

# Influence of types of roots and schemes of placing peach on yield and chemical composition of fruit

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**Abstract.** This scientific article provides experimental material devoted to the study of the influence of varietal characteristics of peach and schemes for placing trees in the garden, using weak vegetatively propagated rootstocks. Experiments have shown that an increase in the density of peach distribution in the orchard grown on the VSV-1 rootstock contributes to a reduction in the crown volume from 16.99 to 9.15 m<sup>3</sup> / v., The VVA-1 rootstock - from 16.99 to 9.15 m<sup>3</sup> / v. ., rootstock GF-667 - from 16.25 to 7.94 m<sup>3</sup> / v. The same pattern persists in the formation of the projection and saturation of the crown with leaves. However, in terms of 1 hectare of the garden, the value of these signs increases 1.9-2.3 times. Growing a peach of the Lola variety on weak vegetatively propagated rootstocks VSV-1, VVA-1 and GF-667, with thickened placement of trees in the garden 5.0x2.0 meters, allows you to receive a net profit from the use of the new technology in the amount of 89.929 - 94.917 million soums / ha, with the cost of fruit production 299.2-315.4%.

## 1 Introduction

Common peach (*Persica vulgaris*) is one of the most valuable and popular fruit crops. Its fruits contain up to 79-89% of water, sugars 6.3-14.4%, sucrose 4.8-10.12%, pectin substances 0.51 - 2%, malic and tartaric acids 0.08-1.02%, vitamin C 9.4-20 mg%, provitamins A 0.6-1.0 mg% (Reference?). In Uzbekistan, the peach crop is grown on an area of 26248 hectares, and the productivity is 119.5 c / ha and a gross yield of 213.158 tons / year (Reference?).

In the main countries producing peach fruits, the area occupied by the crop is: the USA - 130 thousand hectares, France and Italy - 20 thousand hectares, Japan - 12 thousand hectares, Spain - 11 thousand hectares and others annually produce 21.2 million tons. However, this amount of peach fruits is not enough to meet the growing needs of the population and the processing industry for raw materials[1,2,3,4,5].

The existing biologically productive potential of peach varieties with the technology of growing on seed vigorous seed stocks is not able to provide a further increase in crop yield [6-21]. The implementation of this important national economic problem is possible

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by adopting a new concept involving the use of highly productive varieties and hybrids of peach as well as the introduction into production of progressive agrotechnical methods of growing crops [6,7,8,9,10,11,12,13,14].

## 2 Materials and Methods

The study of the development of the peach root system was carried out on five-year-old trees grafted onto the stock GF-667 and developed with planting schemes in the garden 5.0x4.0 meters, 5.0x3.0, 5.0x2.0 and 5.0x1.5 meters.

The development of the root system of trees along the horizons of the soil in depth and in diameter was studied by excavation using the "skeleton" method. The excavation of the soil was carried out along the horizons 0-20, 20-40, 40-60, 60-80, 80-100, 100-120, 120 - 140 cm, followed by structuring of the root system in the form of a herbarium.

During the excavation of the root system, the following types of roots were distinguished in it: overgrowing and conducting with their division according to their diameter, mass and length according to individual soil horizons and the total volume of the mother horizon from 0 to 140 cm.

The general development of trees during the growing season was accompanied by the following biometric measurements: leaf area, leaf area per tree, leaf area per 1 ha, gross yield, marketable yield, dry matter, total sugar, titratable acid, vitamins.

Cameral and variational-statistical processing of experimental data was carried out according to the method of B.A. Dospekhov using Microsoft Excel application programs.

## 3 Results and Discussion

The planting patterns and the density of standing of peach trees of the Lola variety grown on a weak rootstock VSV-1, influencing the development of the main structural shoots, determined the main parameters of the development of the assimilation apparatus of trees. For example, the area of a single leaf decreases by 4.1% -7.2% with an increase in the density of placement of trees in the garden to sparse planting. In the transfer for a single tree, the leaf area with thickening of plants reaches 30.5-33.8 m<sup>2</sup>, which decreases by 14.8-19.1% by sparse planting. However, in terms of 1 hectare of the orchard, the area of the assimilation surface of peach trees of the Lola variety decreases by a significant amount from the sparse placement of plants to the thickened one. So, if in the control variant the leaf area was 18600 m<sup>2</sup> / ha, then with a planting density of 660 der / ha - 22,510 m<sup>2</sup> / ha, 1000 der / ha - 31,700 m<sup>2</sup> / ha and 1333 der / ha - 40,656 m<sup>2</sup> / ha. In percentage terms, the increase in the area of the assimilation surface according to the variants of tree planting density to the control - 500 der / ha was: 666 der / ha -21%, 1000 der / ha - 70.4%, 1333 der / ha - 118.5%.

Experiments have also revealed that peach trees grown on a low-growing rootstock VSV-1, with a thickened placement, form leaf plates exceeding the weight of the control variant - sparse planting by 11.5-21.4%. (Table 1)

**Table 1.** Influence of the Lola peach planting scheme on the development of the assimilation apparatus, 2019-2020 (rootstock VSV-1)

Landing scheme, meters	Number of trees (pcs ha <sup>-1</sup> )	Leaf weight (g)	Leaf area, cm <sup>2</sup>	Leaf area per tree, m <sup>2</sup>	Leaf area per hectare, m <sup>2</sup>	Tree height, m
5,0x4,0 (control)	500	0,533	39,3	37,2	18600,0	2,4
5,0x3,0	666	0,597	37,7	33,8	22510,8	2,4
5,0x2,0	1000	0,650	37,2	31,7	31700,0	2,5
5,0x1,5	1333	0,591	36,5	30,5	40656,5	2,5
HCP05	-	0,027	0,05	0,08	3177	-

The study of the biometric characteristics of the development of the assimilation surface of the leaves formed by peach trees of the Lola variety, grown on a weak vegetatively propagated stock VVA-1, revealed approximately the same decreasing pattern of the formation of leaf plates by trees. When using the VVA-1 rootstock, the area of both individual leaf plates and the tree as a whole decreased from 5.2% to 11.7% from the sparse arrangement of trees to the thickened one. At the same time, the value of the leaf mass had a direct correlation to the thickening of plants, such an increase in the mass of leaves by the density of standing trees in the garden to the control variant (500 der / ha) was: 666 der / ha - 17.6%, 1000 and 1333 der / ha - 28.1%.

The area of the assimilation surface of the leaves increased even more significantly to the control variant in the variants of the increase in the density of peach trees of the Lola cultivar per 1 hectare of the orchard. In particular, with the scheme 5.0x3.0 meters - by 26.7%, 5.0x2.0 meters - by 88.1%, 5.0x1.5 meters - by 133.1%.

The height of trees on the VVA-1 stock in all variants of the experiment, in comparison with the use of the VSV-1 stock, was 4.0-4.3% less (Table 2).

**Table 2.** Influence of the Lola peach planting scheme on the development of the assimilation apparatus, 2019-2020 (rootstock VVA-1)

Landing scheme meters	Number of trees, pcs / ha	Leaf weight, g	Leaf area, cm <sup>2</sup>	Leaf area per tree, m <sup>2</sup>	Leaf area per hectare, m <sup>2</sup>	Tree height, m
5.0 × 4.0 (control)	500	0,533	39,0	37,1	18600,0	2,3
5,0x3,0	666	0,617	37,2	35,4	23576,	2,3
5,0x2,0	1000	0,670	37,2	35,0	35000,	2,4
5,0x1,5	1333	0,672	36,2	32,7	43589,	2,5
HCP05	-	0,03	0,03	0,04	2223	-

Analysis of experimental data on the development of leaves on peach trees during the productive age period, when grown on a weakly vegetatively propagated rootstock GF-667 and various placement schemes, shown in Table 3, shows that, as in the previous two clonal rootstocks, the leaf area on trees decreases from sparse to thickened planting patterns. From

a planting density of 500 der / ha to 1000 and 1333 pieces / ha, the leaf area of an individual tree decreases by 11.8 and 18.8%, or 5.5 and 6.7 m2 / tree, respectively.

In the experiment, a stable sign of an increase in the mass of leaves from a thinned to a thickened planting of trees remains.

When using the clonal rootstock GF-667 for growing peach varieties Lola according to the thickened arrangement of trees in the garden, in comparison with growing on the types of rootstocks BCB-1 and BBA-1, the maximum formation of the assimilation surface by trees was observed per unit of the garden area. With the arrangement of trees according to the scheme 5.0x4.0 meters, trees form an assimilation surface of leaves with a size of 18.20 thousand m2 / ha, 5.0x3.0 meters - 21.64 thousand m2 / ha, 5.0x2.0 meters - 30.90 thousand m2 / ha and 5.0x1.5 meters - 39.50 thousand m2 / ha. In percentage terms, the excess of the leaf area of trees of the thickened planting variants exceeds the plants of the control variant by 1.2 - 2.17 times.

Measurements of the height of peach trees in connection with the types of rootstocks and planting patterns revealed that shorter trees develop on the GF-667 rootstock, the height of which does not exceed 2.2 meters at the age of five.

**Table 3.** Influence of the Lola peach planting scheme on the development of the assimilation apparatus, 2019-2020 (rootstock GF-667)

Landing scheme, meters	Number of trees, pcs / ha	Leaf weight, g	Leaf area, cm <sup>2</sup>	Leaf area per tree, m <sup>2</sup>	Leaf area per hectare, m <sup>2</sup>	Tree height, m
5,0x4,0 (control)	500	0,573	38,8	36,4	18200,0	2,1
5,0x3,0	666	0,637	36,5	32,5	21645,0	2,2
5,0x2,0	1000	0,690	34,4	30,9	30900,0	2,2
5,0x1,5	1333	0,681	32,7	29,7	39590,1	2,4
HCP05	-	54,2	1,2	0,7	-	0,05

3.2 the effect of planting pattern on peach yield

The use of low-growing clonal rootstocks for growing a peach of the Lola variety with thickened planting schemes in the garden is of interest for growing crops using intensive technology. Due to the fact that the trees on these rootstocks have a limited crown volume, by increasing the planting density per unit of garden area, it is possible to obtain 1.4-1.5 more yields than with the currently existing technology in the republic.

The experiments carried out by us on the development of a new technology for growing peach on low-growing rootstocks at various densities of planting trees in the garden showed that all types of rootstocks used provide an increase in yield to the control option (sparse planting) from 3.15 to 6.65 t / ha.

When growing a peach on a VSV-1 rootstock with all tested schemes for placing peach trees in the garden, a yield of 18.421 - 21.995 t / ha was obtained for a VBA-1 rootstock from 16.583 to 22.730 t / ha, GF-667 from 17.693 to 23.015 t / ha.

The optimal layout of the Lola peach variety in the garden, in all cases of using low-growing types of rootstocks, is 5.0x2.0 meters.

Growing conditions of peach trees at different planting densities and types of rootstocks used had a certain impact on the quality of fruit preservation on trees during the growing season. The number of fruits on plants during the growing season increased from thinned to thickened plantings of trees in the garden. This trend of the trait persisted in all variants of the experiment. In the optimal variant of the experiment - the layout of trees in the garden 5.0x2.0 meters, the amount of fallen fruits was 2.2-3.2% or 0.644 -0.720 t / ha (Table 4).

**Table 4.** Influence of the Lola peach planting scheme on the productivity and commercial qualities of fruits, 2019-2020

Landing scheme, meters	Density of standing trees in the garden, pcs / ha	Gross yield, t / ha	Fallen fruits		Marketable harvest		Increase of marketable yield to control,%
			t / ha	%	t / ha	%	
Rootstock VSV-1							
5,0x4,0 (control)	500	15,343	0,663	4,3	14,684	95,7	100,0
5,0x3,0	666	18,421	0,682	3,7	17,732	96,3	120,7
5,0x2,0	1000	21,995	0,701	3,2	21,291	96,8	144,9
5,0x1,5	1333	19,700	0,632	3,2	19,069	96,8	129,8
HCP05	-	0,523	0,015	-	0,732	-	-
Rootstock VVA-1							
5,0x4,0 (control)	500	16,583	0,646	3,9	15,936	96,1	100,0
5,0x3,0	666	19,605	0,627	3,2	18,977	96,8	119,0
5,0x2,0	1000	22,730	0,720	3,2	22,002	96,8	138,0
5,0x1,5	1333	20,350	0,651	3,2	19,698	96,8	123,6
HCP05	-	0,240	0,015	-	0,935	-	-
Rootstock GF-667							
5,0x4,0 (control)	500	17,693	0,601	3,4	17,091	90,6	100,0
5,0x3,0	666	19,575	0,527	3,0	18,987	97,0	111,0
5,0x2,0	1000	23,015	0,644	2,8	22,370	97,2	130,8
5,0x1,5	1333	20,249	0,583	2,8	20,265	97,2	118,5
HCP05	-	0,440	0,050	-	0,632	-	-

The share of the marketable gross yield of the peach variety Lola, due to the types of rootstocks used and the density of planting in the garden, increased with thickened placement of trees.

In the optimal variant of placing a peach in the garden - 5.0x4.0 meters and using VSV-1 as a rootstock, the share of the marketable crop was 21.291 t / ha, VBA-1 - 22.002 t / ha, GF-667, respectively, 22.370 t / ha, then has increased to the control variant of the experience by 30.8 - 44.9%.

3.3 the effect of planting pattern on the chemical composition of peach fruit

The Lola peach crop grown under different agrotechnical conditions had some differences in chemical composition. Due to the fact that when growing a peach with low-volume crowns, the projection area of the fruit wall in a row of trees is reduced, the illumination conditions of the aboveground part are improved. This stimulates the accelerated passage of physiological processes for the synthesis of organic plastic substances during the growing season of plants. As a result, the fruits formed on the trees reach their optimal sizes and technological maturity faster. (Table 5).

**Table 5.** Influence of the Lola peach tree planting scheme on the chemical composition of fruits, 2019- 2020

Landing scheme, meters	Dry matter,%	Sugar,%	Titrateable acid,%	Vitamin C, mg%
Rootstock VSV-1				
5,0x4,0	11,6	9,2	0,68	9,35
5,0x3,0	11,9	9,5	0,56	9,42
5,0x2,0	12,2	9,7	0,49	9,38
5,0x1,5	12,2	9,6	0,43	9,33
Rootstock VVA-1				
5,0x4,0	12,4	10,4	0,54	10,73
5,0x3,0	12,9	11,1	0,51	11,21
5,0x2,0	13,7	11,3	0,47	12,32
5,0x1,5	13,3	11,3	0,47	12,30
Rootstock GF-667				
5,0x4,0	13,6	10,9	0,54	10,72
5,0x3,0	13,7	11,5	0,52	11,0
5,0x2,0	14,0	12,2	0,47	12,5
5,0x1,5	13,8	12,0	0,47	12,5

As shown by the experimental data in Table 5, the content of dry matter, sugar and vitamin C within the used rootstocks did not have significant differences. A slight increase in their content in fruits was observed in the variants of thickened planting of trees in the garden. The titrateable acidity of fruits tended to increase to 0.68 mg,% in the variants of sparse planting of peach trees (5.0x4.0 meters).

3.4 the economic evaluation of planting pattern of peach orchards

The analysis of experimental data on the efficiency of growing peach varieties Lola on a weak vegetatively propagated rootstock VSV-1 with different schemes of planting trees in the garden, shown in Table 6, shows that the financial costs for agricultural machinery for tree care and harvesting were due to the pruning of a different number of trees placed on a unit of garden area and harvesting additional harvest according to the options of experience. The largest total costs of funds were in such variants of the experiment as the tree planting scheme 5.0x2.0 and 5.0-1.5 meters - 26.203 and 26.055 million soums / ha (Table 6).

**Table 6.** Economic efficiency of growing peach varieties Lola on VSV-1 rootstock with different planting schemes in the garden 2019-2020

Production costs and economic indicators	Layout of trees, meters			
	5,0x4,0	5,0x3,0	5,0x2,0	5,0x1,5
For agricultural machinery, million soums / ha	13,800	15,130	15,800	16,460
For harvesting, million soums / ha	5,335	6,362	7,596	6,804
Social tax, %	2,296	2,579	2,807	2,791
Total costs, sum / ha	21,431	24,071	26,203	26,055
Gross yield, t / ha	15,343	18,421	21,995	19,700
Marketable yield (96.0%), t / ha	14,729	17,684	21,991	18,912

Selling price of fruits, sum / ha	5500	5500	5500	5500
Cost of products sold, mln sum / ha	81,009	97,262	116,132	104,016
Net profit, mln sum / ha	59,578	73,191	89,929	77,961
Cost of fruits, sum / kg	1455	1361	1240	1377
Profitability,%	277,9	304,0	343,2	299,2

According to the variants of the experiment, the maximum marketable yield was obtained in the variant of the arrangement of trees in the garden of 5.0x2.0 meters, respectively, 21.115 tons / ha. From its sale at a price of 5500 soums / kg of fruits, a profit of 89.929 million soums / ha was obtained, the cost of one kilogram of fruits is 1240 soums. The profitability of the production of peach fruits of the Lola variety on the VSV-1 rootstock with a tree planting scheme in the garden of 5.0x4.0 meters was 343.2%, that is, each monetary unit invested in the production cycle provided a profit of 2.43 soums. In the control variant of the experiment, this financial indicator was 1.23 times less and amounted to 277.9%.

In the experiment using the BBA-1 rootstock according to the same tree planting patterns in the garden (Table 7), the costs of growing a peach were identical to those of the VSV-1 rootstock.

The net profit from the sale of the marketable crop, the cost of fruits, as well as the profitability of production were maximal in the variant of the tree planting scheme in the garden of 5.0x2.0 meters.

**Table 7.** The economic efficiency of growing a peach variety Lola on a VVA-1 rootstock with various planting schemes in the garden 2019-2020

Production costs and economic indicators	Layout of trees, meters			
	5,0x4,0 control	5,0x3,0	5,0x2,0	5,0x1,5
For agricultural machinery, million soums / ha	13,800	15,130	15,800	16,460
For harvesting, million soums / ha	5,727	6,772	7,851	7,029
Social tax, %	2,343	2,628	2,838	2,818
Total costs, sum / ha	21,870	24,530	26,489	26,307
Gross yield, t / ha	16,583	19,605	22,730	20,350
Marketable yield (96.0%), t / ha	15,919	18,820	22,002	19,536
Selling price of fruits, sum / ha	5500	5500	5500	5500
Cost of products sold, mln sum / ha	27,554	103,510	120,010	107,448
Net profit, mln sum / ha	65,684	78,980	93,521	81,141
Cost of fruits, sum / kg	1373	1303	1213	1346
Profitability,%	300,3	321,9	353,0	308,4

Experimental data on financial costs of growing peach variety Lola on low-growing vegetatively propagated rootstock GF-667 show that this variety fully manifests its morpho-biological properties and provides the highest marketable yield of 22,370 tons/ha with the density of trees in the orchard of 1000 pcs/ha compared to growing on the rootstock VSV-1 and BBA-1.

The net profit from the sale of peach fruits in this variant of the experiment was 94.917 soums / ha, with the cost of one kilogram of fruits -1203 soums.

The profitability of the technology for growing peach varieties Lola on the GF-667 rootstock with a layout of trees in the garden of 5.0x4.0 meters and a density of 1000 pcs / ha turned out to be the highest 356.8%. That is, each monetary unit invested in the technological cycle provided a profit of 2.56 soums (Table 8).

**Table 8.** The economic efficiency of growing peach varieties Lola on the GF-667 rootstock with different planting schemes in the garden 2019-2020

Production costs and economic indicators	Layout of trees, meters			
	5,0x4,0 control	5,0x3,0	5,0x2,0	5,0x1,5
For agricultural machinery, million soums / ha	13,800	15,130	15,800	16,460
For harvesting, million soums / ha	6,111	6,761	7,950	7,201
Social tax, %	2,389	2,626	2,850	2,839
Total costs, sum / ha	22,300	24,517	26,600	26,500
Gross yield, t / ha	17,693	19,575	23,015	20,849
Marketable yield (96.0%), t / ha	16,985	18,792	22,370	20,015
Selling price of fruits, sum / ha	5500	5500	5500	5500
Cost of products sold, mln sum / ha	93,417	103,356	121,517	110,082
Net profit, mln sum / ha	71,117	78,839	94,917	83,582
Cost of fruits, sum / kg	1312	1304	1203	1324
Profitability,%	318,9	321,5	356,8	315,4

4 Conclusion

1. When growing a peach variety Lola on a vigorous seed stock of Ak-shaftali and a low-growth GF- 667, with a sparse planting of 5.0x4.0 meters, equal financial economic indicators of technological processes are provided. Due to the fact that the peach during the productive period, with this scheme, does not have time to morphologically master the allotted area, the issue should be considered in connection with the increase in the density of trees in the garden.
2. Of the tested schemes for placing trees in the garden, the maximum illumination conditions are observed in the control variant of the experiment (5.0x4.0 meters), where the average daily illumination is 73,250 lux. With the thickening of the planting scheme to 5.0x1.5 meters, the crown illumination indicator decreases to 66750 lux, this level is quite sufficient for a good assimilation work of the leaves to accumulate in the redistribution of plastic substances along the structural parts of the crown.
3. An increase in the density of peach distribution in the orchard grown on the VSV-1 rootstock contributed to a reduction in the crown volume from 16.99 to 9.15 m3 / v., The VVA-1 rootstock - from 16.99 to 9.15 m3 / v., rootstock GF-667 - from 16.25 to 7.94 m3 / v. The same pattern persisted in the formation of the projection and saturation of the crown with leaves. However, in terms of 1 hectare of the garden, the value of these signs increased 1.9-2.3 times.
- Growing a peach of the Lola variety on weak vegetatively propagated rootstocks VSV-1, VVA-1 and GF-667 with a thickened arrangement of trees in the garden 5.0x2.0 meters allows you to get from the use of new technology to receive a net profit in the amount of 89.929 - 94.917 million sum / ha, with a production cost of 299.2-315.4%..



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