УДК 634.75

4.1.1. Общее земледелие и растениеводство (биологические науки, сельскохозяйственные науки)

ВЛИЯНИЕ СИСТЕМЫ СОДЕРЖАНИЯ ПОЧВЫ НА ПРОДУКТИВНОСТЬ ЯБЛОНИ В УСЛОВИЯХ ПРИКУБАНСКОЙ ЗОНЫ

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В результате исследований доказано, что система содержания почвы в междурядьях сада оказывает влияние на формирование урожая и качество плодов яблони. Причем, характер этого влияния зависит от силы роста используемого сорта. В плодоносящем неорошаемом саду лучший способ содержание почвы для изучаемых сортов – черный пар

Ключевые слова: СОРТА, ЯБЛОНЯ, СИСТЕМА СОДЕРЖАНИЯ ПОЧВЫ, РОСТ, ПРОДУКТИВНОСТЬ

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4.1.1. General agriculture and crop production (biological sciences, agricultural sciences)

INFLUENCE OF THE SOIL MAINTENANCE SYSTEM ON THE PRODUCTIVITY OF APPLE TREES UNDER THE PRIKUBANSKAYA ZONE CONDITIONS

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As a result of the research, it was proved that the system of soil content in the aisles of the garden has an impact on the formation of the crop and the quality of the fruits of the apple tree. Moreover, the nature of this influence depends on the strength of the growth of the variety used. In a fruit-bearing non-irrigated garden, the best way to maintain the soil for the studied varieties is black fallow

Keywords: VARIETIES, APPLE TREE, SOIL MANAGEMENT SYSTEM, GROWTH, PRODUCTIVITY

Soil is a complex living system consisting of minerals, organic matter, water and air. The mineral part is the main component of the soil. It has special physical and chemical properties. Physical properties such as soil density (soil particle size) and soil structure (how particles are held together) determine the movement of air and water, which in turn affects plant growth. Soil color is determined by the amount of organic matter, drainage conditions, and acidification or weathering.

Tillage affects soil structure and plant growth. The soil should never be tilled when it is too wet. If wet soil is cultivated, it will become hard, which will restrict root growth, causing low plant productivity. If a handful of earth formed into a ball retains its shape, it is necessary to postpone tilling until the water content decreases. If a handful of earth, formed into a ball, crumbles when pressed with the thumb, it is ready for plowing or digging.

Autumn is the best time for plowing the soil, if there is no possibility of erosive activity of water or wind in the region. Fall tillage helps control some insects and diseases that overwinter on plant debris.

Organic matter improves soil quality. Also known as humus, the dark brown or black organic compounds formed from the decomposition of plant and animal remains make up the smallest percentage of soil by volume but are essential in good garden soil.

Organic matter, in turn:

• improves the physical condition or structure of the soil, thereby facilitating work (especially in soils that are sandy or crusty);

• increases water absorption;

• increases aeration, passing more oxygen to the roots;

• increases retention of nitrogen and other nutrients;

• promotes colonization of soil microorganisms.

As crops grow, the amount of organic matter in the soil becomes progressively lower. Mineral fertilizers do not replace the retiring organic matter.

The sources of organic matter are compost, well-rotted animal manure, green manure crops, and finely ground waste. Mixing undecomposed, coarse plant materials into the soil, such as straw (with or without manure), corn stalks, hay waste, or cover crops—uniform application to the soil can be difficult without prior chopping.

Fruit trees grow and bear fruit in one place from 15 to 50 years or more. By this time, they form a powerful skeleton, they have a developed root system, but only if the soil has a light structure and is well drained. Roots can absorb nutrients over a long season - probably all year round in mild southern climates. Nutrients can be stored in roots and stems until they are used in the new progressive growth of leaves, stems and fruits.

The ideal soil for garden trees is deep, well-drained, without impermeable layers that limit the development of roots, has good water-holding capacity, and is slightly acidic - pH 5.5-6.5 [1].

The risk of damage from low temperatures exists in almost all areas of horticulture, especially in the spring during the period of early growth. Therefore, the areas chosen for gardens should be protected as much as possible from spring frosts. They can be placed south of large bodies of water or on hills where there is good air drainage. Low places where cold air accumulates are avoided.

Often elevated and sloping areas that hardly freeze, do not have deep and favorable soil. In addition, there is the problem of preventing soil erosion, especially if the garden must be cultivated during a season when heavy rains are likely.

Planting trees along the contour can be a good solution to this problem.

The apple tree in the temperate zone is a slow growing deciduous tree with deep roots. Leaf formation, most of the vegetative growth, flowering, early crop development and bud set for next year's flowering all occur in spring and early summer.

In the summer and early autumn before harvest, the fruits grow and the leaves continue to produce assimilants that can be used immediately or saved for next year's spring growth. The tree increases its resistance to winter cold during late autumn after harvest. These facts are relevant to the soil fertility management system in apple orchards [2] .

The main climatic problems in the regions where the main crop of apples is grown are the danger of frosts at the beginning of the growing season, the possibility of severe frosts in winter and too little or too much rain during the growing season throughout the year.

The location of the garden determines the degree of frost influence. There are two natural protections: bodies of water large enough to reduce diurnal fluctuations in temperature, and slopes of hills or valleys that allow the coldest air to move freely down. Most apple orchards in Europe are located on sloping lands.

The hardiest varieties of apples can withstand temperatures as low as 34°C below freezing in the middle of winter without damage. The least hardy can be damaged already at 16 ° below zero. All cultivars are more susceptible to winter injury if they have had a bountiful harvest the previous season, if their leaf area has been sparse, and if the growth has been late in the growing season, the trees have gone into the winter without hardening [3].

The prevailing climate in the region determines the danger of disastrous winter temperatures. Any proposed site for a garden implies only a small degree of protection, unless it is next to a large body of water that does not freeze.

The optimal soil content is such that it promotes the formation of a healthy leaf surface and allows you to harden the trees for the winter, helps to reduce losses from winter damage.

Also of great importance is the average amount of precipitation, their distribution throughout the year, the ability of the soil to retain water, and knowledge of the intensity of water evaporation by leaves and the soil surface makes it possible to determine the likelihood of water shortage in apple orchards.

In areas with shallow soils, or in areas where annual rainfall is below 760 mm and where less than 380 mm of precipitation falls during the growing season and transpiration is relatively fast, moisture can often be insufficient to

justify additional irrigation costs. Irrigation is essential if annual rainfall is less than 500 mm, less than 250 mm falls during the growing season, and transpiration is high. Techniques for preserving valuable moisture in places where there is little rainfall may include special elements of soil care [4].

In areas where spring rains can be excessive, fungal disease control becomes a matter of paramount importance, while excess water buildup in the soil can make it difficult for heavy sprayers to move through the garden.

Apple orchards grow in a wide variety of soils that vary in texture from heavy clay to light sandy loam and in nutrient content from low to high. The tillage methods that are best suited for a particular soil variety depend on the depth of penetration of the tree roots and the fertility of the root zone. At the same time, the system of formation of tree crowns is of no small importance. If the crowns are formed according to the "spherical" principles of construction, in this case, with the age of the plantations, it is increasingly necessary to resort to their lateral limitation in order to facilitate the passage of agricultural machinery along the aisles [5].

If soils in humid climates are well aerated and of medium density and allow rooting to a depth of 120 cm or more, then the garden has a sufficiently large area and depth with available moisture, and special methods of moisture conservation are not needed. However, they will be necessary if root penetration is limited to a depth of less than 90 cm. Fertility-enhancing soil care practices and supplemental fertilization are most effective on low-fertility soils. But they may be of little use in places where the original soil fertility was high.

On slopes, contour planting may be desirable, although erosion must be controlled by maintaining sod on the slopes. This is often the best way to get row spacing for sprayers and other equipment.

Particular problems with yield and fruiting management arise from the fact that apple trees remain in the same place for many years. Acidifying

fungicides and fertilizers that enter the soil primarily under trees can cause essential calcium, magnesium and potassium to be leached much more quickly.

As a result, the loss of fertility was the main reason for the disappearance of the grass under the trees in fruit-bearing apple orchards. Fungicidal or insecticidal pesticides can accumulate in the soil and harm plants under trees.

Soil care systems that are used in apple orchards include those based on annual tillage and/or growing systems based on maintaining a permanent turf. Additional practices that can be combined with both systems include irrigation, mulching with organic residues or plant material, fertilization with nitrogen and other inorganic nutrients, liming, and the use of cover crops.

Many variations of the basic soil management systems and their combination with complementary methods have been used successfully in apple orchards. Early in the life of an apple orchard, grass growth, at least in the rows of trees in the first half of the growing season, is almost ubiquitous. In the first 3-5 years, when the trees are small, intense competition for nutrients and water can develop between them. The branches are quite short in the early years, and this makes it possible to use harrows and other tillage implements to eliminate weeds near the trunk. Since the progressive growth of the young tree is completed by the end of July, cultivation is required, in particular from April to August.

After that, you can leave natural annual grasses and weeds to form a cover in the autumn-winter period. A cover crop reduces or prevents erosion and allows trees to fortify their tissues against negative winter temperatures. If the grass growth is weak, additional overseeding can be done in the late summer in the garden.

In apple orchards, additional mulching with undecomposed straw and similar materials is used only in limited places under the trees, as they contaminate tillage equipment.

Calcium and phosphorus fertilizers are quickly available when applied in fallow gardens than in permanently turfed ones because they mix quickly with the surface soil. Most nitrogen fertilizers and some others are so soluble that mixing them with the soil does not increase the efficiency of use.

Sodding, the most common tillage system in apple orchards, meets the requirements for growing apple trees. This helps control erosion. But because the sod competes for nitrogen, relatively little nitrogen is available underneath it, except for a short period of time after fertilization. Therefore, it is necessary to control the level of nitrogen in the leaves of trees growing under turfing. At the same time, there are periods rich in nitrogen in early spring before flowering and periods with a low content of nitrogen - growth and in late summer and early autumn, when the fruits ripen and the trees are hardened for the winter.

Turfing works well with additional nitrogen fertilizers and with additional types of mulching. Hay and straw are satisfactory sources of additional nutrients, but help conserve water in orchards where the soil is shallow and water can become a limiting factor after short periods of drought. Slowly soluble minerals, like calcium and phosphorus, applied to the surface of the sod, move more slowly in the profile than in cultivated soils.

The use of sod in a fruit-bearing garden often results in an increase in the need for additional nitrogen fertilizer beyond what is required by the growing program. If the surface grass cover is predominantly non-leguminous and mulching is not on the program, nitrogen fertilization is almost always required. It can be done in a variety of ways, but to be effective, nitrogen treatment must increase the nitrogen level of trees at the beginning of the growing season to a level that ensures satisfactory fruit set, vegetative growth and flower budding for the next year's crop [6].

Potassium availability can sometimes be increased in soils where cultivation shows symptoms of potassium deficiency.

Mulching gardens that are under sod with hay or straw is an additional practice that can be helpful. Effects of application may include conservation of soil moisture, which can lead to increased levels of soil moisture under trees during dry periods; increasing the amount of available soil nitrogen, which can improve growth and yields; reactions comparable to those caused by nitrogen fertilizers; and increasing the amount of potassium, phosphorus and other nutrients available in the soil.

The cost of applying mulch is usually much greater than the cost of purchasing and applying nutrient-equivalent mineral fertilizers, so specific benefits beyond the effects of conventional fertilizers are usually required to justify mulching. This is most often beneficial in areas where the soil is shallow and water conservation and fertility are particular problems.

Permanent turfing means caring for the vegetation cover throughout the year. In such a cropping system, the herbage must be mowed or cut down at least once per growing season. Disc harrows and shredders - Machines with vertical bits or knives can partially cut up permanent turf without removing it. Among the herbs that have been recommended are garden grass, bluegrass and bonfire. The success of pure crops or seed mixtures containing these and other species depends on the prevailing climate, the physical and chemical conditions of the soil, the amount of sunlight, and the elements of gardening.

In connection with the above, we made an experiment to study the influence of the two main systems of soil maintenance in the aisles of the garden, which are most often used in the Kuban. The purpose of the research is to determine the best system of soil maintenance in apple plantations in the conditions of the Dinskoy district, which ensures the stable production of high-quality and environmentally friendly fruits.

In accordance with the purpose of the research, the following tasks were set:

- to determine the influence of the system of soil maintenance in the row-spacing on the characteristics of the growth of the apple tree;

- to establish the degree of influence of the soil maintenance system on the productivity of various apple varieties.

The objects of research were zoned apple varieties of the winter period of consumption. The studied varieties were grafted on a zoned clonal rootstock - MM-106.

A field experiment to determine the influence of the soil content system on biometric indicators, yield and fruit quality of the studied apple varieties was carried out in an orchard planted in 1999. Planting scheme 6 x 3 m. Apple varieties Renet Simirenko and Idared were studied. The following options were studied:

Option 1 - black steam (control) (Figure 1)

Option 2 - natural sodding (through row spacing) (Figure 2).

Figure 1 - Black steam in the aisles of the garden (control)

Figure 2 - Soil content in the aisles of the garden under naturally growing herbs

The experiment was repeated six times. For a single repetition, a “tree-plot” was taken. Biometric records and observations of growth and fruiting were carried out in accordance with the program and methodology for the study of fruit, berry and nut crops [7].

Soil moisture is very important for the growth of all plants. According to T. I. Gorin, a decrease in soil moisture by 10% of HB leads to a decrease in the growth of annual shoots by 5-7 cm.

According to S.S. Rubin's long-term data, years with abundant moisture are characterized by a lower average air temperature and less evaporation of free water from the surface. In such years, the hydrothermal coefficient is greater than one.

This is confirmed by the data for 2021, which was distinguished by a large amount of precipitation during the growing season and low air temperature. Only in May, June and July, precipitation exceeded the norm by 18-93%. This ensured, regardless of the soil content system, a sufficiently high (up to 73% HB) moisture content in the root layer. Abundant precipitation

reduced the effect of black fallow on soil moisture, especially in deeper layers (40-60 cm). However, it should be noted that by the end of August, with an increase in air temperature and the cessation of precipitation, soil moisture in the area with grassing turned out to be 16-19% lower than in the variant with black fallow.

As you know, the state of the tree can be judged by the length of the annual branch. The annual occurrence of shoots on a tree is the key to good productivity and durability. Annual branches of sufficient length provide the tree with annual replenishment of the most productive wood. The length of annual growth is influenced by both the biological characteristics of the variety and weather conditions [14].

As can be seen from the above data, both in the period with heavy rainfall (July) and after their decrease (August), the average shoot length was 20-40% higher in the variant with black fallow compared to turfing (Table 1).

Table 1 - The system of soil maintenance and its influence on the average growth length and crown size (rootstock MM-106, planting pattern 6x3 m)

Option	Variety	Growth length, cm		Average for 2 years, cm	The area of the horizontal projection of the crown, m2
		2021	2022		
Black steam (k)	Renet Simirenko	68.0	52.0	60.0	18.3
Natural sod b/m	Renet Simirenko	60.5	49.0	54.8	14.9
NSR05	-	2.1	2.5	-	0.4
Black steam (k)	Idared	65.3	48.0	56.7	10.7
Natural sod b/m	Idared	60.0	45.0	52.5	10.4
NSR05	-	2.0	2.6	-	-

2021 in terms of temperature was within the average multi-year data. July was the hottest. The maximum air temperature this month was +36.2 0C, which is 13 0C higher than the long-term average. This month was the driest month with total rainfall.23 mm(30% of the norm). However, in the second half of the summer, when the highest air temperature and the lowest amount of precipitation were recorded, soil moisture in the variant with black fallow was 6-11% higher compared to sodding. This had a significant impact on the growth processes of apple trees.

As the experiment showed, in the studied varieties, a more active growth of shoots was noted when the soil was kept under black fallow. Thus, the length of the shoots of the variety Renet Simirenko in this variant was 8.7%, and the length of the Idared variety was 7.5% more than in the variant with turfing. As a result and

Figure 3 - Sizes of trees when soil is kept under black fallow

Figure 4 - The size of apple trees when the soil is kept under turfing

the crown size in this variant, regardless of the variety, was larger (Table 1, Figure 3, 4).

The yields obtained are a natural result of the action of certain endogenous systems of the plant, which contribute to the coordination of the levels of light, carbon and mineral nutrition with other factors.

Productivity is one of the main indicators characterizing the value of a variety. First of all, it is determined by the biological characteristics of the variety, at the same time it depends on the growing conditions.

The potential for fruit productivity begins to be laid in the summer months of the previous year. The formation of the crop occurs in stages: from budding to mature fruits. The realization of the productivity potential depends on the interaction of biological and abiotic factors, which can significantly reduce the yield [5].

One of the main indicators of productivity is a high flowering score and a useful ovary.

It should be noted that the biological characteristics of the variety influenced the percentage of useful ovaries, and, consequently, the yield of apple fruits.

Depending on the weather conditions and the age of the trees, the soil maintenance system has a different effect on the flowering energy and the amount of useful ovary in the studied varieties. So, in drier years (2022), the advantage belongs to the steam system, in wetter years, to natural turfing (2021) (Figure 5).

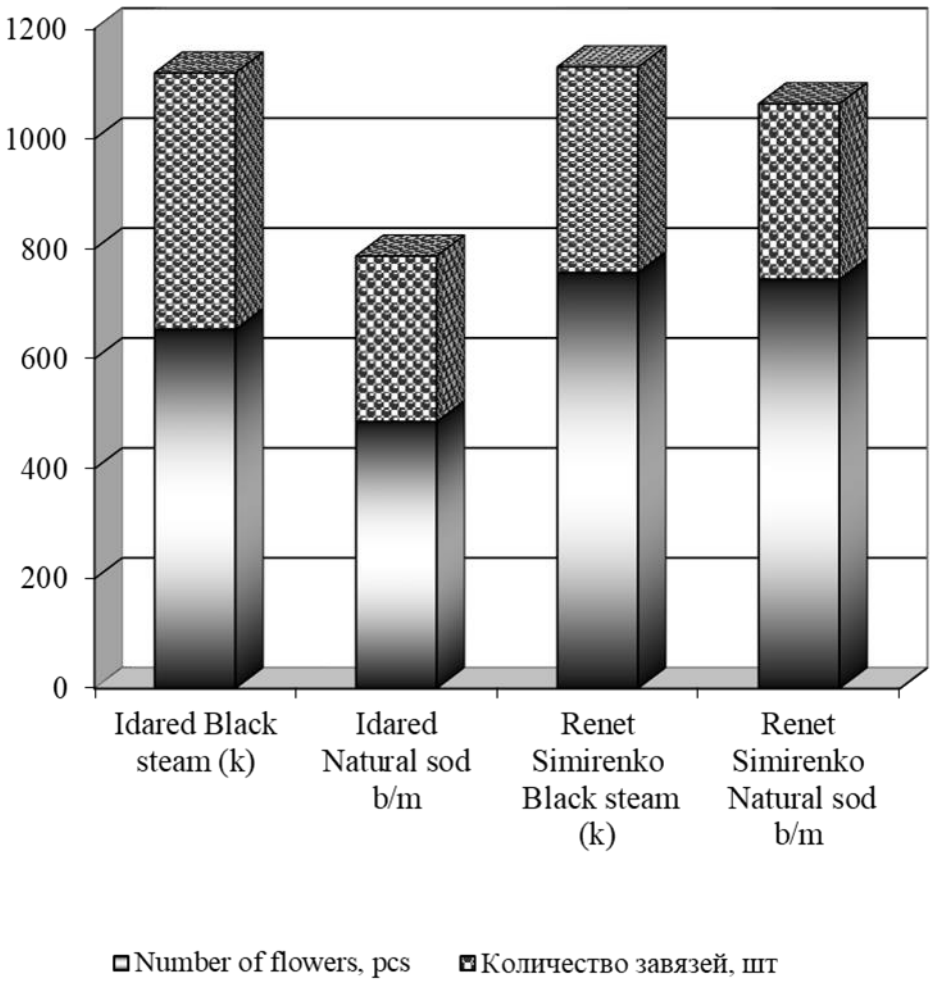

Figure 5 - Influence of the soil management system on the number of generative organs in different apple varieties

The data of the figure show that, on average, over two years of research, the control variant leads in terms of the number of flowers and ovaries in both studied varieties. The most abundant flowering, on average over two years of research, was noted for trees of the Renet Simirenko variety, however, the

percentage of useful ovary was higher for the Idared variety, since it is genetically more productive compared to the Renet Simirenko variety. This is confirmed by the data in Table 2.

Table 2 - Yield of apple trees depending on the soil content system, c/ha (rootstock MM-106, planting pattern 6x3 m)

Option	Variety	Productivity, c/ha		Average for 2 years, c/ha
		2021	2022	
Black steam (k)	Renet Simirenko	250.5	230.6	240.4
Natural sod b/m	Renet Simirenko	228.1	199.2	213.7
NSR05	-	3.1	1.7	-
Black steam (k)	Idared	307.7	228.4	268.1
Natural sod b/m	Idared	349.9	161.1	255.5
NSR05	-	2.2	1.9	-

On average, over the years of research, the largest yield was obtained in both varieties with row spacing under black fallow, and the yield of the Idared variety in this variant is 12% higher than that of the Renet Simirenko variety. When row spacing is maintained by natural turfing, a similar picture is observed, while the difference in yield between varieties reaches 19.5%.

At the same time, it should be noted that in favorable weather conditions (2021), the Idared variety, with sod spacing, had a higher yield than with a black fallow. Perhaps this is due to the fact that this variety is inherently less tall compared to Renet Simirenko, in addition, when the row spacing is planted, the growth of shoots in this variety is weakened by 8.0% compared to the control

(table 1). At the same time, more short fruit formations are formed, providing an increase in the laying of flower buds and, as a result, the productivity of trees.

Thus, the system of soil content in the aisles of the garden has an impact on the formation of the yield of apple fruits.

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