5 mm, over 5 mm.

## RESULTS AND DISCUSSIONS

In order to obtain large and regular productions in intensive plantations, it is necessary to guide the growth of both crown and roots (Babuc 2012). Analyzing the data obtained (Table 1), it is found that cherry trees of the Ferrovia variety at the planting distance of 5x1,5 m have the root system less developed than at the larger distances taken in the study.

Table 1  
The influence of the planting distance of the root system development Ferrovia cherry variety grafted on Gisela 6, age of 3 years

Planting distance, m	Length of roots, cm/tree				Mass of roots, g/tree			
	Under 1mm	1-3 mm	3-5 mm	Over 5mm	Under 1mm	1-3 mm	3-5 mm	Over 5mm
5x1,5	17240	29320	1198	1032	76,8	130,2	105,6	290,0
5x2	25436	29633	1508	1084	83,2	157,5	142,4	336,4
5x2,5	21712	35665	1240	1248	73,6	154,6	156,0	359,2
Media	21462	31539	1315	1121	77,8	147,4	134,6	328,5

By increasing the density of the trees to a surface unit from 800 to 1333 tree/ha, the root length decreases from 59867 cm to 48790 cm. The reduction of the root system in the over grown plantations takes place on roots with a diameter of less than 1 mm and a 1- 3 mm. 3-year-old cherry trees make up 38.7% of roots below 1 mm in diameter, 56.9% in diameter 1-3 mm and only 4.4% in diameters over 3 mm in diameter.

The weight of the roots also varies according to the planting distance. The largest root mass was recorded at the planting distance of 5x2.5 m and consisted of 743 g/tree. The size of the root mass is based on roots with a diameter of more than 3 mm. From the values shown, 67.3% make up the roots with a diameter of over 3 mm, 21.4% of 1-3 mm and 11.3% of the diameter below 1 mm of the total mass. So, the root length of the root system increases from the diameter of the fibrous roots by less than 3 mm in diameter, and the mass - from the skeletal and semi-skeletal roots with a diameter of more than 3 mm.

Analyzing the distribution of the roots in depth (Table 2) it can be emphasized that most of the roots, both in length and after mass, are found in the soil layer 0-60 cm. Thus, 3 years old cherry trees at the planting distance of 5x1.5 m in this layer are placed 82.9% by length and 72.7% by mass. Analogously, the roots and the other planting distances studied are distributed in depth. The highest density of fibrous, skeletal and semi-skeleton roots was recorded in the 21-60 cm soil layer.

These roots are the basis of feeding the trees and have a more directionally less horizontal (Babuc 2012). At the depth of 0-20 cm and 61-80 cm, a small amount of roots is placed. Thus, at the planting distance of 5x1,5 m, the total length of the deep roots is placed as follows: 0-20 cm - 5,3%; 21-40 cm - 32.0%; 41-60 cm - 45.6%; 61-80 cm - 17.1%. The mass of the roots in depth changes in analogy to the length.

It has been found that in young cherry trees in the 0-20 cm layer there is an insignificant amount of roots up to 3 mm in diameter and missing roots with a diameter of more than 3 mm. These findings lead to the conclusion that the soil works in young orchards are made superficially up to the depth of 15-20 cm, due to both the cutting of the roots caused by the repeated works and the frequent summer drying of the superficial soil layer.

The data presented demonstrate that the planting distances taken in the study practically do not influence the distribution of the roots in depth to the cherry trees of 3 years old.

Most of the skeleton roots are found in superficial soil layers, and as the depth

increases, it shrinks abruptly. The deep distribution of the fibrous roots is more uniform than the skeletal roots.

Table 2

Influence of the planting distance on the distribution of roots in the soil in the Ferrovia variety, grafted on Gisela 6, 3 years old.

Soil layer, cm	Length of roots, cm/tree				Mass of roots, g/tree			
	Under 1mm	1-3 mm	3-5 mm	Over 5mm	Under 1mm	1-3 mm	3-5 mm	Over 5mm
Planting distance, 5x1,5 m								
0-20	1192	1413	-	-	4,0	2,6	-	-
21-40	7434	7393	540	248	25,2	28,4	54,8	132,4
41-60	6490	14600	374	784	22,0	81,2	50,8	157,6
61-80	2124	5914	284	-	25,6	18,0	-	-
Total	17240	29320	1198	1032	76,8	130,2	105,6	290,0
Planting distance, 5x2 m								
0-20	3074	2098	-	-	7,6	9,1	-	-
21-40	7788	8409	844	312	26,4	36,4	70,8	68,4
41-60	10916	11550	476	772	36,8	86,4	59,2	268,0
61-80	3658	7576	188	-	12,4	25,6	12,4	-
Total	25436	29633	1508	1084	83,2	157,5	142,4	336,4
Planting distance, 5x2,5 m								
0-20	1298	645	-	-	4,4	2,8	-	-
21-40	7080	7299	440	288	24,0	31,6	53,6	132,0
41-60	7316	15708	748	960	24,8	68,0	91,6	227,2
61-80	4484	10720	52	-	15,2	46,4	10,8	-
81-100	1534	1293	-	-	5,2	5,8	-	-
Total	21712	35665	1240	1248	73,6	154,6	156	359,2

The 3-year cherry tree root system did not occupy the entire nutritional area for them (Table 3). Most roots, both in length and after the meal, are at a distance of 0-75 cm from the trunk.

In this area, at the planting distance of 5x1,5 m, 65,2% of the length and 82,6% of the root mass are placed at the distance of 5x2 m respectively, 66,2% and 81,9%, and at the distance of 5x2,5 m respectively 60,9% and 71,3%. If we analyze the data presented in the table and figure it is found that all the planting distances the length and the root mass decrease from the trunk to the periphery.

The root mass decreases more suddenly than their length. Decreasing the distance between trees in a row helps to increase the amount of roots around the trunk (0-50 cm), reaching 47,2% of the length and 55,5% of the mass at a distance of 5x1.5 m.

Table 3

Influence of the planting distance on the distribution of the roots in the soil in the Ferrovia variety, grafted on Gisela 6, 3 years old.

Planting distance, m	Length of roots, cm/tree				Mass of roots, g/tree			
	Under 1mm	1-3 mm	3-5 mm	Over 5 mm	Under 1mm	1-3 mm	3-5 mm	Over 5 mm
Planting distance, 5x1,5 m								
0-25	4130	7300	160	364	10,4	30,2	5,2	100,5
26-50	4248	5545	712	496	14,4	24,0	92,4	52,4
51-75	2124	6423	108	80	7,2	28,8	24,2	100,4
76-100	2018	2495	48	92	6,8	10,8	4,0	32,4
101-125	2478	3861	-	-	8,4	16,8	-	-
126-150	2235	3696	-	-	7,6	16,0	-	-
Amount	17233	29320	1028	1032	54,8	126,6	125,8	285,7

Planting distance, 5x2 m								
0-25	4130	7393	128	312	14,0	29,0	9,2	80,4
26-50	6018	6376	712	584	20,4	27,6	89,6	212,0
51-75	2832	8010	88	112	9,6	44,4	19,2	16,0
76-100	4248	3327	180	76	14,4	14,4	24,4	28,0
101-125	4956	2772	-	-	16,8	12,0	-	-
126-150	2360	756	-	-	8,0	7,6	-	-
Amount	24544	28634	1108	1084	83,2	135	142,4	336,4
Planting distance, 5x2,5 m								
0-25	5664	9980	120	468	19,2	43,2	10,0	192,0
26-50	4484	6375	620	332	15,2	17,6	82,4	56,0
51-75	2714	5544	160	108	9,2	24,0	14,0	40,0
76-100	2832	2679	60	120	9,6	11,6	8,0	12,4
101-125	2596	3972	220	180	8,8	16,8	24,4	48,0
126-150	3422	7207	60	40	11,6	31,2	17,2	10,8
Amount	21712	35757	1240	1248	73,6	144,4	156,0	359,2

## CONCLUSIONS

The roots of the cherry trees, grafted on the Gisela 6 rootstock, and shaped like a reduced-sized natural crown, advance from the trunk radially evenly in all directions. As the distance between tree trees increases, the length and root mass increase and their density in the soil decreases. The length of roots is determined by fibrous roots (95.4-95.8%), and the mass - of the skeleton roots (65.6-69.3%). The majority of the roots by length (69.8-82.9%) and after the meal (88.8-92.8%) are distributed over a depth of 0-60 cm.

The extension and distribution in the soil of the radicular system allow to make the following findings regarding some agro technical works in modern cherry plantations: In young plantations with the soil maintained as a field, the soil loosening works can be executed up to the depth of 15- 20 cm with the risk of cutting at most 5.3% of the roots by length and 1.1% by mass with a diameter of up to 3 mm; The young trees, the roots near the trunk (up to 75 cm) are higher in the superficial layer of 0-20 cm, it is better to avoid the proximity of tree rows to less than 75 cm.

The administration of nitrogen fertilizers on the row of trees, on a 1.5 m wide strip, in that the fibrous roots are denser in this sector of the nutrition of the trees. The migration of phosphorus and potassium into the soil, being difficult, the administration of these fertilizers is incorporated into the soil at a distance of 50-75 cm at a depth of 20 cm. Determining the depth (need) of water supply to the soil must be the depth at which most roots are distributed, especially 0-60 cm.

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