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BASING THE TURNING ANGLE PARAMETERS OF THE DISK DEVICE THAT WORKS BETWEEN GARDEN ROWS OF DIFFERENT WIDTHS

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Annotation

The article presents the results of the theoretical research on determining the parameters of the angle of rotation of the parallelogram frames of the parallelogram frame, which works between intensive garden rows of different widths.

Keywords

Intensive gardens, row spacing of different widths, main rama, right and left parallelogram frames, unevenness, spherical discs, installation angle, the angle of installation of the spherical disk in relation to the direction of movement.

Introduction. In our republic with the development of intensive horticulture, the demand for devices that consume less energy and work between rows is increasing. In horticulture, VK-5, KSL-5A, MPV-1 manufactured in Uzbekistan and various garden cultivators intended for cotton cultivation, as well as various complex machines that require a lot of energy imported from abroad, are widely used [1].

We all know that the productivity of agricultural crops in our republic is increasing year by year. It depends on the agricultural machines that our experienced farmers and farmers can carry out agrotechnical activities in a timely manner based on the soil and climatic conditions of each type of crop.

In intensive orchards, the spacing of seedlings and rows are selected depending on the type of fruit. At the same time, processing between rows of different widths with one device brings some convenience to farmers.

Based on the above, the construction scheme of the device for processing intensive garden rows of different widths was developed at the Agricultural Mechanization Scientific Research Institute (Fig 1).

The device (hereinafter referred to as the device) for processing intensive orchards between rows of different widths has a suspension device 1, main frame 2, right and left parallelogram frames 3 and 4, hinge 5, spherical discs in the front row 6, spherical discs in the rear row 7, lever for changing the angle of installation of the left and right parallelogram frames relative to the main frame 8, arrow-shaped pawl 9, spherical consists of 10 pulleys, which ensure that the installation angle of the disks does not change in relation to the direction of movement [2].

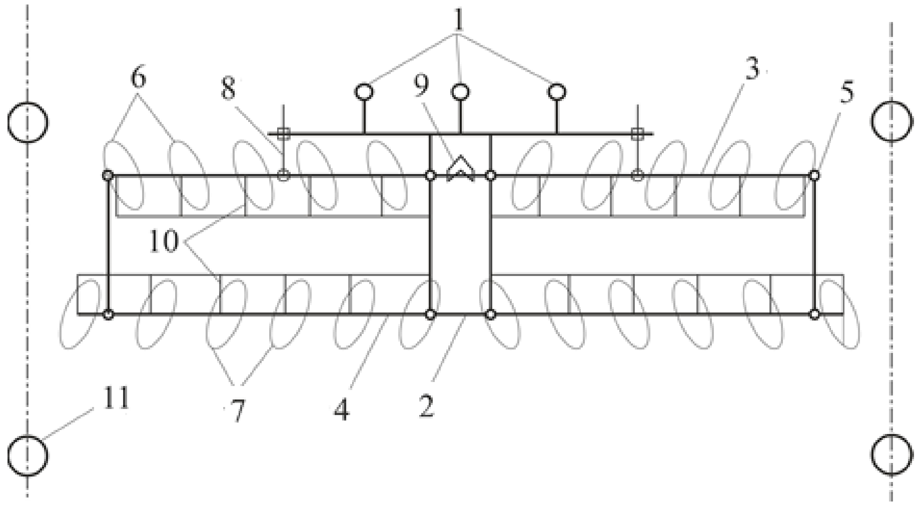
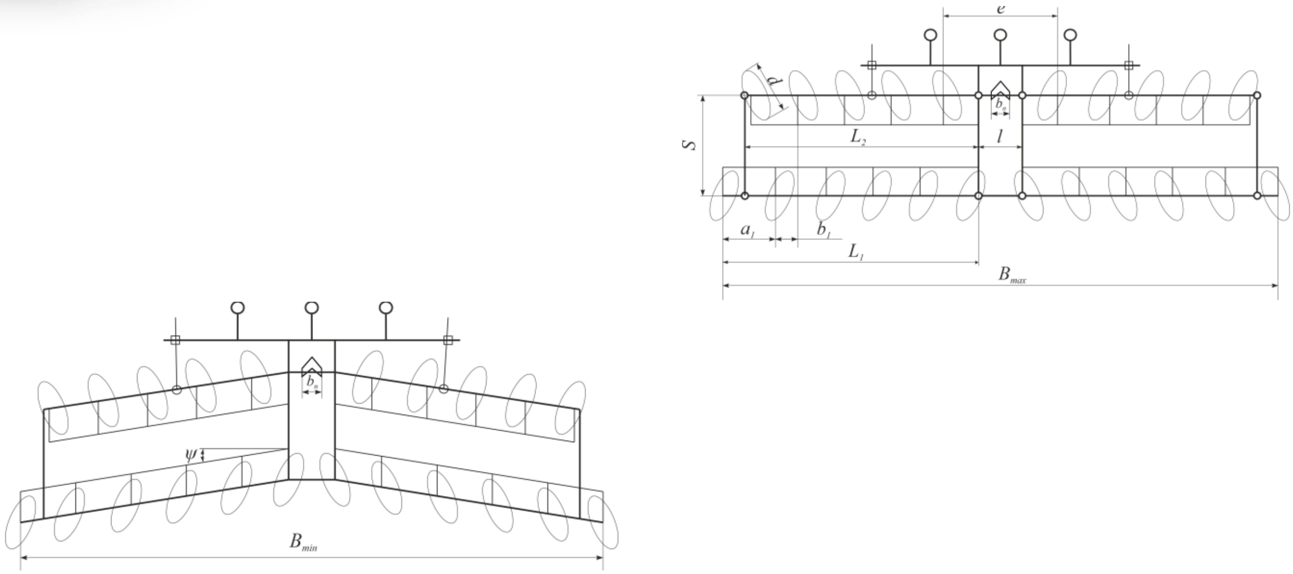


Figure 1. The scheme of the device that works between rows of different widths of intensive orchards

This device is designed to process orchard rows with a row width of 3.5-4.0 m. When the row width is 3.5 m, the left and right parallelogram frames are turned at an angle of ψ ensures that the coverage width is 2.5, taking into account the protection zone.

The following are the main parameters affecting the turning angle of the device that works between rows of different widths of intensive orchards (Fig 2).

B_{max} - maximum coverage width, m; B_{min} - minimum coverage width, m; b_n- the width of the reader's paw, cm; ψ – the angle of installation of the left and right parallelogram frames relative to the main frame, °; d – diameter of a spherical disc, m; R – radius of curvature of a spherical disk, m; β – the angle of installation of the spherical disk relative to the vertical, °; a – the angle of installation of the spherical disc in relation to the direction of movement, °; e – transverse distance between symmetrical spherical disks in the center of the front row, m; l – transverse distance between the longitudinal beams of the main frame, m.



a) breadth of coverage B_{max}- 3,0 m b) breadth of coverage B_{min}-2,5 m

Figure 2. The device is a scheme for determining the angle of rotation of the parallelogram frame

Using the above scheme (Fig. 2), the transverse distance b_1 between the spherical discs located in the first and second row should be such that the height of the longitudinal unevenness (scythe) between them, which remains unprocessed, should not be greater than the permissible value $[\Delta h]$. we determine according to the following expression derived from the condition [3].

$$b_1 \geq \frac{1}{c}\left\{ b\left\{\frac{\sqrt{q}}{2a}\left[b^2\sqrt{\frac{1}{(4ac-b^2)c}}+\sqrt{\left(4a-\frac{b^2}{c}\right)}\right]-[\Delta h]\right\}- \right.$$

$$\left. -\left\{4cq-\left(4ac-b^2\right)\left\{\frac{\sqrt{q}}{2a}\left[b^2\sqrt{\frac{1}{(4ac-b^2)c}}+\sqrt{\left(4a-\frac{b^2}{c}\right)}\right]-[\Delta h]\right\}^2\right\}^{\frac{1}{2}}\right\} \quad (1)$$

here $c=\cos^2\gamma+\sin^2\gamma\cos^2\beta\sin^2\alpha$;

$b=\sin 2\gamma\left(1-\cos^2\beta\cos^2\alpha\right); q=0,25D^2\cos^2\beta\sin^2\alpha$;

$\alpha=\sin^2\gamma+\cos^2\gamma\cos^2\beta\sin^2\alpha; \gamma=arctg\left(tg\beta/\cos\alpha\right)$.

We determine the transverse distance between the spherical disks located in one row using the following expression, provided that the layer being processed by them is completely softened [4].

$$a_1 \le d\sin arctg\left(\frac{tg\beta}{\cos\alpha}\right) - b_1 + h\cos(\alpha+\varphi_1):$$

$$:\left[\cos\varphi_1 \cos\frac{1}{2}\left(90^\circ - \arccos\frac{\sqrt{R^2-(0,5d)^2}}{R} - \beta + \varphi_1 + \varphi_2\right)\right]. \qquad (2)$$

or considering (1)

$$a_1 \le d\sin arctg\left(\frac{tg\beta}{\cos\alpha}\right) - \frac{1}{c}\left\{ b\left\{\frac{\sqrt{q}}{2a}\left[b^2\sqrt{\frac{1}{(4ac-b^2)c}} + \sqrt{\left(4a-\frac{b^2}{c}\right)}\right] - [\Delta h]\right\} - \right.$$

$$\left. -\left\{4cq - \left(4ac-b^2\right)\left\{\frac{\sqrt{q}}{2a}\left[b^2\sqrt{\frac{1}{(4ac-b^2)c}} + \sqrt{\left(4a-\frac{b^2}{c}\right)}\right] - [\Delta h]\right\}^2\right\}^{\frac{1}{2}}\right\} +$$

$$+h\cos\left(\alpha+\varphi_1\right):\left[\cos\varphi_1 \cos\frac{1}{2}\left(90^\circ - \arccos\frac{\sqrt{R^2-0,25d^2}}{R} - \beta + \varphi_1 + \varphi_2\right)\right] \qquad (3)$$

here φ_1, φ_2 – external and internal soil friction angles, respectively, ° [5-6].

When the installation angle ψ of the parallelogram frames relative to the main frame changes, the transverse distance between the spherical discs located in one row changes and can be expressed as follows.

$$a_2 = a_1 \cos\psi. \qquad (4)$$

here a_2 – The value of the transverse distance between the spherical discs located in one row when the parallelogram frames are set at an angle of ψ to the main frame, m.

Taking (3) into account, expression (4) takes the following form

$$a_2 \le \left\{ d \sin arctg\left(\frac{tg\beta}{\cos\alpha}\right) - \frac{1}{c}\left\{ b\left\{\frac{\sqrt{q}}{2a}\left[b^2\sqrt{\frac{1}{(4ac-b^2)c}} + \sqrt{\left(4a-\frac{b^2}{c}\right)}\right] - [\Delta h]\right\} - \right.\right.$$

$$\left. - \left\{4cq - \left(4ac-b^2\right)\left\{\frac{\sqrt{q}}{2a}\left[b^2\sqrt{\frac{1}{(4ac-b^2)c}} + \sqrt{\left(4a-\frac{b^2}{c}\right)}\right] - [\Delta h]\right\}^2\right\}^{\frac{1}{2}}\right\} +$$

$$\left. + h\cos\left(\alpha+\varphi_1\right)\left[\cos\varphi_1 \cos\frac{1}{2}\left(90^\circ - \arccos\frac{\sqrt{R^2-0,25d^2}}{R} - \beta + \varphi_1 + \varphi_2\right)\right]^{-1}\right\}\cos\psi \quad (5)$$

It can be seen from this expression that increasing ψ decreases the transverse distance between the disks located in the same row [7, 8, 9, 10, 11, 12].

According to the scheme presented in Fig. 2, we have the following expression

$$L_1\left(1-\cos\psi\right) = 0,5\left(B_{\max} - B_{\min}\right) \quad (6)$$

here B_{min} – minimum coverage width of the device, m.

Solving (6) with respect to ψ, we get the following [6]

$$\psi = \arccos\frac{\left(B_{\max} - B_{\min}\right)}{2L_1}. \quad (7)$$

Putting the values B_{max}=300 cm, B_{min}=250 cm and L_1=135 cm [13, 14] into this expression, we determine that the installation angle of the parallelogram frames of the device relative to the main frame should be 35°30′. In this case, according to the expression (7), the transverse distance between the disks located in one row is 18 cm.

Conclusion

As a result of the above theoretical studies, it follows that the transverse distance between the spherical discs in the center of the main and front row of the device should be no more than 22 cm, the length of the rear cross bar of the parallelogram frame of the device should be 135 cm, and the length of the front cross bar should be 120 cm.

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