

GROWTH AND PRODUCTIVITY OF PLUM TREES DEPENDING ON THE FORM OF THE CROWN AND VARIETY

CREȘTEREA ȘI FRUCTIFICAREA POMILOR DE PRUN ÎN FUNCȚIE DE FORMA DE COROANĂ ȘI SOI

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Abstract. *In order to reduce the growth vigor of plum trees and increase productivity, it was studied the improved bush crown form.*

Trees with 3, 4 and 5 main branches took part in the experiment. The control group was presented by the “mixed pyramid” crown that is recommended for plum trees in Moldova. Twelve years of research have shown that the improved bush crown contributes to the rapid development of the vegetative mass of trees when they are young, the reduced size of the crown (by 32-40%) and to almost doubled increased orchard productivity. The most productive was the option of improved bush with 5 main branches.

Key words: plums, growing power, form of the crown, variety, yield

Rezumat. *Cu scopul reducerii vigoriei de creștere a pomilor de prun și majorarea productivității, a fost studiată forma de coroană tufa ameliorată. În studiu au fost luați pomii conduși cu 3, 4 și 5 ramuri de schelet. Ca martor au servit pomii conduși după forma de coroană piramida mixtă recomandată pentru Republica Moldova. În rezultatul a 12 ani de studii s-a determinat că forma de coroană tufa ameliorată favorizează acumulării rapide a masei vegetale în perioada de creștere, diminuarea parametrilor coronamentului cu 32-40% și majorarea productivității plantației de aproximativ de două ori. Cea mai productivă s-a adevărit a fi varianta unde pomii conduși după forma de coroană tufa ameliorată cu 5 ramuri de schelet.*

Cuvinte cheie: prun, vigoarea de creștere, forma de coroană, soi, productivitate

INTRODUCTION

Productivity and economic efficiency of plum trees in present are considerably lower than those of apple trees, the intensification level of which is the highest among fruit species. The major problem is the large size of plum trees due to the lack of reliable dwarf rootstocks, which leads to a significant reduction in fruit productivity because of increased costs of pruning, and especially harvesting (Cimpoieș, 2000; Журавель *et al.*, 2007; Grădinaru and Istrate, 2009). Large crown parameters also constrain the increase in the density of plantations, which ultimately affects lower crops in plum orchards (Cociu *et.al.*, 1997; Sitarek, 2006).

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At present, such factors as the growing power, the form of the crown and varieties fruiting particularities are not taken into account. Therefore, the search for agronomic techniques is the main way to reduce the growing power of plum trees and, consequently, to increase the density of plantations (Журавель *et al.* 2007; Rîbințev, 2012; Popa *et al.*, 2015).

The development of crowns with a rational deployment of branches in the space, which allows us to improve the access to light and to reduce the size of plants, is one of these techniques. The improved bush forming that has been subject to studies for 12 years in Moldova is very interesting in this regard.

MATERIAL AND METHOD

In spring 2005 we founded an experimental garden to study the improved bush form of crowns at the experimental station "Criuleni". The garden included 1-year old trees of the Kabardinskaia ranniaia and Stanley plum varieties, grafted on seedling rootstock (*P. cerasifera*), which differ in the nature of growth and fruiting.

When we created an improved bush crown form, trees were shortened after planting at the height of 20-25 cm from the soil surface and during the vegetation period there were created variants with 3, 4 and 5 main branches. All the branches that were growing inside the crown were cut for sunlight rays and the crown looked open centre. The plantation scheme is 5 x 2 m.

The control trees were formed according to the naturally-improved system (a mixed pyramid) and planted under the scheme 6 x 4 m, which is recommended for plum trees in the Republic of Moldova.

The experiment was founded in 3 repetitions, each repetition representing 12 fruit trees.

The research was carried out, applying conventional methods that are widely used when we work with fruit crops. Crown parameters, the average and the total shoot length were measured at the end of the growing season, the crop yield and the number of fruits were counted 2 weeks before harvest, in 3 registered trees for three times.

The statistical processing of the data obtained in the study was done according to B. Dospekhov (1985), with the use of computer programs.

RESULTS AND DISCUSSIONS

The conducted research showed that the vegetative mass of young plants increases faster and more intensively if they are formed according to the improved bush system.

The correlation between the root and the shoot systems in improved bush is almost completely removed. The total length of annual shoots, as one of the indicators that characterizes processes of growth and their intensity in plum trees, which are younger than 6 years old, was bigger in improved bush crowns (tab. 1).

Thus, the total shoot length in the variant with 5 main branches exceeded the control group by 14.5 m in Stanley variety and by 19.2 m in Kabardinskaia ranniaia variety. Since 2011, the total length of shoots is higher in the control group, where the trees are formed according to the naturally improved system.

This is explained by the fact that by the age of 7 years, processes of growth in the improved bush form are constrained by a density plantation and a more restrictive pruning of trees.

Table 1

The total length of shoots depending on the crown form and variety

Variety	The form of the crown	The number of branches in the bush	Years					
			2010	2011	2012	2013	2014	2015
Kabardinskaia ranniaia	Mixed pyramid (control)	-	74.4	97.4	62.7	64.3	66.7	61.9
	Improved bush	3	80.3	88.2	58.7	60.1	52.3	55.7
	Improved bush	4	88.7	92.3	60.4	52.7	61.4	57.3
	Improved bush	5	93.6	96.4	63.2	63.9	63.7	58.4
Stanley	Mixed pyramid (control)	-	87.7	108.2	74.8	83.1	92.6	79.5
	Improved bush	3	95.6	93.8	71.4	78.7	82.4	75.1
	Improved bush	4	98.7	96.8	73.7	80.2	82.9	77.4
	Improved bush	5	102.2	100.5	73.3	82.1	84.0	78.2
LSD _{0,05}			2.36	7.07	2.34	2.40	2.45	2.21

Having analyzed the influence of the number of main branches on the processes of growth in plum trees, one should note that the more main branches we have, the bigger the total shoot length is regardless of the variety. Moreover, the difference between varieties is bigger in young plants; it diminishes as they grow older. For instance, in 2011 the difference between the variants with 5, 4 and 3 main branches was 4.1-8.2 m in Kabardinskaia ranniaia variety, while in 2015 it was only 1.0-2.7 m.

Having analyzed the processes of growth in plum trees by years, we can state that the maximum value of the total shoot length was observed in 2011 and ranged from 88.2 m/tree in Kabardinskaia ranniaia variety to 108.2 m/tree in Stanley variety. This indicator decreased in the following years. It was significant enough in 2012, as it was quite a dry year and the annual rainfall was only 146.1 mm. It was low in 2015 too, when we got the maximum yield of fruits.

Generally speaking, one should mention that the annual growth of shoots was stabilized by the 7th year and ranged from 52 to 64 m/tree in Kabardinskaia ranniaia variety and from 71 to 92 m/tree in Stanley variety that is more vigorous.

The analysis of the tree size (tab. 2) shows that in 2015 the height of trees in Stanley variety in case of the improved bush form system was by 140-156 cm lower in all the variants than in the control group, while it was 161-173 cm in Kabardinskaia ranniaia variety. It is first of all explained by the fact that this form of the crown has no standard and it has from 3 to 5 main branches of the same thickness and they redistribute nutrients among themselves and the overall height of trees is generally reduced.

It was also found out that the improved bush form promotes decreased width of the crown.

Table 2

Crown parameters in plum trees, depending on the form of the crown and variety, the experimental station "Criuleni", 2015

The form of the crown	The number of branches in the bush, pcs.	Kabardinskaia ranniaia		Stanley	
		The height of trees, m	The width of the crown	The height of trees, m	The width of the crown
Mixed pyramid (control)	-	4.35	3.15	4.56	3.92
Improved bush	3	2.74	2.10	3.16	2.31
Improved bush	4	2.75	2.10	3.08	2.36
Improved bush	5	2.62	2.15	3.00	2.42

For example, the width of the crown in Stanley variety with 3 main branches was 38% less and the one with 5 main branches was 41% less than in the control group.

The main efficiency indicator of the studied forms of crowns is their yield (tab. 3).

According to the data received during the experiment, the most productive were the trees with the improved bush form of crowns, regardless of the number of main branches; the productivity was on average 34-44% higher than in the control group. First and foremost, this is explained by a smaller size of trees with improved bush crowns and, therefore, a larger number of trees can be planted on a unit of area.

Having analyzed the impact of the number of main branches left in the bush, we have noticed that the more main branches we have, the higher the productivity is; the highest values are observed in the variant with 5 main

branches. So, the maximum harvest (34.5 t/ha) during the whole period of studies was observed in Stanley variety with 5 main branches in 2015.

Table 3

The crop yield of plum plantations depending on the form of the crown and variety, t/ha

Variety	The form of the crown	The number of branches in the bush / pcs.	Year					The average value
			2011	2012	2013	2014	2015	
Kabardinskaia ranniaia	Mixed pyramid (control)	-	8.4	6.4	16.3	5.9	10.2	9.4
	Improved bush	3	16.70	12.60	18.80	7.4	15.70	14.20
	Improved bush	4	18.90	13.70	20.50	7.80	17.20	15.60
	Improved bush	5	20.3	14.9	21.9	8.70	17.9	16.7
Stanley	Mixed pyramid (control)	-	10.5	6.2	16.2	9.1	17.8	12.0
	Improved bush	3	18.90	13.90	20.90	14.20	29.60	19.50
	Improved bush	4	20.60	15.20	21.50	14.80	33.30	21.10
	Improved bush	5	20.70	15.80	21.40	15.60	34.50	21.60

However, it should be noted that it is rather difficult to get a bush with 5 main branches in Kabardinskaia ranniaia variety as it branches out very slowly. Therefore, in the first year after planting we have to pinch the strongest runner to promote additional branching. Furthermore, as the variant with 5 main branches grows, its growth is strongly retarded and ultimately one branch is suppressed. All this suggests that the optimal variants include improved bush with 4 main branches and the one with 5 main branches in the varieties that easily branch out with a later removal of one of the branches as the growth of the tree is strongly retarded.

We have also noticed a significant change in the yield of plum trees by years. The years with an abundant harvest (2011, 2013 and 2015) alternated with a weaker harvest in 2012 and 2014. One should limit the yield of plum trees by 15-20 t/ha for a more stable fruiting by year. Irrigation as well as application of additional fertilizers is needed to obtain higher yields.

CONCLUSIONS

1. The analysis of the received data makes it possible to conclude that the improved bush form of the crown promotes intensive growth of the vegetative mass of plants at a young age and earlier crops of fruit. The annual increment of shoots stabilizes at the age of 7 and ranges from 52 to 64 m/tree in Kabardinskaia ranniaia and from 71 to 92 m/tree in Stanley variety.

2. Improved bush reduces the height of the crown by 35-40% and its width – by 32-42% as compared to the naturally improved forming and helps to increase the plantation density of trees.

3. Reduced crown parameters and increased density of plantations almost doubles the yield of plum trees as compared to the forming practiced in present.

All the ideas mentioned above allow us to recommend the production of improved bush with 4-5 main branches, depending on the variety.

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