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THEORETICAL STUDIES ON THE DEVELOPMENT OF THE CONSTRUCTION OF A COMBINED DEVICE THAT SOFTENS CRSUT

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Annotation:
The article describes the research work on the improvement of a crust softening device. In order to reduce the traction resistance of the crust softener device and to improve the quality of soil softening, the device is equipped with rollers with a circular cross-section and a rectangular cross-section. It is shown about the resistance forces falling on the device in the process of tillage.

Keywords: arc, coverage, contact, tracer, reel, softener, dig, cotton, crust, crop, radius, bending, static, tire, construction, deformation, soil.

INTRODUCTION

It is known that the air climate of the region where we live is strongly continental, which, in turn, creates some comforts and also causes certain problems. As an example, I will cite the problems encountered in the production of agricultural products: in our climate, strong precipitation (rain and snow) is observed mainly in spring, autumn and winter. Cotton, an agricultural crop sown in the spring season, is replanted due to rainfall during its germination or processed by agricultural machines (tractors).

METHODS AND RESULTS

Motiga consists of six batteries made up of a three-section frame (Figure 1), a brush and needle discs. Motiga's working bodies - discs with special needles are installed in a checkerboard pattern on two parallel axles with the help of bushings.

Figure 1. MVN-2,8 to the rotating suspension motiga

The discs rotate due to the interaction of the teeth with the soil. Each disc has sixteen cone-tipped sharp needles bent along the path of the mat, which punch 150 holes per square meter of treated area.
MVN-2.8 will completely soften the soil in the fields where the cotton seed is planted. In return, the number of processed rows, movement speed and aggregate productivity can be increased. MVN-2.8 has some disadvantages: the weight is large, the coverage width is small, it is difficult to adjust to the specified mode, the degree of damage to seedlings is high, etc.. The MVX-5.4 rotary sectional harrow (Figure 2) is designed for softening the cotton seed in fields planted with 60 and 90 cm row spacing [1].

Figure 2. MBX-5,4 rotary section motiga

Each section consists of a reducer, needle discs connected to it through a motsdfiga, and a spring that adjusts the depth of movement and the pressure force applied to the discs. The width (interval) of the tracks of needle discs is 80 mm, three pieces are installed on two axles. By moving the reducers on the frame, the sickle machine can be adjusted to operate at the desired row spacing.[1,5]

DISCUSSION

The rains that fall after the crops are planted in the ground also affect the crops, especially cotton. The formation of mud after the rain has a negative effect on the germination of the planted crop.

Figure 3. Crust formed after rain.

We offer a multi-stage soil crust softener to prevent cotton replanting and improve germination. This device is adapted to be mounted on a universal crawler tractor suspension and has 4 posts mounted on the frame of the device and each post has a straight cross-section, which can fully rotate around its own axis. equipped with two softeners, rectangular and round.

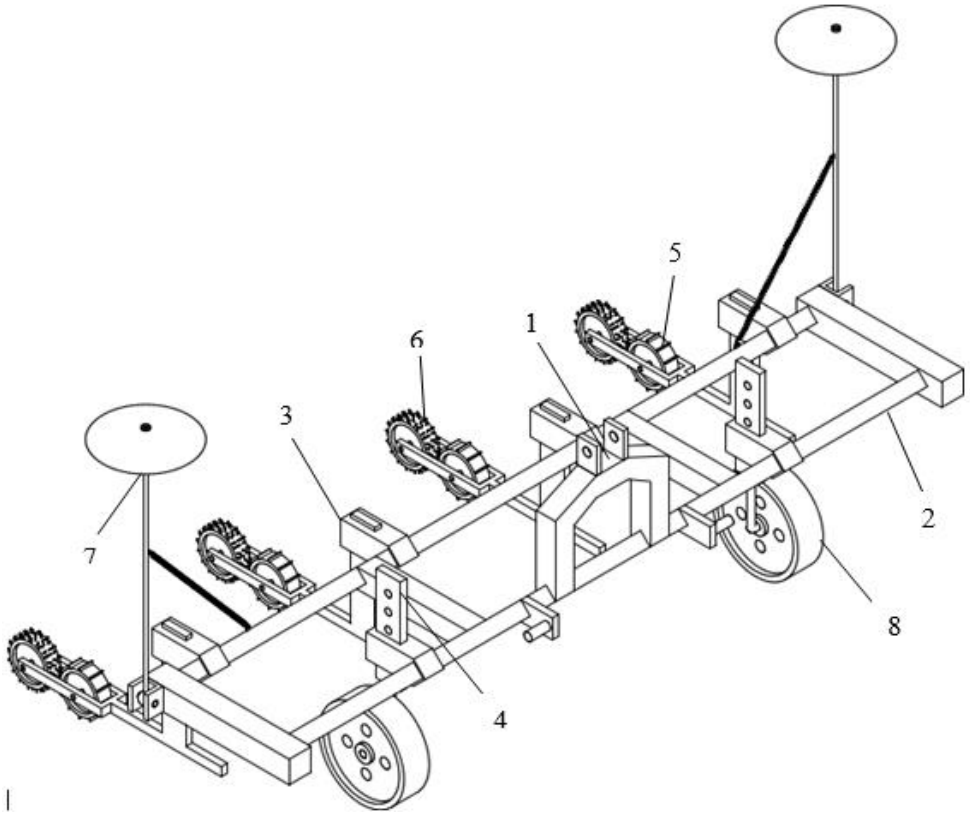

Figure 3. Schematic view of a multi-stage crust softening device.

Softening device hanger 1, main frame 2, retainer 3, column 4, smoothing roller with a rectangular cross section 5, roller with a circular cross section 6, track puller 7 and the base wheel is formed at 8.

The device works as follows; the device is aggregated to the lawn tractor using a suspension device. When the tractor moves between the rows, the device is lowered to the working position through the suspension of the tractor. Then the main frame is loosened with the help of a retainer installed in series through the column. As a result of the forward movement of the tractor, the working equipment softening rollers get stuck in the soil and rotate and soften the resulting soil clod. Even and stable movement of the device is ensured by the support wheels. During the forward movement of the tractor, the device's uniform processing across the field is carried out by track pullers. As a result, softened crusts turn into crushed soil, creating conditions for full and even germination of goza seedlings.[5,6,7]

During the process of crust softening, the device experiences some resistance due to the position of the crust and the pull of the device equipment: during the movement of the device, we use two softening coils with a rectangular and circular cross-section, depending on the aggregate movement speed We made a graph of the chang.

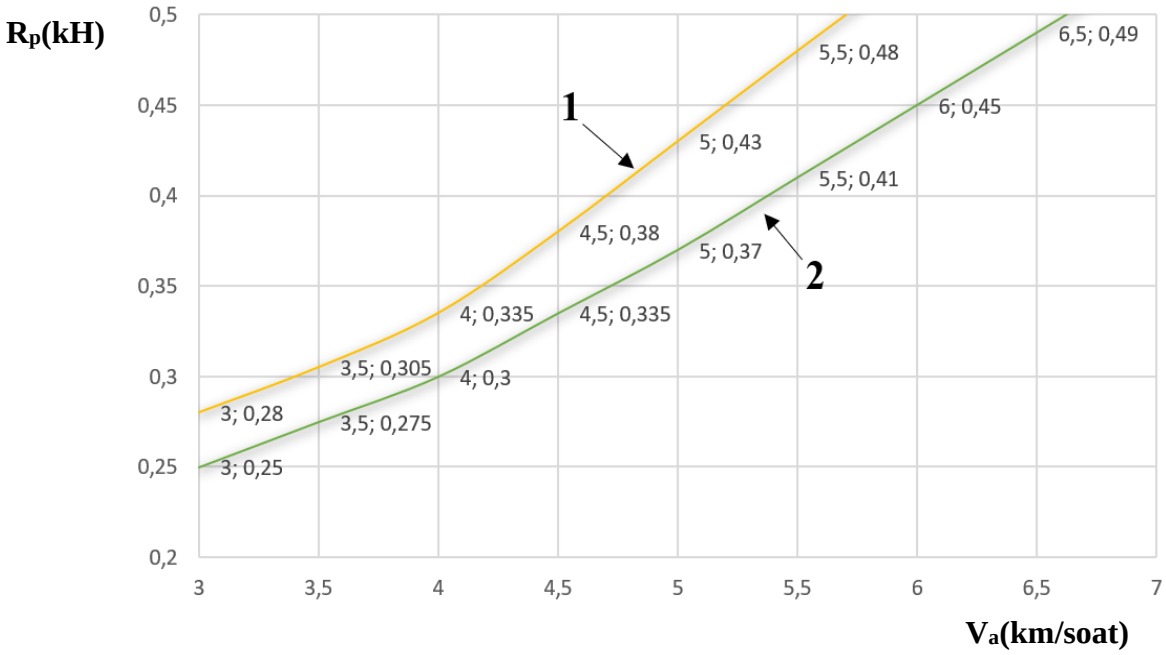

Figure 4. The graph of the change of the drag resistance of the working bodies depending on the speed of the aggregate movement.

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So, we can conclude from the table that with the increase in aggregate movement speed, the drag resistance of the working bodies also increases (Fig. 3). At the same vertical load and movement speed, the drag resistance of a reel with a rectangular tooth cross-section is 1-1 compared to the resistance of a reel with a round tooth cross-section, 1 times higher. It can be seen from this that when the vertical load is the same, the roller with a circular cross-section of the tooth sinks more into the soil.

According to the results of the comparison, the cross-section of the tooth of the reel with a round shape and the reel with the cross-section of the tooth of the rectangular shape is relatively small. provides high-quality softening into varnishes.[2,5]

The main parameters of the softener reel included in the technical tool include coverage width, inner and outer diameters, height and angle of deviation of the softeners. The softener roller designed for grinding the soil layer and lumps is supposed to move along the profile between the rows, it has inner and outer

diameters due to the difference between the edge and the edge of the soil(Fig. 3).

When basing the parameters of the softener roller, we accept the assumptions that its shape corresponds to the parameters of the brush, the conditions of crushing the soil layer and lumps are uniform over the entire coverage width, and that the softeners have a vertical effect on the soil particles and lumps. According to the condition, the roller should gently roll the pieces, grind them and dip them into the soil to ensure high-quality compaction of the soil. In order for the softener coil to work at the required level, the pieces must be cut, ground and ground on its surface.

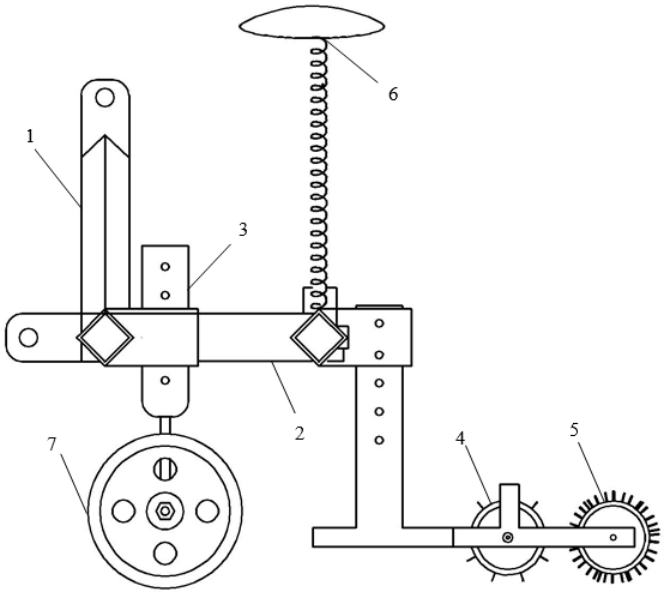

Figure 5. Side view of multi-stage crust softener.

1- hanging device; 2 – the main frame; 3 – column; 4 - smoothing coil with a rectangular cross-section; 5 - a coil with a circular cross-section; 6 – track puller;

7 – support wheel.

In the proposed design, this condition is fully fulfilled due to softeners installed on the reel (Figure 5).

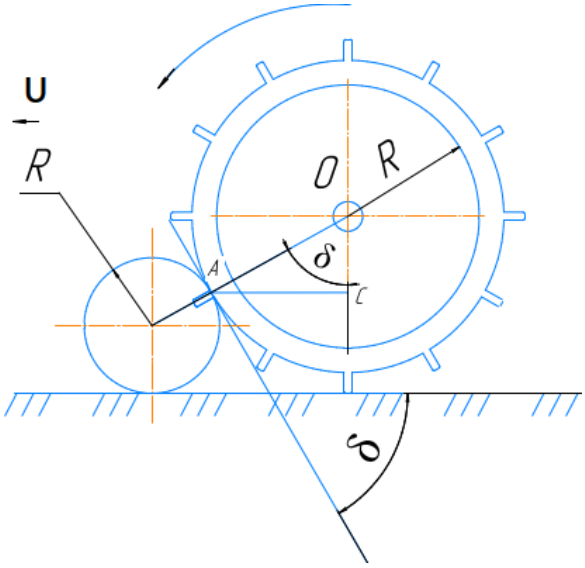

Figure 6. Scheme for determining the minimum radius of the reel.

According to the condition

$$\delta \leq \varphi_s + \varphi_p \qquad (1)$$

here δ - angle of contact, grad; φ_s, φ_p - external and internal friction angles of the soil, grad.

To determine the relationship between the radius of the coil r_g and the radius of the cut r_k, we determine the height of the contact point between the coil and the cut by AV (Fig. 5).

$$AV \square\square r_k \square\square r_k \square\cos\square\square\square\square r_g \square\square r_g \square\cos\square\square \quad (2)$$

After some changes

$$r_k \cdot \cos^2 \frac{\delta}{2} = r_{g'} \cdot \sin^2 \frac{\delta}{2} \quad (3)$$

Taking into account the boundary condition, for the case $\delta = \varphi_s + \varphi_p$, we solve the equation (3) in terms of r_k and determine the maximum radius of the crushing cut

$$r_{k\cdot mak} = r_{g'} \cdot tg^2 \frac{\phi_c + \phi_n}{2} \quad (4)$$

Expressing the radius $r_{g'}$ of the coil by the radius r_k of the cut, we can determine the minimum diameter of the coil that cuts the cut

$$r_{g'.\min} = r_k ctg^2 \frac{\phi_c + \phi_k}{2} \quad (5)$$

By putting certain values in the expression (3) (rk = 50 mm; φs = 330; php = 480), it is based on the fact that the minimum radius of the coil is pr' = 68 mm. The coverage width of the roller should usually be smaller than the width between the crop rows. Taking into account the protection zone and technical capabilities for a row spacing of 90 cm, the value of the coverage width of the reel b = 700 mm is considered acceptable.

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Taking into account that the working parts of the technical tool are adjusted to the processed layer of 6-10 cm, the length of the coil softeners can be met at a value corresponding to the diameter of the cuts l softener=50...60 mm; we consider that the thickness of S softener should be in the range of 4...5 mm.

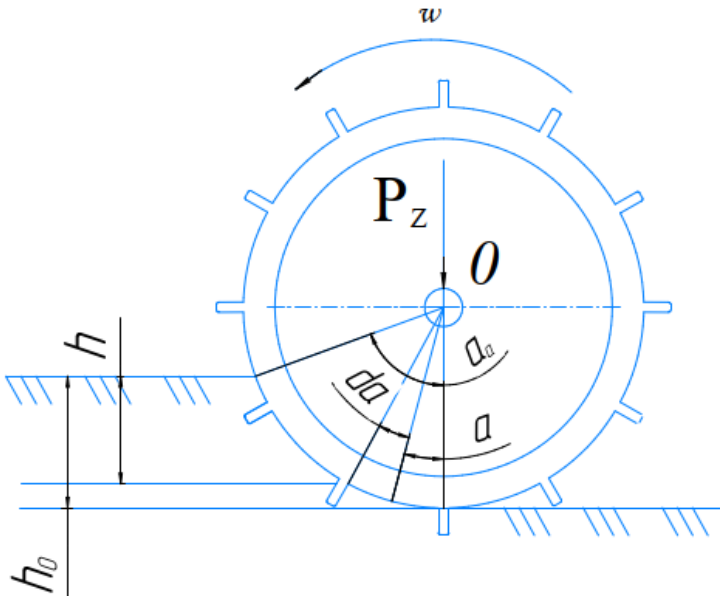

Figure 7. The scheme for determining the depth of immersion of the reel teeth into the soil.

We can separate the section dl from the part of the coil that sinks into the ground along the circular arc, and

define the surface that sinks into the ground according to the coverage width V by ds = Bdl [5,6.].

Elementary reaction force of the soil acting on the surface

$$dQ = \sigma B dl \quad (6)$$

here σ – specific pressure (compressive stress), kg/sm^2.

If we divide the dQ force into vertical dQ_z and horizontal dQ_x components, the total ΣdQ_z of the vertical components is equal to the pressure force pressing the coil to the ground, and the total of the horizontal components ΣdQ_x is equal to the rolling resistance force.

Deformation of the soil at a relatively small value

$$dQ_Z = q_0 h B dl \quad (7)$$

here q_o – volume compression coefficient of the soil, q_0 = 1,30 N/sm^3;

h – soil crushing, mm.

at the scheme (Fig. 7) $h = R(\cos\alpha - \cos\alpha_0)$ (8)

here R – the minimum radius of the coil, mm.

$dl = Rd\alpha$ and (7) considering the expression $dQ_Z = q_0 R^2 B(\cos\alpha - \cos\alpha_0)d\alpha$ (8)

Integrating the equation, we get the following expression

$$Q_Z = q_0 R^2 B(\sin\alpha_o - \alpha_0 \cos\alpha_0) \quad (9)$$

$$\sin\alpha_0 = \frac{\sqrt{2Rh_0 - h_0^2}}{R};\ \alpha_0 = \arccos\frac{R-h_0}{R};\ \cos\alpha_0 = \frac{R-h_0}{R}$$

After some changes

$$Q_Z = q_0 R B 2Rh_0 \quad (10)$$

Taking Q_Z = PZ into account, expanding the expression (10) with respect to h_0, we get the following expression.

$$h_0 = \frac{P_z^2}{2q_0^2 \cdot B^2 \cdot R^3}$$

From the analysis of the graph (Fig. 6), it is observed that the depth of immersion increases due to the vertical pressure force added to the coil by the spring, and it decreases due to the increase in the coverage width and radius.

According to the current agrotechnical requirement [7,8.], the deviation of the working tool from the specified depth should not exceed ± 3 cm. In order for the reel to meet agrotechnical requirements, the vertical pressure force should be at least 3 kN, the coverage width should be 70 cm, and the radius should be 8 cm.

CONCLUSION

The device equipped with our research and softeners, recommended by us, will ensure the stable operation of the coils compared to existing devices, reduce fuel consumption by 8-10% and increase the productivity by 2 times.

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