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Design Of Working Bodies Softening High Density Soils

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Abstract. Direct seeding of repeated crops is installed in the chain of working bodies that loosen the soil. The hardness and density of the soil of the directly planted area is 3.5...4 times higher than their standard amount. Therefore, this study is devoted to the choice of working bodies in such conditions, according to the amount of their resistance to gravity.

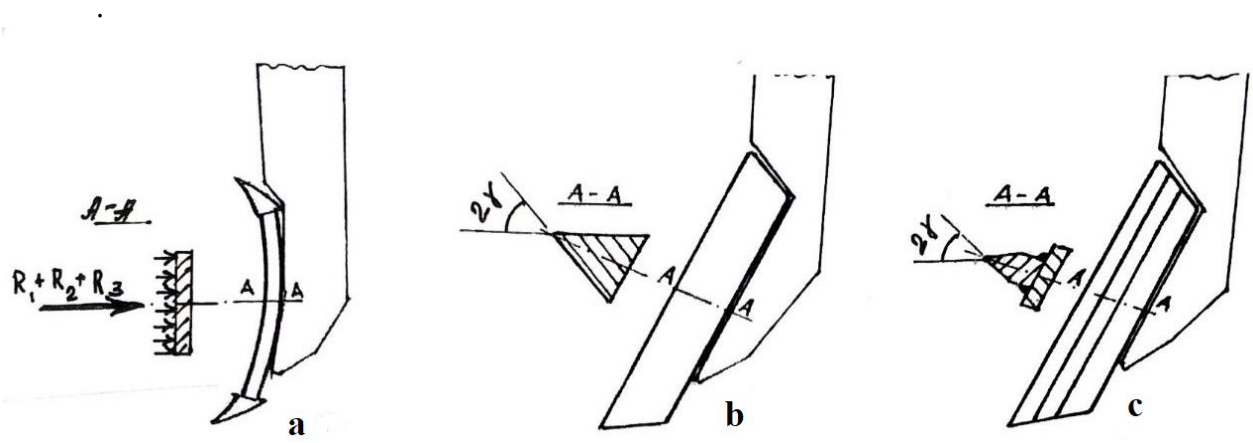
Keywords. Repeat planting, soil hardness, soil moisture and density, working bodies, rotary softener, blade softener, scaffold softener, resistance to traction, working body blade, blade thickness.

Introduction

A seeder that directly sows a repeated crop has been developed, and their trial versions have been prepared [1]. They have four working bodies that interact with the soil, all of which are used to plant a repeat crop after the main crop has been harvested. They are as follows: triangular irrigation ditch receiver, trapezoidal irrigation ditch receiver, softener-seeder and softener-fertilizers.

Softener-seeders and softener-fertilizers both use softeners. The fields they work on are replanted without tillage. It was determined that the hardness and density of cultivated fields without cultivation is 3.5...4 times higher than normal fields, and the humidity is 2...2.5 times less. Therefore, requirements are set for softener bodies, where planters and fertilizers are installed, from the point of view of being able to work in such conditions. Working bodies are selected based on the requirements. The main requirement is their resistance to traction. For this purpose, if there are several working bodies, their resistance to weighting in the same conditions is determined and the results are compared.

The working bodies of three softeners are selected for testing: 1st rotary softener, 2nd needle cooler, 3rd scaffold softener, Picture. 1



a- circulation softener;
b- blade softener (FAP 01896)
c- needle softener,

Picture 1. Softening work bodies.

For testing softeners, the following conditions were adopted relative to the standard condition:

- soil hardness, $T=4\cdot10^6$ Pa;
- soil density, $\rho = 5400$ kg/m^3;
- width of working bodies, b=0,04м;

- depth of movement of the working body, h=0,08m;
- soil moisture W=7…8 % ;
- soil erosion resistance [τ]=6,8•10^4 Pa
- friction angles, $\varphi_1 = 30^0, \varphi_2 = 40^0$

Some sizes are selected based on the characteristics of working bodies. The resistance of the working bodies is determined in the following sequence:

1. Resistance of the rotary working body;
2. The resistance of the working body;
3. Resistance of the scaffolding body.

The resistance of the rotary working body.

A number of studies have been conducted to determine the resistance of the working body. [2,3,4]. From these, we use the expressions that correspond to the studied conditions, that is, the resistance is equal to the sum of four resistances, the scheme of which is tentatively shown in Picture 1a.

$$\Sigma R_1 = R_1 + R_2 + R_3 + R_4 \quad (1)$$

here R_1 – resistance of the softener blade to the soil, N;

R_2 – resistance to soil deformation, N;

R_3 – resistance to lifting of the soil softener along the surface, N;

R_4 – resistance resulting from the inertial force of the rising soil, N.

The operation of the working body is connected with the repeated two-folding, and the inertial force in the rise of the soil to form h_0 for two-fold does not completely reach the crop. There fore, we consider the power to be zero. In this case, the obtained resistances are determined [5,6].

$$R_1 = T \cdot t_{ю} \cdot b, \quad (2)$$

$$R_2 = \frac{[\tau_ч]\left(b + htg\left(\frac{\pi}{4} - \frac{\varphi_1}{2}\right)\right)\left[\sin\frac{1}{2}(\alpha + \varphi_1 + \varphi_2) + f\cos\frac{1}{2}(\alpha - \varphi_1 - \varphi_2)\cos\alpha\right]h}{\cos\frac{1}{2}(\alpha + \varphi_1 + \varphi_2)} \quad (3)$$

$$R_3 = p \cdot b \cdot h \cdot l \cdot g(\alpha + \varphi)(1 + \frac{W}{100}) \quad (4)$$

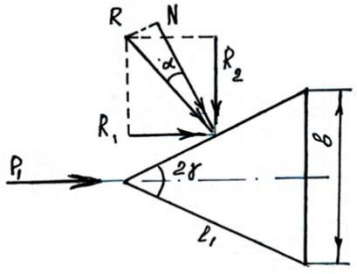
where the thickness of the blade of the $t_{ю}$ softener is 0.001 m, the angle of entry of the working body into the soil, a=39^0 g-acceleration of free fall, f - the coefficient of friction between the soil and the working body, f=0.5

Protected quantities are defined by assigning the values of pre and post-support parameters to the expressions. [8]

ie $R_1 = 160\ N, \quad R_2 = 188{,}2N, R_3 = 9{,}05N.$ here **ΣR= 357,25*N*** was found to be equal to

The resistance of the working body.

The forces acting on the tiller during movement are shown in Picture 2.



Picture 2. Forces acting on the working body of the plow.

The resistance consists of two parts

$$\Sigma R_2 = \mathrm{P}_1 + 2R_1 \qquad (5)$$

here P_1- resistance force acting on the blade, N;

N- normal force acting on the side of the working body N;

R_1 – the force resisting the movement of the working body, N.

The force acting on the blade of the working body is derived from the hardness of the soil and is determined by the following expression [7].

$$\mathrm{P}_1 = T \cdot \delta \cdot b \qquad (6)$$

here T- soil hardness, T= $4 \cdot 10^6$ Па;

δ- blade thickness, 0,001м

b- the width of the body of work, 0,04м.

here $\mathrm{P}_1 = 160\ N$ equal to.

The resistance force R_1 generated by the normal force N resulting from the volumetric crushing of the soil next to the working body is determined by the following expression. [9]

$$R_1 = 2q_{\text{м}} \cdot b \cdot h \cdot l \frac{\sin(\gamma + \varphi)}{sin\alpha \cdot cos\alpha} \qquad (7)$$

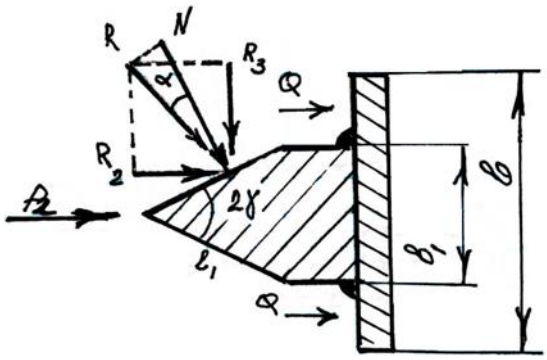
here $q_{\text{м}}$- resistance to volumetric crushing of soil in the state of high hardness

4,5· 10^5Н/м^3. Let's express the determined and accepted quantities $R_1 = 115{,}2N$ was found to be equal to.

here $\boldsymbol{\Sigma R_2 = 160 + 115,2 = 275,2.N}$ ни ташкил этади.organizes.

The resistance of the working body of the scaffolding.

The forces acting on this body during operation are shown in Picture 3**.**



Picture3. Forces acting on the scaffolding body.

The resistance to traction of the scaffolding body is equal to the sum of the following resistance forces.

$$\Sigma R_3 = \mathrm{P}_2 + 2R_2 + 2\mathrm{Q} \qquad (8)$$

here P_2- the force acting on the needle blade, N;

N- the normal force acting on the sides of the acute angle, N;

R_2 – харакатга forces resisting motion, N;

Q- forces of resistance to the deformation of the soil through the flat surface on both sides of the working body, N.

The force P_2 acting on the cutting blade is determined using the expression (5) (but it differs from the expression by the quantities of quantities) i.e.

$$\mathrm{P}_2 = \mathrm{T} \cdot \delta_1 \cdot b_1 \qquad (9)$$

here b_1 - the width, 0,02м.

δ_1- blade thickness, 0,001м.

here $\mathrm{P}_2 = 80N$ га will be equal to The horizontal impact force R_2 is determined using the expression (6) and has the following form [10]

$$R_2 = 2 \cdot q_м \cdot b_1\, h \cdot l_1 \frac{\sin(\gamma + \varphi)}{\sin\alpha \cdot \cos\alpha}$$

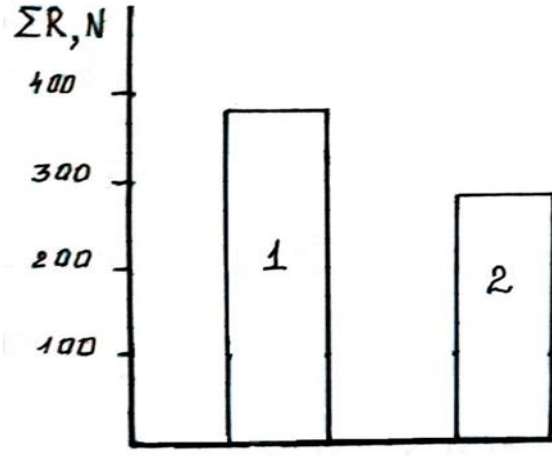
(10)

here l_1 – the length of the side plane of the needle blade 0,02м.

If we put the magnitudes in the expression (9). $R_2 = 57{,}6N$ was found to be equal to A flat surface affects the deformation of the soil. The deformation force is determined by expression (3). This is because the auger softens the soil $[\tau]$normal value of was obtained. [11]

In that case, it was found that is equal to 2q=69.2N. Total resistance of the scaffolding softener $\Sigma R_3 =$ **80+57,6+69,2=206,8 N** formed.

Picture 4 shows the amount of tensile resistance of the three working bodies under the same conditions, i.e., four times higher soil hardness.



1- circulation softener;
2- blade softener,
3- needle softener,

Picture 4. Comparative results of the resistance of working bodies to gravity.

The results showed that under the condition of increased stiffness, the resistance of the rotary claw was the most, and the softener of the scaffold was the least.

Summary.

1. It is advisable to use blade softeners when the physical and mechanical parameters of the soil are in a normal state.
2. The results of both theoretical and logical studies showed that in direct planting of repeated crops, that is, in the case of increased hardness, the efficiency of the scaffolding from working bodies is high.

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