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PRELIMINARY RESULTS REGARDING THE BEHAVIOUR OF DIFFERENT PEACH VARIETIES UNDER DIFFERENT PLANTING DENSITY

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Abstract

The paper shows preliminary results of the study regarding the behaviour of peach varieties cultivated in intensive system, aiming to find the best solution in terms of economic and sustainability results. The study was carried out on plantation established in 2019 at FRDS Băneasa, farm Moara Domnească, county Ilfov in the Vlăsiei Plain. In 2019, three peach varieties ('Catherine Sel. 1', 'Filip', 'Sprincrest') with different ripening periods were planted. Rootstock used: Tomis 1. The tree canopy is: Bi-Baum®. The peach trees were planted at 4,0×1.5 m, 4.0×2.0 m and 4.0×2.5 m, upon a randomized block design, with drip irrigation. Between the rows, soil was kept tilled and without grass. In 2020 and 2021 measurements were made on early stage growth of tree for: the trunk diameter increase, the shoot length and the trunk cross-sectional area of tree. During our study we found that the planting distance influenced especially average shoot length increase and average trunk diameter and average shoot length are linked together. The study will continue especially to find out the density influence on productivity.

Key words*: peach, varieties, densities, growth dynamic.*

INTRODUCTION

Peach cultivation has been attested in our country since the 14th and 15th centuries according to a series of documents mentioned in Pomologia vol. I (1963), in the whole hilly area of Moldovia, Wallachia and Transylvania, along with other species (Ghena et al., 2010). Peach [*Prunus persica* (L.) Batsch] is a thermophilic fruit tree species that is highly appreciated in Romania, but its production area is relatively restricted from de climate point of view (Septar et al., 2021).

Fruit Research and Development Station Băneasa has a history of studying this specie because it is located in the southeast of the country, an area suitable for peach cultivation.

According to the FAO ranking, regarding the dynamics of peach production worldwide, we can realize that Romania is not in the first positions, both in terms of production and cultivated areas.

The countries that occupy the leading positions in this top have the advantage of the climatic factor with which Romania cannot compete. In order to revitalize the current situation of peach cultivation in our country and to keep up with international trends regarding the strategic objectives of the research-development-innovation system for the field of horticulture, this paper aims to present the preliminary results of the study regarding the behaviour of peach varieties cultivated in intensive system, with the aim of finding the best solution in terms of economic and sustainability results.

Traditional orchards involve long planting distances, which allows the trees a wide and vigorous development.

The conventional orchard system for growing peaches is the Open Vase (DeJong et al., 1999; Çetinbaș et al., 2021). Traditionally peaches are planted in low density (6 × 6 m, 7 × 7 m) resulting low yield per unit area (Lal et al., 2018). These practices are no longer advantageous today, as the resource crisis is increasingly being discussed, with land and labour becoming more expensive and less available.

The different planting system have been successfully demonstrated in different fruit crops: peach and nectarine (Lal et al., 2018), apricot (Guerriero & Scalabrelli, 1989; Kumar et al., 2013; Moloșag et al., 2021), apple

(Comănescu et al., 2012), pear (Machado et al., 2014), cherry (Stănică and Eremia, 2014). Tree cultivation systems are constantly evolving, today there is a great diversity among them, each with its advantages and disadvantages. Super high-density (SHD) systems also known as hedgerows (Diez et al., 2016).

Various studies have been made to find out the effect of different training systems, rootstocks and planting systems on early fruit yield and quality for peach growing (DeJong et al., 1999; Farina et al., 2005; Caruso et al., 2015; Sobierajski et al, 2019; Souza et al., 2019; Çetinbaș et al., 2021).

The advantages of these systems consist in an improved orchard management, by satisfying the need of early production (Robinson, 2007), minimum pruning strategies, light interpretation and distribution (Robinson, 2007; Hoza et al., 2015) and improved tree canopies.

MATERIALS AND METHODS

We conducted the study at the Experimental Base Moara Domnească, within the Research and Development Station for Fruit Growing (RDSFG) Băneasa, located N-E of Bucharest in Afumați, Ilfov County, part of Vlasiei Plain, a subunit of the Roman Plain (44°50' Northern latitude and 26°24' Eastern longitude and 70 m above the sea level). The annual mean temperature is 12°C and the total annual amount of precipitation is ranging between 550 and 600 mm, the maximum occurring between May and July, torrential rains being common. The dominant air circulation direction is from the East and North-East in winter, and from the West in the rest of the year, with a maximum wind speed of 12.6-14.4 km/h and the zonal soil type reddish luvisol. In the depressed areas and in the crevices there are reddish luvisols and stagnosols.

Three peach varieties ('Catherine Sel. 1', 'Filip', Sprincrest') with different ripening periods: were planted in 2019. All peach varieties were grafted on rootstock: Tomis 1. The canopy that was considered adequate for testing is: Bi-Baum®. The apricot trees were planted at 4.0 × 1.5 m (1.666 trees ha^{-1}), 4.0 × 2.0 (1.250 trees ha^{-1}) m and 4.0 × 2.5 m (1.000 trees ha^{-1}), upon a randomized block design. The irrigation system is provided by drip pipes, with a flow rate of 1.6 l/hour-1.75 l/hour. Between the rows, the soil was kept tilled and without grass.

Our experience is a bifactorial one and is carried out in order to observe the agrobiological potential of the varieties studied, aiming to intensify the cultivation technologies, through high density.

The chosen rootstock is Tomis 1, a generative Romanian rootstock for peaches, obtained by selection in 1979 by Indreiaș Alexandra, approved in 1997. It has good affinity for grafting with all varieties in the assortment, induces medium vigour, fruiting precocity and good fruit productivity and quality of grafted varieties.

In order to identify the most suitable variety and planting distance with the final goal of crop intensification, corroborated with the degree of maximization of the tree density, determinations were made on early stage growth of tree. The determination of observed characteristics was made in 2020 and 2021, at the end of the growth cycle, with electronic calliper and roulette for shoot length. Several tree growth indicators were analysed: the average trunk diameter increase (ATDI, mm), the average shoot length increase (ASLI, mm) and the trunk cross-sectional area of tree (TCSA, cm^2) was calculated by using formula TCSA = Girth2/4π (Westwood et al., 1963).

The collected data were processed with the facilities of MSExcel 2010 and are presented as tables and charts. The tables include statistical indicators as average, standard deviation and variation coefficients.

RESULTS AND DISCUSSIONS

A closer look in Tables 1 and 2 reveals the influence of planting distance on the three synthetic growth indicators: the average trunk diameter increase (ATDI, mm), the average shoot length increase (ASLI, cm) and the trunk cross-sectional area of the tree (TCSA, cm^2).

When the peach was planted at 1.5 m apart in the trees line, the (ATDI, mm) was 1.20 mm per season (STDEV=1.1348; VAR=94.5641), with the lowest increase 0.13 mm on 'Filip' variety and the higher increase 2.39 mm on 'Springcrest'.

Table 1. Annual growth dynamic. Average shoots length increase related to the planting distance

Variant	Intra-row planting distance [m]	Variety / Rootstock	Average shoots length [cm]	Average shoots length [cm]	*Average shoots length increase [cm]*
V1	1,5	CATHERINE SEL. I / TOMIS 1	43,38	63,63	20,25
	1,5	FILIP / TOMIS 1	24,00	52,25	28,25
	1,5	SPRINGCREST / TOMIS 1	15,88	30,50	14,63
Indicators		**AVG**	**27,75**	**48,79**	**21,04**
		STDEV	*14,1283*	*16,8311*	*6,8469*
		VAR	*50,9129*	*34,4959*	*32,5398*
V2	2,0	CATHERINE SEL. I / TOMIS 1	30,25	47,25	17,00
	2,0	FILIP / TOMIS 1	30,88	45,75	14,88
	2,0	SPRINGCREST / TOMIS 1	35,00	49,88	14,88
Indicators		**AVG**	**32,04**	**47,63**	**15,58**
		STDEV	*2,5810*	*2,0879*	*1,2269*
		VAR	*8,0551*	*4,3841*	*7,8730*
V3	2,5	CATHERINE SEL. I / TOMIS 1	29,38	43,50	14,13
	2,5	FILIP / TOMIS 1	24,25	49,63	25,38
	2,5	SPRINGCREST / TOMIS 1	28,38	41,38	13,00
Indicators		**AVG**	**27,33**	**44,83**	**17,50**
		STDEV	*2,7167*	*4,2836*	*6,8431*
		VAR	*9,9390*	*9,5544*	*39,1035*

Table 2. Annual growth dynamic. Average trunk diameter and trunk cross-sectional area of tree increase related to the planting distance

Variant	Intra-row planting distance [m]	Variety / Rootstock	Average trunk diameter [mm] 01.10.2020	Average trunk diameter [mm] 06.04.2021	*Average trunk diameter increase [mm]*	TCSA [cm²] 01.10.2020	TCSA [cm²] 01.10.2021	*Average TCSA increase [cm²]*
V1	1,5	CATHERINE SEL. I / TOMIS 1	14,92	16,00	1,08	17,47	20,10	2,62
	1,5	FILIP / TOMIS 1	15,12	15,25	0,13	17,95	18,26	0,31
	1,5	SPRINGCREST / TOMIS 1	10,33	12,72	2,39	8,38	12,70	4,32
Indicators		**AVG**	**13,46**	**14,66**	**1,20**	**14,60**	**17,02**	**2,42**
		STDEV	*2,7096*	*1,7186*	*1,1348*	*5,3940*	*3,8498*	*2,0150*
		VAR	*20,1359*	*11,7258*	*94,5641*	*36,9474*	*22,6223*	*83,3107*
V2	2,0	CATHERINE SEL. I / TOMIS 1	12,77	15,75	2,98	12,80	19,47	6,67
	2,0	FILIP / TOMIS 1	15,68	15,75	0,07	19,30	19,47	0,17
	2,0	SPRINGCREST / TOMIS 1	13,40	16,00	2,60	14,10	20,10	6,00
Indicators		**AVG**	**13,95**	**15,83**	**1,88**	**15,40**	**19,68**	**4,28**
		STDEV	*1,5310*	*0,1443*	*1,5818*	*3,4400*	*0,3597*	*3,5742*
		VAR	*10,9748*	*0,9116*	*83,9918*	*22,3391*	*1,8279*	*83,4780*
V3	2,5	CATHERINE SEL. I / TOMIS 1	12,68	13,25	0,57	12,62	13,78	1,17
	2,5	FILIP / TOMIS 1	12,63	14,40	1,77	12,52	16,28	3,76
	2,5	SPRINGCREST / TOMIS 1	12,40	14,63	2,23	12,07	16,80	4,74
Indicators		**AVG**	**12,57**	**14,09**	**1,53**	**12,40**	**15,62**	**3,22**
		STDEV	*0,1498*	*0,7393*	*0,8567*	*0,2948*	*1,6139*	*1,8452*
		VAR	*1,1922*	*5,2461*	*56,1764*	*2,3769*	*10,3317*	*57,3177*

Under similar conditions, (ASLI, cm) was 21.04 cm per season (STDEV=6.8469; VAR=32.5398), with the lowest increase 14.63 mm on 'Springcrest' variety and the higher increase 28.25 cm on 'Filip' and (TCSA, cm^2) was 2.42 cm^2 per season (STDEV=2.0150; VAR=83.3107), with the lowest increase 0.31 cm^2 on 'Filip' variety and the higher increase 4.32 cm^2 on 'Springcrest'.

When the peach was planted at 2.0 m apart in the trees line, the (ATDI, mm) was 1.88 mm per season (STDEV=1.5818; VAR=83.9918), with the lowest increase 0.07 mm on 'Filip' and the higher increase 2.98 mm on 'Catherine Sel. 1' variety. Under similar conditions, (ASLI, cm) was 15.58 cm per season (STDEV=1.2269; VAR=7.8730), with the lowest increase 14.88 cm both on 'Filip' and 'Springcrest' varieties and the higher increase 17.00 cm on 'Catherine Sel. 1' variety and (TCSA, cm^2) was 4.28 cm^2 per season (STDEV=3.5742; VAR=83.4780), with the lowest increase 0.17 cm^2 on 'Filip' variety and the higher increase 6.67 cm^2 on 'Catherine Sel. 1'.

Finally, when the peach was planted at 2.5 m apart in the trees line the (ATDI, mm) was 1.53 mm per season (STDEV=0.8567; VAR=56.1764), with the lowest increase 0.57 mm on 'Catherine Sel. 1' variety, and the higher increase 2.23 mm on 'Springcrest'. Under similar conditions, (ASLI, cm) was 17.50 cm per season (STDEV=6.8431; VAR=39.1035), with the lowest increase 13.00 cm on 'Springcrest' variety and the higher increase 25.38 cm on 'Filip' variety and (TCSA, cm^2) was 3.22 cm^2 per season (STDEV=1.8452; VAR=57.3177), with the lowest increase 1.17 cm^2 on 'Catherine Sel. 1' variety and the higher increase 4.74 cm^2 on 'Springcrest'.

The data collected and assessed by calculation of determination and regression coefficients leader to highlight of a relationship between the average trunk diameter increase (ATDI, mm) and the average shoots length increase (ASLI, cm). These were R^2=0.5055 and r=0.7110**, which is statistically insured even at 12 pairs of values and n=12-2 liberty degrees of liberty. The relationship between the two assessed parameter is described by the equation of ascendent tendency line y=2.1716x + 9.2107 (Figure 1).

Another important relationship was found between annual trunk diameter increase (ATDI, mm) and trunk cross section area (TCSA, cm^2). The coefficients were R^2=0.9771** and r=0.9885**, which are very significant statistically insured even at 12 pairs of values and n=12-2 liberty degrees (Figure 2).

A very closed relationship was found between trunk cross section area (TCSA, cm^2) and the average shoots length increase (ASLI, cm). The coefficients found were R^2=0.1223 and r=0.3497, at n=12 pairs of values and 12-2 liberty degrees which is described by the equation: y=-0.8055+20.7050 (Figure 3). The descendent trend of the line suggests that the both parameters are influenced not only by the variety-rootstocks combination and planting distances but also by applied maintenance technology (irrigation, fertilisation, pruning, etc.). These aspects and additional data will be collected, processed and interpreted in the coming years.

CONCLUSIONS

Based on the presented data we found that the planting distance influenced all tree growth indicators that were analysed in all three studied peach varieties.

For the varieties planted at 1.5 m apart in the trees line, the 'Sprincrest' variety recorded the highest values of the indicators analysed, with 4.32 cm^2 (TCSA, cm^2) value.

For the varieties planted at 2.0 m apart in the trees line, the 'Catherine Sel. I' variety recorded the highest values of the all indicators analysed, with 6.67 cm^2 (TCSA, cm^2) value.

For the varieties planted at 2.5 m apart in the trees line, the 'Springcrest' variety recorded the highest values of the indicators analysed, with 4.74 cm^2 (TCSA, cm^2) value.

By using the synthetic growth indicator TCSA, will be possible to correlate the productivity with the planting distances in the future studies.

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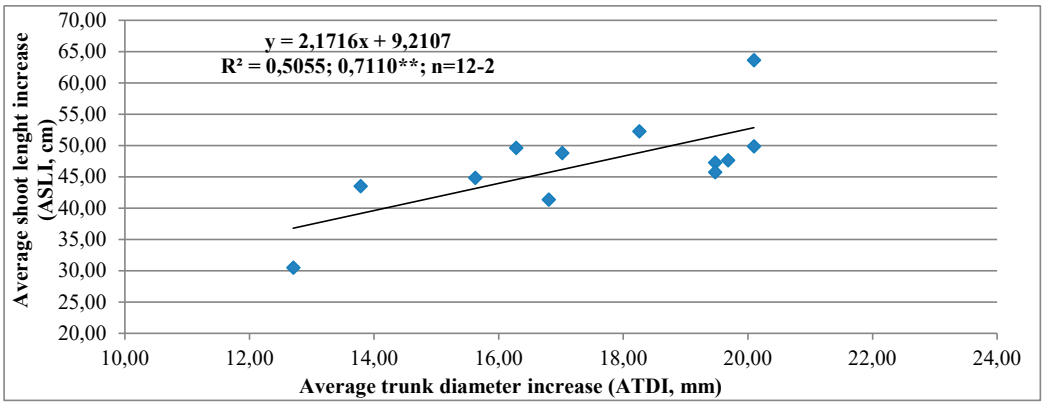

Figure 1. Correlation between average trunk diameter increase (ATDI, mm) and average shoot length increase (ASLI, cm)

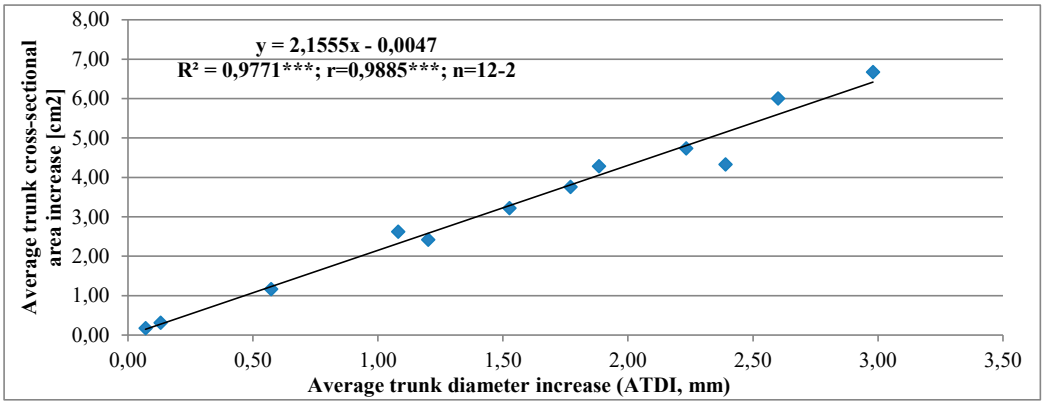

Figure 2. Correlation between average trunk cross- sectional area increase (TCSA, cm^2) and average trunk diameter increase (ATDI, mm)

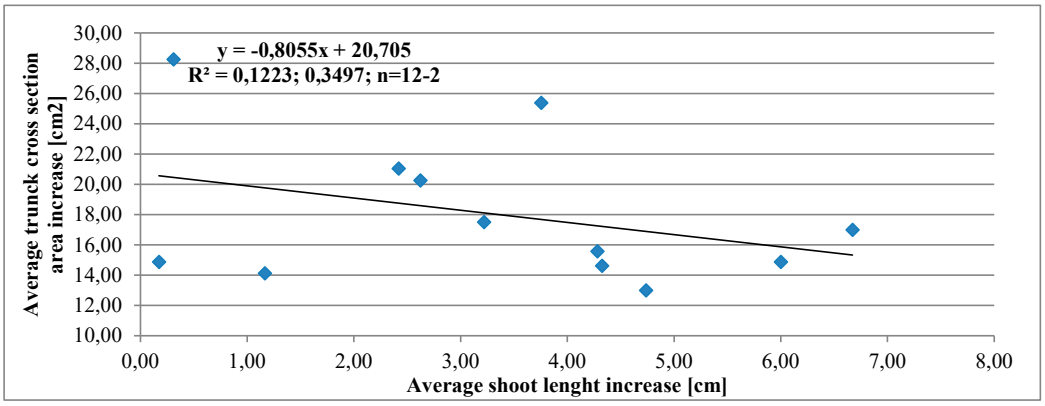

Figure 3. Correlation between average trunk diameter increase (ATDI, mm) and average shoot length

REFERENCES

Caruso, T., Guarino, F., Bianco R.L., Marra, F.P. (2015). Yield and Profitability of Modified Spanish Bush and Y_Trellis Training Systems for peach. *HortScience 50*(8): 1160-1164 https://doi.org/10.21273/hortsci.50.8.1160.

Comănescu, D., Petre, G., Petre, V. (2012). The behaviour of some apple tree varieties with genetic disease-resistance in the high density system. *Scientific Papers. Series B, Horticulture, Vol. LVI*, 63-68.

Çetinbaş, M., Butar, S., Akyüz, F., Sarisu, H. C. & Gür, I. (2021). The effects of planting distance and training system on yield and fruit quality of peach. *Mitteilungen Klosterneuburg 71*, 74-89.

Dejong, T. M., Tsuji, W., Doyle, J. F., Grossman, Y. L. (1999). Comparative economic efficiency of four peach production systems in California. *HortScience 34*(1): 73-78 https://doi.org/10.21273/hortsci.34.1.73.

Diez, C. M., Moral, J., Cabello, D., Morello, P., Rallo, L., & Barranco, D. (2016). Cultivar and tree density as key factors in the long-term performance of super high-density olive orchards. *Front. Plant Sci. 7*:1226, https://doi.org/10.3389/fpls.2016.01226.

Farina, V., Lo Bianco, R., Iglese, P. (2005). Vertical distribution of crop load an fruit quality within vase- and Y-shape canopies of 'Elegant Lady' peach. *HortScience 40*(3): 587-591 https://doi.org/10.21273/hortsci.40.3.587.

Ghena, N., Braniște, N., Stănică, F. (2010). *Pomicultură generală*. Otopeni, RO: Invel Multimedia.

Guerriero, R., Scalabrelli, G. (1989). Six years observations on apricot high density plantings. *Acta Hort. 243*, 365-372 https://doi.org/10.17660/ActaHortic.1989.243.51.

Hoza, D., Delian, E., Asănică, A., Hoza, G. (2015). Research regarding the intensity of certain physiological processes for peach varieties within high density plantations. *Agriculture and Agricultural Science Procedia 6*, 165-170 https://doi.org/10.1016/j.aaspro.2015.08.054

Kumar, D., Ahmed, N., Verma, M. K., Dar, T. A. (2013). Growth, yield, quality and leaf nutrient status as influenced by planting densities and varieties of apricot. *Indian J. Hort. 70*(2), 195-199.

Lal, S., Sharma, O. C., Singh, D. B., Rather, S. A., Qureshi, I. (2018). Tree growth, fruit quality and yield attributes as affected by tree spacing and varieties of peaches/nectarine under temperate climate. *International Journal of Chemical Studies 6*(2): 308-311 http://krishi.icar.gov.in/jspui/handle/123456789/14781.

Machado, B. D., Rufato, L., Kretzschmar, A. A., Bogo, A., Silveira, F. N., Magro, M. (2014). Effect of plant densities and cultivars on vegetative and productive variables of European pears in Southern Brazil. *Acta Hort. 1058*, 193-197 https://doi.org/10.17660/ActaHortic.2014.1058.22.

Moloșag, A., Dumitru., M., Căliniță, C., Drăgan, G., Dragnea, M., Dogaru, M., Dragomir, D., Petrișor, C. (2021). Preliminary results regarding the behaviour of different apricot varieties under different planting density. *Annals of the University of Craiova, Series Biology, Horticulture, Food products processing technology, Environmental engineering, 26*, 111-116 doi: 10.52846/bhfe.26.2021.17.

Robinson, T., L. (2007). Recent advances and future directions in orchard planting systems. *Acta Hortic. 732*, 367-381 https://doi.org/10.17660/ActaHortic.2007.732.57.

Septar, L., Moale, C., Gavăt, C., Opriță, V.A., Caplan, I., Stanca, M. & Lămureanu, G. (2021). Influence of deficit irrigation on the 'Catherine Sel.1' peach cultivar in the semiarid region of Dobrogea. *Acta Hortic. 1304*, 249-256 https://doi.org/10.17660/ActaHortic.2021.1304.35.

Sobierajski, G.R., Silva, T.S., Hernandes, J.L., Júnior, M.J.P. (2019). Y-shaped and fruiting wall peach orchard training system in subtropical Brazil. *Bragantia, Campinas 78*(2): 229-235 https://doi.org/10.1590/1678-4499.20180188.

Souza, A.L.K., Souza, E.L., Camargo, S.S., Feldberg, N.P., Pasa, M.S., Bender, A. (2019). The effect of planting density on 'BRS Rubimel' peach trained as a "Y-shaped" system. *Revista Brasileira Fruticultura 41*(2): 115-122 http://dx.doi.org/10.1590/0100-29452019122.

Stănică F. & Eremia A. (2014). Behaviour of some new apricot cultivars under the parallel trident planting system. *Acta Hort. 1058*, 129-136.

Westwood, M. N., Reimer, F. C., Quackenbush, V. L. (1963). Long term yield as related to ultimate tree size of three pears varieties grown on rootstocks of five *Pyrus* species. *Proc. American Soc. Hort. Sci. 82*: 103-8.