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Substantiation of Technological Parameters of Devices for Interstable Treatment of Soil in Gardens with Rotational Working Bodies.

Azmiddin Sadriddinov, Xursand Rakhimov, Vecheslav Ivanov,Azzam Musurmonov

Professor, Tashkent state technical university, Tashkent, Uzbekistan
Master, Tashkent state technical university, Tashkent, Uzbekistan
Designer, BMKB Agromash, Tashkent, Uzbekistan
Assistant professor, Samarkand Veterinary Medical Institute, Samarkand, Uzbekistan

ABSTRACT. The article presents the technological indicators that affect the constructive and kinematic indicators of an active working body with a vertical axis of rotation (rotor) for tillage of near – stem stripes in gardens. Having studied the kinematics of the rotational working body, we obtained calculating formulas for the area of the untreated near – barrel protective zone left by the rotating working bodies. The length of the sensor probe L_{sh} was determined depending on the technological parameters, as the distance between the axis of the cross section of the tree and the end point of the X_{agr} rotor, the radius of the protective zone R_{agr} and the conditional radius of the bush r_{sh}

KEYWORDS. Garden, row, interstitial strip, processing, knife, mill.

I. INTRODUCTION

On sierozemic soils with good water availability during the growing season (8 – 10 irrigation) with a pomegranate planting pattern of 4x3 m in 5-7 year old bushes the radius of the root system spread is 3,0 – 4,0 m, depth – 2,0 – 2,5 m and more. However, the bulk of the most densely branched roots are located in a layer of 10 – 80 sm, in a radius of up to 1,0 – 1,5 m.

When the pomegranate garden is kept under the black steam in the spring, after opening the bushes and planning the soil, they are plowing between rows to a depth of 20 – 25 sm, irrigation furrows are cut, and fertilizers are applied. Spring tillage in rows to a depth of 15 – 20 sm is of great importance for improving the growing and fruiting conditions of plants. During the growing season, the soil is maintained in a loose state, clean from weeds, for which two or three cultivations are carried out. In the autumn, after the harvest, before the shelter, plowing between the rows is carried out to a depth of 25 – 30 sm. [1].

II. SIGNIFICANCE OF THE SYSTEM

In article presents the technological indicators that affect the constructive and kinematic indicators of an active working body with a vertical axis of rotation (rotor) for tillage of near – stem stripes in gardens. The study of literature survey is presented in section III, methodology is explained in section IV, section V covers the experimental results of the study, and section VI discusses the future study and conclusion.

III. LITERATURE SURVEY

In the complex of measures for the care of fruit plantations a lot of work is spent on surface tillage in near-stem belts. Currently, this process is carried out by passive or active working bodies-mills. In recent years, in our country and abroad, more and more attention is paid to soil cutters with a vertical axis of rotation.

These mills are less energy – Intensive, practically do not get clogged with weeds, provide a high degree of their destruction.

Interbarrelled in the gardens are treated to destroy weeds, loosen the soil, retain moisture, improve the growth and fruiting of fruit plants [1,2,3].

The decisive factor in choosing the optimal scheme of the device is the quality of the technological process - the completeness of weed cutting in the about standard zone and the degree of damage to the bark of a tree trunk.

For the mechanization of tillage, in the interstitial strips of the garden, we have developed a number of sliding sections with automatic control [4].

Analysis of the state of the issue has shown that the most effective is a mill with a vertical axis of rotation, for processing interstitial strips of intensive gardens, it works well on heavily littered and tired areas, can work on heavy, dense soils. with control of hydro – tracking system.

IV. METHODOLOGY

The rotational working body with the vertical axis of rotation established to side section of a garden cultivator for interbarrelled processing of the soil in gardens makes the complex movement Vn, rotary round its pivot-center and also a round of a bole of a tree, being displaced in a row-spacing under the influence of a power hydraulic cylinder [5.6].

The analysis of working process is carried out from the moment of operation of the hydro watching system. Let's consider kinematics of the movement of rotational working body with a vertical axis of rotation (fig. 1).

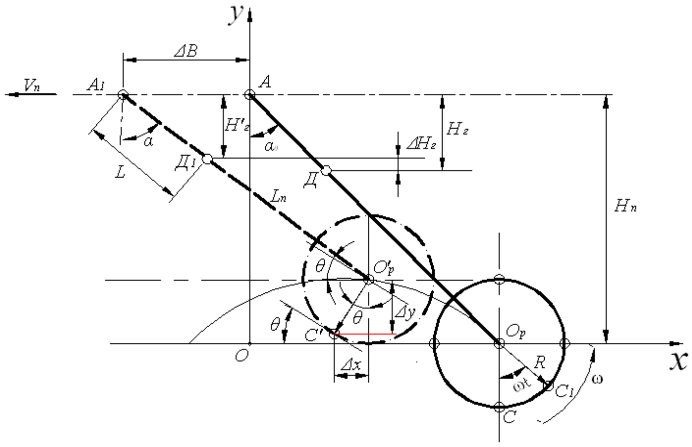

Fig. 1 Kinematic scheme of a round of a bole rotational working body

Let's enter the following designations:

α_0-the initial (established) angle of installation of a lead, is glad;

α-the current corner, is glad;

L-distance from the geometrical center of rotation of a lead to the center of accession of a rod of a hydraulic cylinder with a lead, m;

H_g- the initial length of a hydraulic cylinder, m;

-the current length of a hydraulic cylinder, m;

ΔH_g- a sprouting (shortening) of length of a rod, m;

H_n-distance from the geometrical center of rotation of a lead to an axis of a row, m;

L_n- is length of a lead, m;

R-radius of a rotor, m;

ΔB- the distance passed by the unit, m.

From the scheme (fig. 1) a trajectory the Shouting is described by the system of the equations:

$$\begin{cases} y = H_n - L_n \cos\alpha; \\ x = V_n t. \end{cases} \tag{1}$$

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$$\alpha = \arccos \frac{H'_г}{L}. \tag{2}$$

It is obvious that:

$$H'_г = H_г - \Delta H_г, \tag{3}$$

$$\Delta H_г = V_ц \cdot t. \tag{4}$$

Where V_s- hydraulic cylinder rod speed,
The system of the equations will take a form:

$$\begin{cases} y = H_n - \dfrac{L_n (H_г - V_ц t)}{L}, \\ x = V_n \cdot t. \end{cases} \tag{5}$$

The point trajectory equation the Shouting in an explicit form will be:

$$y = H_n - \frac{L_n}{L} \cdot H_г - \frac{L_n}{L} \cdot \frac{V_ц}{V_n} \cdot x, \tag{6}$$

Let's designate: $$\lambda_1 = \frac{V_ц}{V_n}. \tag{7}$$

Then: $$y = H_n - \frac{L_n}{L} \cdot H_г - \frac{L_n}{L} \cdot \lambda_1 x. \tag{8}$$

As we are interested in a form of curve border of the raw zone, the rotor is representable a circle *R* radius, *Lp* fixed on a lead in a point O_r. Then the circle the edge will describe the trajectory limiting the raw area. As *R=const*, is obvious that both curves will be similar. And a point O'_r, will correspond similar to it a point *C'*, displaced respectively on axes Δx and Δy. From the scheme (fig. 1)

$$\begin{cases} \Delta x = R \sin \theta; \\ \Delta y = R \cos \theta. \end{cases} \tag{9}$$

The corner θ will be expressed as an equation derivative in a point of *C'*, and so curves are similar, to the same corner there corresponds the derivative in a point O_r.. We have

$$\theta = y' = -\frac{L_n}{L} \cdot \lambda_1. \tag{10}$$

The system (1) taking into account amendments (9) will describe the curve limiting the area

$$\begin{cases} y = H_n - \dfrac{L_n}{L} Hг - \dfrac{L_n}{L} V_ц \cdot t - R \cos \theta, \\ x = V_n t + R \sin \theta \end{cases} \tag{11}$$

or

$$y = H_n - \frac{L_n}{L} H_г - \frac{L_n}{L} \lambda_1 \left[x + R \sin \left(\frac{L_n}{L} \cdot \lambda_1 \right) \right] - R \cos \left(\frac{L_n}{L} \cdot \lambda_1 \right). \tag{12}$$

We will calculate the speed of a hydraulic cylinder the known formula [7]:

to the right $$V_{ц1} = \frac{6 \cdot Q}{F_1}, \tag{13}$$

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to the left $$V_{ц2} = \frac{6 \cdot Q}{F_2},\tag{14}$$

where
Q -consumption of liquid, m^3/s;
F_1 and F_1- the area of the piston, m^2
It is known that the effort on the piston is equal

$$G_1=P_1 \bullet F_1;\tag{15}$$
$$G_2=P_2 \bullet F_2,\tag{16}$$

where
P - specific pressure, N/m^2;
G - total pressure on the area of a hydraulic cylinder, N/m^2.
Substituting a formula (15) and a formula (16) in formula (13) and (14), we will receive:

$$V_{ц1} = \frac{Q \cdot P_1}{6G_1},\tag{17}$$

$$V_{ц2} = \frac{Q \cdot P_2}{6G_2}\tag{18}$$

As effort of pressure upon pistons of a cylinder are defined by the jet force of resistance of the processed object which we accept constant maximum size, having united formulas (15) and (16), we will receive:

$$V_ц = \frac{QP}{6G}.\tag{19}$$

In this case change of speed of the movement of a rod of a hydraulic cylinder to the right will also happen due to fluctuations of values of an expense to the left. Really, that, for example, on the smaller area of the piston to develop equal efforts, it is necessary to create additional pressure, however with a constant capacity of the pump on it time will be required, as will cause delay of the movement of a rod of a hydraulic cylinder.

Then expression (7) taking into account a formula (19) will take a form:

$$\lambda_1 = \frac{QP}{6GV_n}.\tag{20}$$

By means of formulas (9) … (11) and (20), it is possible to calculate the area of the left protective zone of the limiting curve which is equal:

$$S = 2\int_{x_0}^{x} У(x)dx - S_ш,\tag{21}$$

Where $U_{(x)}$ - the equation to a curve corresponding half of the raw zone, i.e., at pass of the unit to one party.
S_{sh} - cross-sectional area of a bole.

V. EXPERIMENTAL RESULTS

For decrease in the protective zone established by agrotechnical requirements we will allow the probe to take out forward on the unit course on some distance of advancing, In which will depend on design data of the probe and a lead with a rotor and also on time of delay and insensitivity of a system.

From the scheme (fig. 2) it is had:

$$B = x^{\varphi}_{\max} + x_{агр} + R_{агр} + R - x^{\alpha}_0,\tag{22}$$

where B- advancing distance;

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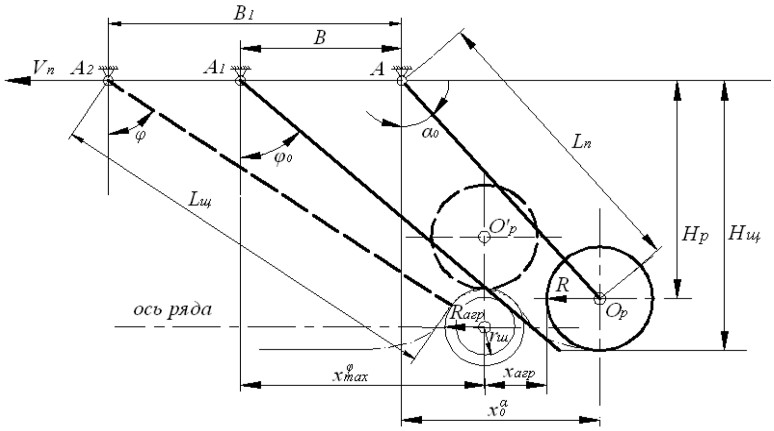

Fig. 2.Scheme of definition of a relative positioning of axes of rotation of the probe and lead.

The probe adjoining with bole a tree turns round its pivot-center on a corner φ, the axis of rotation of the probe from provision A_1 will move to provision A_2.

Expressing distance from an axis of rotation of a lead A to a point of movement of A_2 we will designate B_1 through design data, we will receive:

$$\hat{A}_1 = (L_ø + r_ø)\sin\varphi + x_{àãð} + R_{àãð} + R - L_n \sin\alpha_0 . \qquad (23)$$

It is obvious that with reduction of distance between axes of the probe and a lead the response time of the hydro watching system of the long L_{sh} operated by the probe sensor decreases. At establishment coaxially of the probe sensor and a lead the coefficient of transfer of the watching drive approaches unit of $K_p = 1$, the distance of advancing equals zero $B_1 = 0$ [6.7].

On the scheme (fig. 2), x_{agr} - represents the distance between an extreme point of a circle of a rotor and a vertical axis of a bole taken on condition that the circle of a rotor concerns a circle of a protective zone. With some insignificant error it is possible to take $R_{agr} = x_{agr}$where R_{agr} is the radius of a circle of a protective zone following from agrotechnical requirements.

By means of a formula (24) it is possible to pick up an optimum ratio of design data with observance of a condition

$$\tilde{o}_{àãð} \geq L_n \sin\alpha_0 - R - R_{àãð} - (L_ø + r_ø)\sin\varphi . \qquad (25)$$

where, r_{sh} is the conditional radius of a bush of pomegranate.

After the probe, having deviated on some corner, forces to work the hydrowatching system, it has to keep for some time a system in the specified state to give the chance to working body to bypass штамб or an obstacle.

From the scheme (fig. 2) it is visible that during this time the unit has to pass distance $x_{agr}+R$, then the rotor will reach the position designated by a shaped circle with the O'_rcenter. At this moment the probe has to come off a shtamb.

Then length of the probe sensor has to be:

$$L_щ = \frac{L_n \sin\alpha_0 - R - R_{агр} - X_{агр}}{\sin\varphi} - r_ш . \qquad (26)$$

As a result of theoretical researches shows that the axis of rotation of a lead of rotational working body with a vertical axis of rotation and an axis of rotation of the probe is established coaxially. It allows to increase coefficient of the watching drive, to reduce the area of the raw zone.

VI. CONCLUSION AND FUTURE WORK

The calculating formula of the raw area left by working body around a shtamb (21) is received. The agrotechnical requirements imposed to intersectional processing of the soil in the gardens which are a condition for the program of position tracking between the probe and working body. A resultant trajectory of processing of the soil at a

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shtamb of a tree, taking into account the figurative movement of the unit, the angular movement of a lead with working body predetermines.

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