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The Parameters of the Working Organ of the Furrow Opener Were Determined Based on the Application in the Combined Machine

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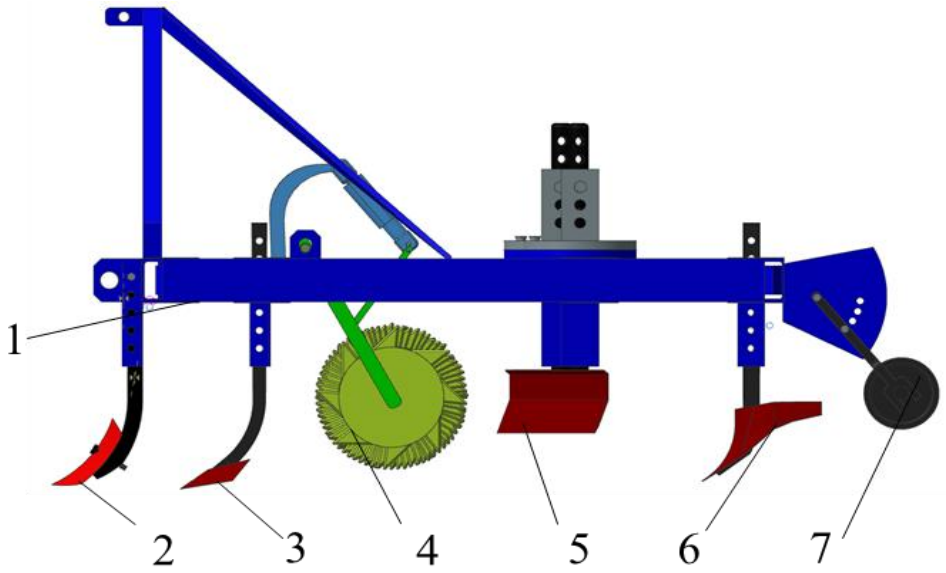
Annotation: In the field of agricultural mechanization, the level of use of combined machines capable of performing several technological processes in one run is increasing every day. In this article, the parameters of the working part of the furrow cutter used in the combined machine, which can be used in the inter-row spaces of orchards, are theoretically studied.

Keywords: Combined machine, blade ripper, arrow blade, leveler, cultivator, support wheel, entry angle, furrow depth, friction angle, cultivator chest height.

To reduce the introduction of machines into the field, it is useful to use combined machines that can perform several technological processes in one run. [1].

In the front part of the combined machine for preparing the soil between the rows of orchards for sowing, working bodies are arranged in two rows in a zigzag pattern. In the next row, four-piece soil crushers and two parallel levelers are installed. In the fourth row, five specially prepared furrowers are installed for cutting furrows, Fig. 1.



1 - frame; 2 - blade ripper; 3 - arrow-shaped paw; 4-roller; 5-leveler; 6-furrow opener; 7-support wheel.

Figure 1. Design diagram of a combined machine for preparing orchard inter-rows for sowing crops.

The parameters of the furrow opener as the main working body of this combined machine are determined based on the dimensions of the irrigation ditch, Fig. 2.

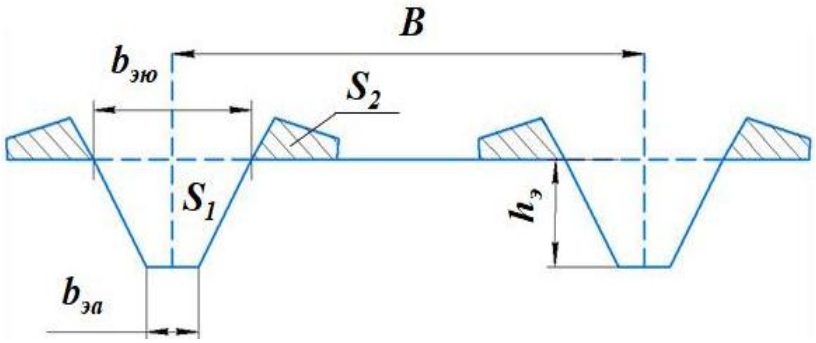


Figure 2. The shape of irrigation furrows used for sowing melon and vegetable seeds.

As a result of observations, it was established that the dimensions of the furrow are equal to:

- furrow depth, $h_э$ =0.11-0.12 m; furrow top width, $b_{эю}$=0.25 m;

width of the furrow base, $b_{эа}$=0.06 m.; surface area of soil removed in one direction during furrow opening, S_1.

$$S_1 = \frac{b_{эа} + b_{эю}}{4} \cdot h_э \text{ , or } S_1=0{,}93 \text{ m}^2 \quad (1)$$

The shape of the furrow opener and its parameters, ensuring the dimensions of the furrow, are shown in Fig. 3.

To determine the angle of entry of the furrow cutter tip into the soil, we use the diagram shown in Figure 4 [2, 3].

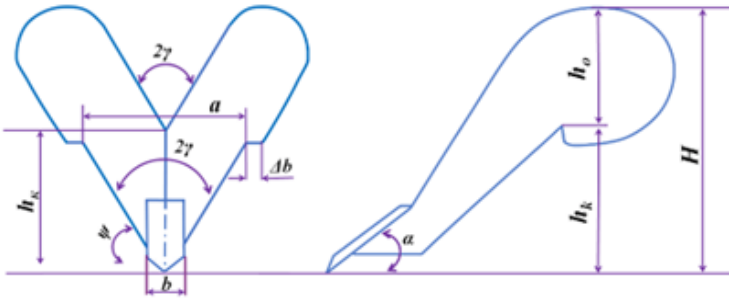


Figure 3. Furrowers and their parameters

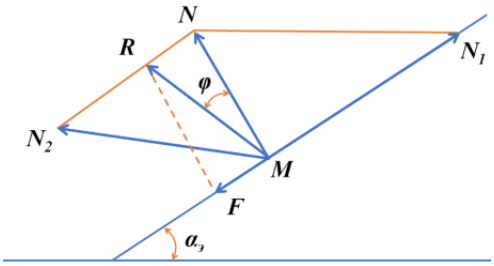


Figure 4. Diagram for determining the angle of entry of the furrow opener into the soil

The low energy consumption of the furrow opener when moving its tip into the soil to the bottom of the ditch and the prevention of soil accumulation on its surface depends on the angle of entry into the soil αe.

To determine the fulfillment of the condition of upward sliding of the soil on the surface of the furrow opener, we study the forces acting on point M on its surface, i.e., we decompose the normal force N acting on point M into components N_1 and N_2. From them, N_1 slides upwards along the surface of the working body.

$$N_1 = N \cdot tg(90 - \alpha_э) \text{ , (2)}$$

When the condition N_1>F is met, sliding occurs. Where F is the friction force,

$$F = N \cdot tg\varphi \text{ , (3)}$$

Substituting the values of the forces N_1>F i we obtain

$$\alpha_э = 90 - \varphi \text{ , (4)}$$

During operation, not only soil is rubbed against the surface of the furrow opener, but also the residues of weeds present in the soil are rubbed. Then [5, 6].

$$\varphi = \varphi_1 + \varphi_2 \text{ , (5)}$$

where φ_1 and φ_2-angle of external and internal friction of the soil, degrees. φ_1=29°-33°; φ_2=20°-36°.

Taking into account the above, it was found that $\alpha_э$=29°-31°.

The height of the furrow opener's chest is determined from the condition that the soil heap in front of the chest does not exceed the height of the chest during movement. Then h_k is determined as follows [7].

$$h_k = (1 + \mu)h_э \text{ , (6)}$$

where $h_э$-processing depth, m;

μ-coefficient, taking into account the accumulation of soil in front of the chest during the opening of the ditch μ=0.5-0.7.

It was established that the height of the furrow opener's chest is equal to h_k=20.4 cm.

The width of the furrow opener's wings is determined using the following expression (7), taking into account the adopted and determined values [8].

$$B_1 = b_{эа} + \left[2 + (1+k)h_э\right]ctg\,\psi\,, \quad (7)$$

where k is the coefficient that takes into account the accumulation of soil near the ditch breaker, k=0.1;

In this case, the width of the furrow opener's wings in both shapes was taken as B_1=0,356≈0.36 m.

According to the accepted shape of the furrows, the slope of the ditch will be equal to ψ=55°. Then the opening angle of the furrow opener will be in the range $2\gamma_э$ =64°-70° ($\gamma_э$=32°-35°).

The parameters of the furrow opener for opening furrows of specified dimensions are determined to be $h_э$=12 cm, h_k=20.4 cm, $\alpha_э$=29° -31°, ψ=55°, $\gamma_э$=32°-35°.

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