Method of pruning apple tree crown size and increase in photosynthesis productivity

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Abstract. The most important condition for increasing the productivity of fruit trees in intensive orchards is the optimal and efficient use of solar radiation, as well as an increase in leaf surface area. For apple trees, the size of the leaf surface, the illumination of the tree crowns and the increase in the productivity of photosynthesis are often determined by the combination of variety-rootstock combinations, the method of pruning and forming trees, and the size of the tree crowns. It has been established that the most effective rejuvenating and normalizing pruning is the shortening of fruit-bearing branches by 8-16 fruit buds.

1 Introduction

The care and cultivation of fruit crops on different variety-rootstock combinations is an important branch of agriculture, which has its own characteristics, high stable yields and good product quality.

In recent years, intensive orchards have been established in Uzbekistan, the cultivation of fruit trees in these orchards is carried out on a scientific basis, taking into account the formation of young growth, methods and levels of pruning, as well as the biological characteristics of cultivated varieties of intensive apple trees.

It should be noted that in scientific works in the field of fruit growing, sound scientific recommendations are given, in which the biological properties of fruit varieties, fruiting and the formation of crop elements are thoroughly studied, however, in these studies, the methods and levels of rejuvenating and normalizing-cyclic pruning of fruit trees have not been studied in to the fullest.

The production conditions of Uzbekistan in recent years, methods of rejuvenating normalizing pruning of trees have been widely used, aimed at maintaining the cyclic renewal of fruit-bearing branches for 3-4 years and the degree of shortening of fruit-bearing branches left depending on the growth and age of the shoots.

2 Materials and Methods

Scientific research is being carried out in 2006-2022 at the Amin Khayot Bogi farm in the Bukhara district of the Bukhara region. In recent years, pruning of trees has been widely

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used in the production verification of methods and degrees of rejuvenating and normalizing pruning.

The Bukhara region is located in the desert zone of the republic, consequently, soil formation occurs mainly in a hot and dry climate

The climate of the Bukhara region is considered as sharply continental, with an average annual rainfall of 125-175 mm, mainly observed in early spring, late autumn and winter, an average temperature of 26-300C, an average relative humidity of 40-60%. According to the results of agrochemical studies on pastures, old and new irrigated areas, the amount of humus is very low. The amount of humus in the soil of the arable layer is 0.8-1.4%; the amount of nitrogen is 0.06-1.2%. The total amount of phosphorus is 0.11-0.18%, the amount of exchangeable potassium is 1.5-3.0%. The soil of the farm "Amin Khayot bogi" is old-irrigated, consisting of slightly saline soils, with the formation of shallow water [3,5,11].

The main goal of this scientific experiment is to use in the production of the most optimal and effective rejuvenating normalizing methods and degrees of pruning fruitful in the branches that yield crops, mainly productive branches, to ensure sustainable and continuous growth in fruit yields in intensive apple orchards by studying the method and degree of pruning, increasing efficiency of fruit growth, obtaining high-quality fruit yields and the widespread introduction of high-yielding varieties, methods and levels of pruning under production conditions. Intensive apple orchards of the farm "Amin KhayetBogi" varieties Renet Simirenko, Golden Delicious, Firstborn of Samarkand were planted in 2010, planting pattern 6x4m, medium-sized rootstock MM-106. Watered in the garden at the rate of 3200-3500 m3/ha, watered 4-5 times during the year.

Experimental part. In order to study the method of pruning and rejuvenation of fruit-bearing branches on the studied apple varieties, a system of experiments was carried out, presented in table No. 1.

Table 1. Experience options

Application options for rejuvenating pruning number of remaining fruiting buds, pcs. a method of growing on old fruit-bearing branches that have already produced a crop	
The recommended trimming method used in production conditions (control)	No branch pruning
A method of rejuvenating and normalizing pruning of a 3-year cycle.	8-12 12-16 No branch pruning
Anti-aging pruning method for 4-annual cyclical rotation.	4-8 8-12 12-16 No branch pruning

In this experiment, we studied the determination of the methods and degree of pruning, as well as the shortening of fruit-bearing branches with a 3- and 4-year cycle, with alternating rejuvenating and normalizing pruning methods on growing branches.

In the control variant, the pruning method is used in Bukhara, which consists in pruning apple trees, where mostly dry, diseased branches that interfere with each other's growth are removed.

Against the background of the pruning method (control) of a 3-4-year cycle used in production, 3-4-year-old growing branches of each apple tree are annually rejuvenated, leaving 2-3 combined buds for the next year to obtain new growing and high-yielding fruits on shortened branches.

Research methods: During the experiment, to study the biometric characteristics of apple trees, crown illumination and photosynthesis productivity, fruit productivity and quality.

The calculations were carried out on the study of the aerial part of the apple tree - the trunk, the thickness of the trunk, the growth of the average annual and total branches, the size of the branches. At the end of each period of the year, metric measurements were made on the trees planted in the garden for calculation. At the same time, the length and thickness of the branches obtained during the pruning process were measured, and the number of buds in them was determined.

In the studied apple varieties, the leaf surface area was determined by the "thread" method.

A. A. Nichiparovich (1961) on the accumulation of leaf surface and dry matter on accounting trees.

The distribution of sunlight along the branches of trees was measured with a Yu-16 luxmeter during the period when the leaves have optimal sizes. The counts were carried out on 15.06-15.07. in the periods of 8, 12, 15 and 18 hours relative to the illumination of the open field [1-22].

The productivity of photosynthesis was determined on three accounting trees according to the method of A. S. Ovsyannikov (1965). The dynamics of crop formation was studied by the variety-studied method (VNIIS, 1976). The yield of apple trees was studied on each accounting tree. The productivity of the branches was determined for 1m2, 1m3 and 1cm2

3 Results and Discussion

The most important condition for increasing the productivity of fruit trees, including apple trees, is the effective use of the amount of solar radiation and an increase in leaf surface area. The size of apple tree leaves is often determined by the strength and combination of fruit varieties of grafted seedlings, the order of pruning and formation of trees, and the actual thickness of the leaf surface [4,9].

The growth of plant organism biomass, including useful and economic crop biomass, is considered to be photosynthesis. All leaves work with very different productivity, for example, how photosynthesis changes depending on how they are located in the trunk of a tree and how they provide solar radiation, photosynthetic productivity changes accordingly, creating the basis for increasing the productivity of a tree.

The task of those specialists and scientists involved in the care of fruits in intensive orchards is to increase the productivity of photosynthesis as a result, ultimately, due to the correct placement of the leaf surface in the tiers of branches of each tree, compliance with the levels of formation and pruning of trees. The optimal level of such general illumination in open areas is considered to be 50-70%. When the normal level of radiation rises or falls at some point, the process of photosynthesis proceeds at a normal level and leads to the normal growth of fruit-bearing fruit trees and contributes to good growth and a stable annual crop. It cannot be said that it is possible to increase the yield by bringing the leaf surface area to a normal level. All leaves must work productively and productively enough.

Practical differences in the increase in serum function, productivity and activity of the leaf surface Very high serum activity and productivity of photosynthesis depend on the type of leaf location, the time of its formation, the size of the leaf surface, structure, age, the presence of acceptors - organs or tissues that intensively involve assimilators in the

construction of one's body, performing physiological processes or providing a supply of nutrients in the winter-spring periods of the year [6,7,8].

The intensity of photosynthesis is also determined by the influence of the environment, external factors. They depend on light, temperature, carbon dioxide concentration, air mixture in the leaf, humidity and the amount of mineral nutrients. The results of scientific research and production tests have shown that the leaf area of ten-year-old apple trees during the period of growth and development is optimal for an apple tree. Depending on the shape of the tree and the planting scheme (416 pcs/ha), a decrease in the size of the assimilated surface was observed due to an increase in the degree of rejuvenation by shortening the rejuvenation cycle from three to four years. It has been established that their number decreases until fruit-bearing buds appear, and increases per hectare.

Also, based on the results of many years of research and production tests, it was found that the leaf area of each tree decreased with increasing pruning.

Table 2. The influence of the method and degree of pruning on the level of biometric indicators, the size of the leaf surface (2020)

Anti-aging pruning options with a 3-4 year cycle	Number of remaining buds on fruiting branches	crown area		Leaf area size	
		M2/wood	M2/ha	M2/wood	M2/ha
Control	Without pruning	13.4	5574	42.2	17555
3 year old cycle	4-8	11.8	4909	33.2	13811
	8-12	12.0	4992	35.0	14560
	12-16	12.5	5200	38.0	15801
	Without pruning branches	12.6	5242	39.6	16474
	4-8	12.0	4992	35.0	14560
4 year old cycle	8-12	12.4	5158	37.0	15392
	12-16	12.8	5242	33.0	16234
	Without pruning branches	13.0	5408	40.2	16723
Variety apples rennet Simirenko					
Control	Without pruning branches 4-8	14.2	5907	44.0	18304
3 year old cycle		12.4	5158	34.5	14350
	8-12	12.8	5325	36.2	15236
	12-16	13.0	5408	38.8	16141
	Without pruning branches	13.7	5659	40.6	16890
	4-8	12.8	5242	36.0	14976
4 year old cycle	8-12	13.4	5574	37.8	15726
	12-16	13.6	5659	39.6	16474
	Without pruning branches	14.0	5824	41.2	17139
Variety	apple trees firstborn Samarkand				
	Without pruning	12.6	5242	39.6	16474

	branches 4-8				
Control 3 year old	cycle	11.2	4659	30.2	12563
	8-12	11.6	4825	31.4	13068
	12-16	12.0	4992	32.6	13552
	No branch pruning	12.2	5075	35.0	14560
4 year cycle	4-8	11.4	4742	31.6	12971
	8-12	11.9	4950	32.9	13645
	12-16	12.2	5078	33.0	13728
	No branch pruning	12.4	5157	36.4	15142
Least Significant Difference NSR 095 R %		4.2 4.0		3.8 2.2	

From the data in Table 2 it can be seen that the leaf surface area of apple orchards of the Golden Delicious variety is 11.8-13.0 m2 / tree, the Renet Simirenko variety is 12.4-14.0 m2 / tree, the Pervenets Samarkand variety is 11.2-12, 4 m2 / tree. These figures are confirmed by other scientific results obtained in the care of intensive apple orchards, as well as tests carried out in industrial conditions.

One of the most necessary requirements for regulating the illumination of branches of fruit trees is the choice of a site with the required exposure, a unit of tree nutrition area (planting patterns), a shaping system, a method and degree of pruning, the growth of fruit trees, etc. [9,10,11].

In our experiments, it was noticed that the leaves of the branches of a fruit tree are not illuminated to the same extent. This can be seen in the deeper part of the trunk and on the sides, where little light falls. Depending on the age of the tree, the size of the tree and the biomass of nutrients, as well as the growth of the leaf surface, it changes the nature of the distribution of solar radiation. In general, according to the results of our research and production tests, it was found that the best indicator among the 3 studied zoned apple varieties in terms of area, as well as the level of leaf surface density per day, leaving fruiting branches with 3-4 cycles of rejuvenating and normalizing pruning is 8-12 pieces fruitful branches. In this variant, when 8-16 fruit-bearing buds remain on the growing branches, the branches develop well, and the level of illumination is 18-26% less than the illumination of the open area for the studied variety, mainly in the center of the crowns of fruit trees per day, which is sufficient for normal photosynthetic activity. , which contributes to obtaining a high yield with good qualities.

4 Conclusion

The correct formation of trees, pruning according to the method and degree of rejuvenating pruning of branches has a positive effect on their growth and development, high quality and fast fruiting, including the efficient use of solar energy in large quantities, low costs per unit of production. The productivity and quality of tree fruits will improve sharply, their profitability will increase, the cost of fruit production will decrease, and ultimately the profitability of fruit production will increase.

The amount of direct light energy plays an important role in accelerating the process of photosynthesis in fruit trees and increasing its productivity. Here, the intensity of light performs not only the function of illumination, but also has a direct impact on the structure of the assimilation apparatus as an energy source, the intensity of growth and development processes, and nutrients. It regulates the distribution of assimilation in various organs, which contributes to a good penetration of light into the crown of trees.

Thus, in our studies and experiments carried out in industrial conditions, it was noticed that the net productivity of photosynthesis increases with an increase in the degree of illumination and the degree of shortening of growing branches, which leads to an increase in illumination in variants using the method and degree of rejuvenating and normalizing pruning.

References

1. Kh. Artikova, S. Shadiyeva. Web of Conferences **389**, 04014 (2023)
2. F.A.Ganiyeva. E3S Web of Conferences **389**, 03014 (2023)
3. S.Khojiev E3S Web of Conferences **381**, 01013 (2023)
4. A.Ilyosoy. E3S Web of Conferences **462**, 02001 (2023)
5. A. Hamroyev, H. Jumayeva, E3S Web of Conferences 420. 10007 (2023)
6. G.A. Saidova. E3S Web of Conferences **389**, 03012 (2023)
7. B. Mamurov et al., E3S Web of Conferences **538**. 05025 (2024)
8. B. Mamurov et al., E3S Web of Conferences **538**. 05031 (2024)
9. G. Akramova et al., E3S Web of Conferences **538**. 05034 (2024)
10. H. Salimova and H. Artikova. E3S Web of Conferences **389**, 04012 (2023)
11. Kuldoshev R. A. Methodological foundations of teaching left-handed students of primary grade to write (Doctor of Philosophy (PhD) dissertation in pedagogic sciences). Termiz - 2021
12. M. Sattorova, and M.Raximova E3S Web of Conferences **420**, 03010 (2023)
13. M. Shirinova et al., E3S Web of Conferences **538**. 05016 (2024)
14. N. Turayeva. E3S Web of Conferences **389**, 03062 (2023)
15. N.M. Turayeva. E3S Web of Conferences **389**, 03011 (2023)
16. N.Torayeva. E3S Web of Conferences **389**, 02010 (2023)
17. Qo‘ldoshev A. R. Psychology and Education Journal. **58**. 1. 4981-4988 (2021)
18. R. Kuldoshev et al., E3S Web of Conferences **371**. 05069 (2023)
19. R. Qo’ldoshev et al., E3S Web of Conferences **538**. 05017 (2024)
20. R. Qo’ldoshev et al., E3S Web of Conferences **538**. 05042 (2024)
21. S.M.Nazarova. E3S Web of Conferences **389**, 04016 (2023)
22. U. Khayitov et al., E3S Web of Conferences **538**. 05022 (2024)