SYSTEM OF MACHINES FOR SOIL PROCESSING IN SPACES BETWEEN ROWS OF PERENNIAL PLANTATIONS

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Annotation. This article introduces new technical means for cultivating the soil in the inter-row of the gardens. Different versions of soil maintenance systems are considered and, based on the conducted studies, a basic chisel plow machine and a set of additional equipment are proposed. The set of additional equipment includes a roller for leveling the surface of the treated soil, a device for applying mineral fertilizers and herbicides, and an apparatus for treating the subcutaneous zone of fruit trees. On the basis of the proposed equipment, a possible system tillage in the gardens.
KEYWORDS: SOIL TREATMENT, SOIL CONTENT SYSTEM, ADDITIONAL EQUIPMENT, WORKING BODIES.

1. Introduction

The technological process of soil cultivation in gardens represents a set of targeted impacts on a biological object or a treated medium (soil, fruit plantations) by the working bodies of the machine to provide the necessary quality indicators. Most processes are accompanied by simultaneous execution of several technological operations, of which one or two are the main ones, and the rest are concomitant.

To ensure fruiting plants in the garden you need to create favorable conditions in the soil for an active and long-term growth of the root system, which fills a need trees for moisture and nutrients. For this purpose, deep chiseling is periodically carried out in the rows of the garden, and in the row there is a superficial loosening.

Depending on the depth of the working bodies and the technological operations performed, the surface (up to 8 cm), shallow (8-16 cm) and deep (more than 25 cm) processing soil. At the same time, rotational working elements have some advantages over passive loosening qualities of the formation, creating better conditions for the activity of soil microorganisms. Therefore, rotational working organs are not opposed to passive. Chopping soil lumps, completely destroying rhizome weeds, rotational working organs only create favorable conditions for the use of passive [1, 2].

2. The problem of discussion

The system of soil content in the gardens should ensure a constant replenishment of the stocks of organic substances in the soil, improve its structure and physical and mechanical properties, protect against erosion, weed vegetation, as well as pests and pathogens of diseases of fruit crops.

The system of soil content in the gardens is selected and adjusted taking into account the soil and climatic conditions of the region and the biological characteristics of the fruit crops. In the orchards of the arid regions of southern Russia, the main soil content system provides for systematic loosening throughout the vegetation period (black steam), as fruit crops are poorly supplied with moisture.

The soil content in the gardens under the black steam provides favorable conditions for the development of fruit plantations, promotes the retention of moisture within the formation, improves the air, nutritious and temperature regimes. It is known that in the meter layer of the soil layer, contained under black steam, the moisture content is greater than when it is retained [1, 2].

When processing the soil in the garden, it is necessary to take into account the properties and characteristics of the treated medium. As a treated environment in the garden is the soil and fruit plantations. It should be taken into account when designing the machine that in young and fruit-bearing gardens the width of the rows between 6 and 8 m, and the distance between trees in the row is from 2.5 to 6 m. The following tree planting schemes are adopted in gardens: 8x8, 8x6, 8x4, 7x7, 4x4, 4x3, 5x2.5 m, etc. Wide rows provide good illumination of fruit cultures and allow the use of technical means, and thickening in a series improves conditions of growth, increases their resistance to adverse conditions and positively affects yields.

3. Purpose and methods of research

The aisles are free passages for the machines in the series of crowns of trees are closed. In young orchards due to poor treetops working body of tillage machines can freely approach the shtamb. As the growth of trees and increase the diameter of crown untreated area increases.

However, many well-known soil tillage machines in orchards are unable to provide passage under the crowns without damaging the lower skeletal branches. So, in the design of the UNLM-3.5 machine developed in Bulgaria, designed for cultivation with simultaneous treatment of the soil in the aisle and in two rows of garden, there is no adjustment of the depth of the extreme working organs, functioning in close proximity to trees. Such adjustment is necessary for setting a shallower depth to the edge working elements that form the boundary of the protective zone around the shtamb, in order to avoid damage to the root system of trees.

A similar adjustment is envisaged in the design of a garden chisel plow developed with [3, 4, 5, 6] with a differentially varying depth of tillage, the extreme working elements of which perform a deep loosening (10-15-22 cm), and the middle (deep) plow is deep chiseling up to 45 cm). In this case, the lower furrow generatrix after zigzagging, passes the location of the root system of trees along the depth of the bed (Fig. 1).

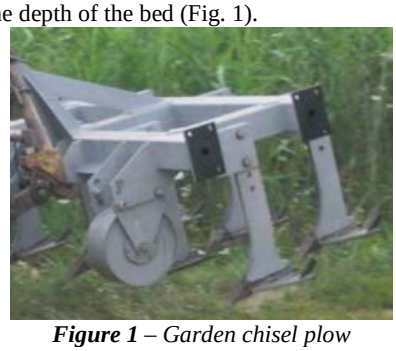

Figure 1 *– Garden chisel plow*

Depth of stroke of the working organs of the garden chisel plow is established in accordance with the architectonics of the location of the root system of trees, depending on the distance from the shtamb.

To reduce the untreated area of tillage machines must have a roaming working body in the horizontal plane. In this case, the sections must have a limited height to ensure passage under the crowns without damaging the lower skeletal branches. For this purpose [7] a garden harrow for surface tillage consisting of a rotor was developed, on the cylindrical surface of which there are direct needles with a conical sharpening (Fig. 2).

Figure 2 *– Garden Harrow*

The harrow is rotated as a result of the passive interaction of the needle with the formation in the forward motion of the tiller under the traction force of the tractor. To loosen the soil in the aisle and two rows simultaneously, the garden chisel plow (Figure 1) is equipped with additional harrow sections (Figure 2).

During operation the needles roll along the ground in a row of trees, recessed 8-10 cm, thereby loosening the process is carried out. Interaction with the needle root of the tree is performed tangentially, thereby avoiding damage.

Harrow by trapezoidal mechanism moving with reasonable parameters [8, 9, 10], controlled hydraulic system, is withdrawn from the row of trees. Entering the rotor in a row of trees is carried out under the action of the moment from the forces of soil resistance. This property of the trapezoidal mechanism [11, 12] allows to reduce energy costs, since in this case, the forced (by hydraulic system) input and hold in the row of the working member is not required.

The garden chisel plow can be equipped with a roller for additional loosening and grinding of large clods of soil with simultaneous leveling of the surface (Figure 3).

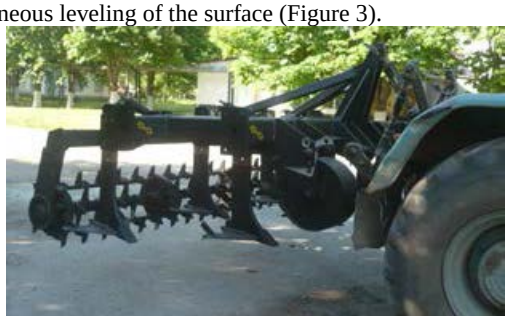

Figure 3 – Garden chisel plow with roller

In the design of the garden chisel plow, it is possible to implement the technological process of intrasoil application of fertilizers. For this purpose, the equipment for the maintenance and distribution of fertilizers or herbicides is directly placed on the frame of the garden chisel plow at the level of the root system of trees [13].

4. Results of the study

Table 1 gives an example of the use of the developed machines in the soil cultivation system in the gardens of the southern regions of Russia.

Table 1 *– Soil cultivation system in the gardens of the southern regions of Russia*

Name technological impacts	Timeline	Developed machines
Superficial processing between-rows	March (III decade)	Garden Harrow
Depth loosening between-series with introduction fertilizers and superficial series	April (III decade)	Garden chisel plow with equipment for the off-fertilizers and harrow garden
Fine processing inter-row and superficial series	June (I, II decade), July (II decade), August (I, III decade)	Garden chisel plow with harrow garden
Deep chisel- with the introduction of fertilizers	October (II-III decade)	Garden chisel plow with equipment for the off-fertilizers and roller

In southern regions of Russia, developed soil cultivation machines in orchards were tested and showed good results. There is a decrease in the untreated area near the shtamb, a decrease in fuel consumption. The high economic benefit from the use of developed machines.

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