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Optimization of the nutrition area of an apple garden as a factor of intensification of fruit production

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Abstract *- The scientific article provides experimental material on the result of a study on the influence of the distribution scheme of spore apple varieties grafted on a dwarf rootstock of apple tree M-IX. Studies have established that in the juvenile period of development of the distribution scheme, the development of young trees does not significantly affect. Starting from 5-6 years of age, the influence of this factor manifests itself significantly in the thickening of the crown of trees. During this period, in order to maintain a stable volume of the crown and the level of illumination, it is necessary to thin out the shoots in the crown of trees, combining with moderate shortening of large branches. In order to increase productivity, the Fuji apple variety should be placed according to the 4x1 meter scheme, Golden Delicious 4x1.5 meters.*

Keywords: *stock, variety, pattern, apple tree, crown, intensification, development, crop, quality.*

1.INTRODUCTION

Today, world apple fruit production is 80.5 million tons, the leading apple fruit producers in the world are China (44.45 million tons), the USA (4.65 million tons), Poland (3.6 million tons), Turkey (2.93 million tons). In countries that occupy leading positions in the world in the production of apples and its export, up to 90-95% of them are grown in intensive orchards based on stunted stocks. In these countries, in order to further develop intensive gardens and produce environmentally friendly and high-quality products, in-depth scientific research is being carried out on the use of super dwarf rootstocks, sloping meadow gardening, on the development of new varieties that are resistant to stressful environmental factors, competitiveness, as well as high and high-quality productivity.

In the leading countries of the world involved in the cultivation of apple trees in mid-sized, dwarf and super-dwarf orchards, in addition to types of rootstocks, optimal layout schemes for fruit trees in the garden have been developed, as well as improved methods for forming their crown. Applied these modern technologies allow you to get a crop of 7-8 times more than gardens based on extensive technology. Thus, today in the world when laying intensive and superintensive apple orchards, the introduction of optimal schemes for placing trees in the garden and methods of a crown formation system taking into account soil and climatic conditions is an urgent task and has important practical and theoretical value.

Currently, the most often densified plantings of apple trees are created on the basis of the application of weak-rootstock stocks of the M-IX type, with thickened placement of trees and the formation of flattened crown forms, which make up a continuous fruit wall in each row. The optimal nutritional area in such stands is established taking into account the experience of growing crops in specific soil conditions, since the same cultivar-rootstock combination planted on different soils forms trees of different sizes. So, undersized apple trees on poor sandy soil, even under irrigation, grow much less than on southern chernozems. In the first case, many industrial varieties on dwarf rootstocks form dwarf trees that can be placed in a garden with a high density, but on rich soils they form quite large trees, not very similar to dwarf trees and, naturally, plant them with such density as on poor sand trees, not allowed. [1,2,3,4].

2. MATERIALS AND METHODS

Scientific work was carried out in 2016-2019 with varieties of the Fuji and Golden Delishes apple

trees. Vegetatively propagated M-IX was used as a stock.

Trees in the experimental plot were grown with the layout of 4,0×1,0, 4,0×1,5 and 4,0×2,0 meters. In each repetition, 5 trees were counted. The repetition of experience four times. The formation of the crown of trees spindle-shaped bush.

3. DISCUSSIONS AND METHODS

The The study revealed that in the first two years, young trees grew quite strongly and equally, that is, the density of placement did not significantly affect growth. In the future, the feeding area began to affect primarily the increase in the diameter of the stem and the volume of the crown. Golden Delishes with a feeding area of 4,0x1,0 m had a smaller annual growth of the diameter of the stem, formed shorter annual shoots, which led to a smaller crown volume of all varietal-rootstock combinations. The Fuji variety on the M9 rootstock by the age of four has not yet fully mastered the designated feeding area and is represented by single-standing plants even in areas with a 4x1 m placement. This indicates the need for a differentiated approach to establishing a tree planting scheme in the garden.

In the third year, the trees began bearing fruit. A higher yield was given to the Golden Delicious variety, where 7,6-11,2 t/ha were harvested depending on the planting density. In the fourth year of plantings, a higher yield was obtained: 38-40 kg of fruits were harvested from the Golden Delishes variety from the tree, 14-16 kg of Fuji. The productivity level at this age was determined by planting density: according to the Golden Delicious variety on a site with a feeding area of 4,0x2,0 m, it amounted to 50,0 t/ha (100%), 4x1,5 m.-63,3 t/ha (127%), 4x1 m. -95,0 t/ha (190%). The yield of the Fuji variety was significantly lower and with a feeding area of 4,0x2,0 m was 20,0 t/ha, with 4,0x1,0 m 32,5-35,0 t/ha.

In 2017, the yield of Golden Delishes with a feeding area of 4,0x2,0 m was 30,0 t/ha, with 4,0x1,5 m – 36,6, with 4,0x1,0 m – 45,0 t/ha, Fuji varieties, respectively, 25,0, 30,0, 35,0, 37,5 t/ha. Consequently, the effect of the density of the trees on the yield remains the same as in the previous year, although the differences in the yield from the tree are becoming more significant: the Golden Delishes variety with a feeding area of 4,0x2,0 m - 24 kg (100%), with 4,0x1,5 m. 22 kg (91.6%), with 4,0x1,0 m. - 18 kg (75%).

For Fuji, these indicators were 90 and 75%, respectively. (table 1).

The total yield and average yield over the years of research indicate a large influence of the density of tree placement on the productivity of apple trees on the M-IX stock. A decrease in the area of tree nutrition from 8 to 6 m^2 increased the density of plantations by 33%, and the yield in this regard increased by 25-26%. Reducing the area of tree nutrition to 4 m^2 doubled the density of standing, which increased the yield by 59-75%. Thus, the growth of planting productivity to a large extent depends on the density of distribution. This is confirmed by the data obtained from the fruit, with a unit volume of the crown.

In four summer trees of both varieties, the crown volume decreased by about half with an increase in the density of plantings from 1250 to 2500 trees per hectare. The yield of fruits per 1 m3 of crowns increased according to Golden Delishes by 28%, Fuji - by 42-43%. This is due to better illumination and higher productivity of leaf photosynthesis in all parts of the smaller tree crowns in thickened stands. With an improvement in the light regime and an increase in the productivity of leaf photosynthesis, the size of the phytomass produced per unit area of apple plantings increases and, most importantly, the proportion of photosynthesis products used to form the crop increases. (5.6).

Seeking to intensify the cultivation of apple trees, increase yields by increasing the density of trees, one must not allow a decrease in the quality of fruits. Data on the average weight of fruits in a four-year-old apple orchard on the M-IX rootstock indicate that increasing the density of trees does not significantly affect the size of the fruits and their marketability. With an increase in planting density, they remain almost at the same level as in stands with a feed area of 4x2 m.

The density of trees in an intensive garden should be optimal, that is, they should not obscure each other, so that the illumination and the level of productivity of photosynthesis do not decrease, and the yield from the tree and the area of plantings do not decrease. At the age of six, the crown of the Golden Delicious variety grafted onto a rootstock on M-IX with all nutrition areas closed in a row, but so far they have obscured and oppressed each other a little and this has not significantly reduced the yield and quality of the fruits. In subsequent years, in order to maintain a stable crown volume, illumination level, and

photosynthesis, the Golden Delicious apple tree variety must be cut in detail with thinning and moderate shortening of large branches.

Fuji trees, when planted according to the 4x2 m pattern, by four years of age have mastered the designated feeding area by only 55%, and with 4,0x1,0 m, by 75-80%. At the same time, the illumination of the internal parts of the crown was approximately the same with different densities. Therefore, it is more profitable to plant trees of the sparse Fuji sparse varieties on the M-IX rootstock in a garden with a feeding area of 4,0x1,0 m. This ensures the highest yield per unit area without reducing the commercial quality of the fruit.

The results of studies of the characteristics of the growth and fruiting of apple trees on the M-IX rootstock at different densities indicate that it is impossible to plant all varieties of apple trees with the same feeding area in the garden. Crowns of vigorous varieties, already at the age of four, close in a row, and when placed 1-1.5 m thicken each other, which leads to a deterioration in light conditions inside the crown. Varieties of this type should be planted in the garden with large areas of nutrition 4,0x2,5 m. Or apply more dwarfed than M-IX, stocks M8 or M27.

Table 1.

The influence of the layout of varieties of apple trees grown on stock M-IX. y.y. (2016-2019).

Indicators	Golden Delicious			Fuji			NSR$_{0,5}$
	4x1,0 m	4x1,5 m	4x2,0 m	4x1,0 m	4x1,5 m	4x2,0 m	
Harvest from a tree, kg	18	23	25	16	17	21	0,5
Productivity, t/ha	69,0	48,9	39,0	36,5	29,0	24,0	40,0
Crown volume, m^3	1,3	2,1	2,4	0,5	0,8	1,0	0,15
Harvest from 1 m^3 of crown, kg	13,5	11,2	10,6	31,7	25,9	22,6	2,1
The mass of the fetus, g	190	194	200	220	225	236	5,0
Marketability of fruits:							
Highest rubbish,%	67	67	65	72	74	71	2,0
First grade, %	30	27	27	21	19	19	2,0
Second grade,%	3	6	8	7	10	10	2,0

Weak Fuji-type varieties on M-IX form small trees in the garden, which by the beginning of obtaining high industrial crops do not fully develop the allotted food area. In order to increase their productivity, they should be planted in the garden more densely than recommended by agricultural indications, 4,0x1,0 m. For medium-tall varieties such as Golden Delishes, the optimal planting density should be considered 4,0x1,5 m.

4. CONCLUSION

1. With an increase in the density of distribution of spore apple varieties during the period of fruiting, the crown volume decreases by two, while the productivity per unit volume of the crown is significantly increased - in the Golden Delicious varieties by 28%, Fuji - by 42%. 2. Weedy varieties of the Fuji type on the M-IX rootstock form small trees in the garden, which by the beginning of obtaining high industrial crops do not fully develop the allotted food area. In order to increase productivity, they should be planted in the garden according to the 4x1m scheme. for medium-sized varieties of type Golden Delicious, the optimal planting density should be considered 4,0x1,5 m.

The germination period is 100-140 days.

These samples are a valuable resource for various aspects of selection and are implemented for selection purposes.

Seeds of amaranth are planted at a depth of 1-1.5 cm at a temperature of 10-12 degrees.

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