RESEARCHES ON THE INFLUENCE OF THE ROOTSTOCK ON THE GROWTH VIGOUR OF SOME VARIETIES OF PLUM TREE IN THE CENTRAL AREA OF OLTENIA

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ABSTRACT

The plum species presents low requirements for climate and soil and is particularly prevalent in hilly areas, where they occupy field areas unfit for other crops.

The research was carried out between 2015 and 2017 within a plantation set up in 1995. The biological material used in the present paper is represented by three plum varieties (Stanley, Pescăruş and Dâmboviţa) grafted on 4 rootstocks (Oteşani 8, Pixy, Miroval and Roşior vărатic).

The paper aims to establish the rootstock's influence on growth vigour in the graft/rootstock biosystem.

From the three varieties studied, the Pescăruş and Dâmboviţa varieties fall into the medium vigour group and the Stanley variety in the low vigour group.

INTRODUCTION

Plum is a rustic species that succeeds in the conditions of a minimal agrotechnic need and therefore has expanded extensively in the gardens of the population.

Plums are an excellent source of calcium, potassium and iron, which are necessary for the human body and are very good digestive aid due to the high fiber content (cellulose), being recommended for both adults and children in the growing period, in the form of purees, compotes, juices.

Research on the influence of rootstock on the vigor of plum growth has been done both abroad and in our country.

Lepsis et. al., (2004), studying the behavior from the point of view of growth vigour and production of Victoria and Kometa Kubanskaya varieties, grafted on eight generative rootstocks and eight vegetative rootstocks, concluded that the most indicated rootstocks to be used are St. Julien Noir, Wangenheims Cwetche and St. Julien Wandenswill.

Sytarek et. al., (2004), studying the behavior of 5 plum varieties (Oullins Golden Gage, Cacanska Najbolja, Stanley, Empress and Valor) grafted on three rootstocks, out of which two generative (P. divaricate and Wangenheim Prune) and a vegetative one (Pixy), under different pedoclimatic conditions, concluded that varieties grafted on P. divaricata rootstock had the highest growth vigour compared to the same varieties grafted on the other rootstocks.

Kosina studied the performance of three plum varieties (Stanley, Cacanska Lepotica and Valjevka) grafted on four rootstocks (GF 655/2, Pixy, Fereley and Ishtara), following the trunk section, production, fruit weight and root sucker growth capacity. All three varieties grafted on Pixy rootstock were less vigorous. The Stanley variety grafted on the Fereley rootstock grows less than when grafted on the rootstock GF 655/2, while the grafting on Ishtara is the same size as grafting on the GF 655/2 rootstock. In the

other two varieties there are no significant differences in trunk growth, irrespective of the rootstocks.

In Oradea, Danciu V.M., (2002) studied the behavior of four plum varieties grafted on the Mirobolan rootstock in high density orchards in the fruit-growing ecosystem in the area. He came to the conclusion that the level of the production in the 6th year after planting indicates that the Stanley variety is superior to the Record variety in the 4x2m planting distances, and the Ialomiţa variety is superior to the Albe mici variety in the planting distances of 4x3 m.

Roman R., (1993) studied the space needs of 33 plum varieties grafted on two rootstocks (Corcoduş and Oteşani 8) at I.C.D.P. Mărăcineni and found that for intensive cultivation using the planting distance of 4.5/4 m, most of the varieties studied are part of the variety allowed for propagation grafted on the mirabelle. In the case of varieties grafted on Oteşani 8, the planting distance between trees in line can be 3.5 m.

Botu I. et. al. (1993) studied the multiplication behavior of 6 vegetative rootstocks (Oteşani 8, Oteşani 11, Pixy, Saint Julien A, Mirobolan 2V and Mirobolan 5V) and then into the orchard by grafting three varieties (Tuleu Gras, Centenar and Anna Spath), concluding that the studied vegetal rootstocks influenced the vigor of growing grafted varieties. Pixy and Oteşani 8 rootstocks imprinted a small vigour, Oteşani 11 and Saint Julien A a medium vigour, and Mirobolan 2V and Mirobolan 5V a great vigour. The trees grafted on Pixy and Oteşani 8 rootstocks can be cultivated at lower planting distances.

Achim Gh. et al. (2004), in the paper " 'Miroval - a new vegetative rootstock for the European plum varieties" concluded that the Miroval rootstock determined the obtaining of varieties of great vigour, and the production of fruits was better at rootstocks Oteşani 8 and Pixy (12-25 t/ha), the fruits being of normal size. As a result, Miroval rootstock is recommended to be used as rootstocks for European plum varieties in sub-Carpathian areas of southern Romania, respectively on soils with good drainage and moderate clay content.

Also, aspects of plant vigour, namely plum species, have been studied in Oltenia, in the southern part of the country, aspects regarding the growth of plum varieties on the rootstock that imprints certain vigour (Cichi M., 2013).

MATERIAL AND METHOD

During the period 2015-2017 a series of research was carried out on the mode of behavior in the process of growing three plum varieties (Stanley, Pescăruş, Dâmboviţa) grafted on four rootstocks (Oteşani 8, Pixy, Miroval and Roşior văratic). The research was carried out in a plum plantation set up in 1995. The research methods used in the three years of study (2015-2017) have taken into account the proposed objectives.

In order to determine the rootstock's influence on growth, within the graft/rootstock bio-system, the following *biometric measurements h*ave been made: trunk circumference (cm); trunk section area (cm^2); crown diameter (cm); tree height (cm); crown volume (m^3) and land use grade (%). The research consisted in making measurements on trees each year, using the calliper, roulette, meter, etc. Following the results obtained, based on the points granted for each studied element, the growth vigour of each graft / rootstock biosystem was determined.

RESULTS AND DISCUSSIONS

Average value of the trunk section surface area of the variety **Stanley** is 127 cm^2 (Table 1). The values recorded on each biosystem are: 83 cm^2 (Stanley/Oteşani 8), 123 cm^2 (Stanley/Pixy), 131 cm^2 (Stanley/Roşior văratic) and 172 cm^2 (Stanley/Miroval). If the last biosystem (Stanley/Miroval) is taken as a control group, statistically significant negative differences are found: -89 cm^2 (Stanley/Oteşani 8), -49 cm^2 (Stanley/Pixy), -41 cm^2 (Stanley/Roşior văratic) and -45 cm^2 (as compared to the average).

Table 1

Characteristics of the growth manner depending on the graft/rootstock biosystem in STANLEY plum variety

No	VARIETY/ ROOTSTOCK	Biometric measurements average		
		TSA (cm^2)	Difference +/-	Signifi-cance
1.	**STANLEY/ OTEŞANI 8**	83	-89	000
2.	**STANLEY /PIXY**	123	-49	000
3.	**STANLEY/MIROVAL (Ct)**	172	-	Control (Ct)
4.	**STANLEY/ROŞIOR V.**	131	-41	000
AVERAGE		**127**	**-45**	**000**

LSD 5% = 3.5 cm^2
LSD 1% = 5.1 cm^2
LSD 0,1% = 7.6 cm^2

The average diameter of the crown is 375 cm, the values recorded for each biosystem being: 335 cm (Stanley/Oteşani 8), 357 cm (Stanley/Pixy), 381 (Stanley/Roşior văratic) and 426 cm (Stanley/Miroval)(Table 2).

The average tree height is 385 cm, with the following values: 332 cm (Stanley/Oteşani 8), 371 cm (Stanley/Roşior văratic), 388 cm Stanley/Pixy) and 448 cm (Stanley/Miroval).

The average volume of the tree crown is 36 m^3, decreasing order of values being: 54 m^3 (Stanley/Miroval), 33 m^3 (Stanley/Roşior văratic), 32 m^3 (Stanley/Pixy) and 24 m^3 (Stanley/Oteşani 8).

Table 2

Characteristics of the growth manner depending on the graft/rootstock biosystem in STANLEY plum variety

No.	VARIETY/ ROOTSTOCK	Biometric measurements average			
		The diametre of the crown	Height of the tree (cm)	The average volum (m^3)	The average utilization rate of the land (%)
1.	**STANLEY/ OTEŞANI 8**	335	332	24	55.0
2.	**STANLEY/ PIXY**	357	388	32	62.5
3.	**STANLEY/ MIROVAL (Ct)**	426	448	54	89.0
4.	**STANLEY/ ROŞIOR V.**	381	371	33	712
AVERAGE		**375**	**385**	**36**	**68.9**

The average use rate of land is 68.9%, with values ranging between 55.0% (Stanley/Oteşani 8) and 89.0% (Stanley/Miroval). At the Stanley/Pixy biosystem, the land occupancy is 62.5%, and the Stanley/Roşior văratic biosystem is 71.2%.

The variety **Pescăruş** is grafted on four rootstocks and has a trunk section area of 135 cm ^{2} (Table 3). The maximum value is found in the Pescăruş / Miroval biosystem (171 cm^2), while the minimum at the Pescăruş / Oteşani 8 (96 cm^2). The Pescăruş/Pixy biosystem has the trunk section area of 128 cm^2, and the Pescăruş Roşior văratic biosystem of 145 cm^2. As compared to the control group (Pescăruş/Miroval) there are recorded very significant negative differences, both for the biosystems Pescăruş / Oteşani 8 (-75 cm^2), Pescăruş / Pixy (-43 cm^2), Pescăruş/Roşior văratic, as well as the average of biosystems (-36 cm^2).

Table 3

Characteristics of the growth manner depending on the graft/rootstock biosystem in PESCĂRUŞ plum variety

No	VARIETY/ ROOTSTOCK	Biometric measurements average		
		TSA (cm^2)	Difference +/-	Signifi-cance
1.	**PESCĂRUŞ/ OTEŞANI 8**	96	-75	000
2.	**PESCĂRUŞ /PIXY**	128	-43	000
3.	**PESCĂRUŞ/MIROVAL(Ct)**	171	-	Control (Ct)
4.	**PESCĂRUŞ/ROŞIOR V.**	145	-26	000
AVERAGE		135	-45	000

LSD 5% = 6.7 cm^2
LSD 1% = 9.7 cm^2
LSD 0,1% = 14.6 cm^2

The diameter of the crown has an average value of 389 cm, depending on the biosystem, the following values are recorded: 370 cm (Pescăruş/Oteşani 8), 384 cm (Pescăruş / Pixy), 397 cm (Pescăruş/Roşior văratic) and 406 cm (Pescăruş/Miroval)(Table 4).

Table 4

Characteristics of the growth manner depending on the graft/rootstock biosystem in PESCĂRUŞ plum variety

No.	VARIETY/ ROOTSTOCK	Biometric measurements average			
		The diametre of the crown	Height of the tree (cm)	The average volum (m^3)	The average utilization rate of the land (%)
1.	**PESCĂRUŞ/ OTEŞANI 8**	370	326	28	67.1
2.	**PESCĂRUŞ/ PIXY**	384	411	39	72.3
3.	**PESCĂRUŞ/ MIROVAL (Ct)**	406	406	42	80.8
4.	**PESCĂRUŞ/ ROŞIOR V.**	397	394	41	77.3
AVERAGE		**389**	**384**	**38**	**74.2**

The average height of the trees is 384 cm, the values oscillated between 326 cm at the Pescăruş / Oteşani 8 and 411 cm in biosystem at the Pescăruş/Pixy biosystem. Biosystems Pescăruş/Roşior văratic and Pescăruş/Miroval show trees

with a height of 394 cm and 406 cm, respectively.

The tree crown volume has an average value of 38 m^3, with values close to the average for the biosystems Pescăruş/Pixy (39 m^3), Pescăruş/Roşior văratic (41 m^3) and Pescăruş/Miroval (42 m^3). The Pescăruş/Oteşani 8 biosystem shows a crown volume much smaller than the average (28 m^3).

The utilization rate of the land is on average 74.2%, with values close to this in the Pescăruş/Pixy (72.3%) and Pescăruş/ Roşior văratic (77.3%) biosystems. The value of the Pescăruş/Oteşani 8 biosystem is below average (67.1%), and the Pescăruş/Miroval (80.8%) biosystem is above average.

The variety **Dâmboviţa** shows on average the trunk section area of 196 cm^2 (Table 5). Depending on the graft/rootstock biosystem, the values found are: 153 cm^2 (Dâmboviţa/Oteşani 8), 172 cm^2 (Dâmboviţa/Pixy), 190 cm^2 (Dâmboviţa/Roşior văratic) and 268 cm^2

(Dâmboviţa/Miroval). Compared to the Dâmboviţa/Miroval biosystem, there are found very significant negative differences: -115 cm^2 (Dâmboviţa / Oteşani 8), -96 cm^2 (Dâmboviţa/Pixy), -78 cm^2 (Dâmboviţa/Roşior văratic) and -72 cm^2 (as compared to the average).

Table 5

Characteristics of the growth manner depending on the graft/rootstock biosystem in DÂMBOVIȚA plum variety

No	VARIETY/ ROOTSTOCK	Biometric measurements average		
		TSA (cm^2)	Difference +/-	Signifi-cance
1.	**DÂMBOVIȚA/OTEŞANI 8**	153	-115	000
2.	**DÂMBOVIȚA/PIXY**	172	-96	000
3.	**DÂMBOVIȚA/MIROVAL(Ct)**	268	-	Control (Ct)
4.	**DÂMBOVIȚA/ROŞIOR V.**	190	-78	000
AVERAGE		196	-72	000

LSD 5% = 3.6 cm^2
LSD 1% = 5.2 cm^2
LSD 0,1% = 7.9 cm^2

The trees have a crown with a diameter of 370 cm, close values being found in the biosystems Dâmboviţa/Oteşani 8 (382 cm) and Dâmboviţa/Pixy (381 cm), and for the Dâmboviţa/Miroval and Dâmboviţa/Roşior văratic biosystems the diameter of the crown has the value of 398 cm and 388 cm, respectively (Table 6).

The average tree height is 413 cm, the biosystems having the following values: 381 cm (Dâmboviţa/Pixy), 382 cm (Dâmboviţa/Oteşani 8), 422 cm (Dâmboviţa/ Roşior văratic) and 466 cm (Dâmboviţa/Miroval).

The average tree crown volume in the four biosystems is 38 m^3, with the following values depending on the graft/rootstock bio system: 30 m^3 (Dâmboviţa/Pixy), 31 m^3 (Dâmboviţa/Oteşani 8), 43 m^3 (Dâmboviţa/ Roşior văratic) and 49 m^3 (Dāmboviţa/Miroval).

The land is occupied on average 67.1%, respectively 59.0% (Dâmboviţa/Oteşani 8), 59.4% (Dâmboviţa/Pixy), 73.8% (Dâmboviţa/R Roşior văratic) and 77. 7% (Dâmboviţa /Miroval).

Table 6

Characteristics of the growth manner depending on the graft/rootstock biosystem in DÂMBOVIȚA plum variety

No.	VARIETY/ ROOTSTOCK	Biometric measurements average			
		The diametre of the crown	Height of the tree (cm)	The average volum (m^3)	The average utilization rate of the land (%)
1.	**DÂMBOVIȚA/ OTEŞANI 8**	347	382	31	59.0
2.	**DÂMBOVIȚA/ PIXY**	348	381	30	59.4
3.	**DÂMBOVIȚA/ MIROVAL (Ct)**	398	466	49	77.7
4.	**DÂMBOVIȚA/ ROŞIOR V.**	388	422	43	73.8
AVERAGE		**370**	**413**	**38**	**67.1**

In order to determine plant growth vigour, taking into account all the growth factors, the formula established by Botu I. (1978) (Table 4) was applied. Therefore:

- Trunk section area (SST) - 50 cm^2 = 1 point;
- Crown diameter - 2 m = 1 point;
- Actual crown volume - 10 m^3 = 1 point;
- Tree height - 2 m = 1 point.

As a result of the accumulated points, the varieties are divided into three groups of values: - small vigour - 0-10 points;

- medium vigour - 10 - 20 points;
- high vigour -> 20 points.

Table 7

Establishing the growth vigour of varieties depending on the dimensional elements and points granted

Nr. crt.	SOIUL	TSA (cm^2)	The average utilization rate of the land (%)	The growth vigour
1.	**STANLEY**	127	68.9	**MICĂ**
2.	**PESCĂRUŞ**	135	74.2	**MEDIE**
3.	**DÂMBOVIȚA**	196	67.1	**MEDIE**

From the three varieties studied, the Pescăruş and Dâmboviţa varieties fall into the medium vigour group and the Stanley variety in the small vigour group.

CONCLUSIONS

Following the growth mode of plants in the climatic and edaphic conditions of the central area of Oltenia, where the study was conducted, the following conclusions were found:

* the highest value of the trunk section surface is met in Dâmboviţa/Miroval biosystem (268 cm^2), while the Stanley/Oteşani 8 biosystem has the smallest value (83 cm^2)

* tree crown diameter, obtained as average between tree crown diameter and tree crown diameter between rows, oscillated between 426 cm in Stanley/Miroval biosystem and 335 cm in Stanley/Oteşani 8 biosystem;

* The height of the trees was at the highest value in Dâmboviţa/Miroval biosystem (466 cm), the lowest value being found in Pescăruş/Oteşani 8 biosystem (326 cm);

* The volume of the crown varied between 24 m^3 in Stanley/Oteşani 8 biosystem and 54 m^3 in Stanley/Miroval biosystem;

* The best use of the land was found in the Stanley/Miroval biosystem (89%), while the Stanley/Oteşani 8 biosystem showed the lowest occupancy of the land (55%), therefore adopting differentiated planting distances on the biosystem is imposed;

From the three varieties studied, the Pescăruş and Dâmboviţa varieties fall into the medium vigour group, and the Stanley variety in the small vigour group.

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