

Determining the Drag Resistance of a Little Little

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Abstract: As a result of studying the designs of existing seed drills, it was found that they are not suitable for sowing grain seeds in rows between cotton rows. Based on this, a new design of the seeder was selected. In order for the seeder to fully and qualitatively fulfill the tasks set before it, its parameters must be justified. This scientific article is devoted to justifying the parameters of the seeder based on its relationship with the soil.

Keywords: Grain seed, seeder, seeder, multi-row sowing, seeder blade, radius of curvature, sharpening angle.

Introduction. Planters of various designs are known for planting seeds of various plants [1, 2]. They are mainly intended for planting seeds in open fields.

In order to select seeders for planting between cotton rows, seeders for planting vegetable and melon crops were also analyzed [3, 4, 5, 6, 7]. As a result, it was concluded that the design and dimensions of seeders intended for open fields are not suitable for use between cotton rows.

Along with the above, planters designed for use between rows of cotton were also studied [8, 9, 10]. Although the design of these planters is adapted to work between rows, they have some shortcomings in performing the tasks assigned to the planters. Taking into account the above data, the design of a planter that sows grain seeds in multiple rows between rows of cotton and performs the task assigned to them qualitatively was selected, Figure 1. Because of the high maneuverability of this planter, it was called a “squirrel”-shaped planter.

Determination of the drag resistance of a wheel . The drag resistance of a wheel is the sum of several resistances, Figure 4. We determine them based on the following studies [11, 12, 14, 15, 16, 17], i.e.

$$R_s = T + 2P_1 + 2F_1 \quad (1)$$

Here T is the force, N, resisting the penetration of the blade into the soil during the movement of the auger;

This force was determined by the following expression [13]

$$T = 2q_m \delta \cdot h_o (ctg\beta^1 \cdot tg\varphi_T + 1) \quad (2)$$

Here q_m is the resistance of the soil to volumetric compression, N/m^3 ;

δ – blade thickness, m;

h_o – planting depth, m;

φ_T – friction angle, degrees;

β^1 – blade sharpening angle, grad.

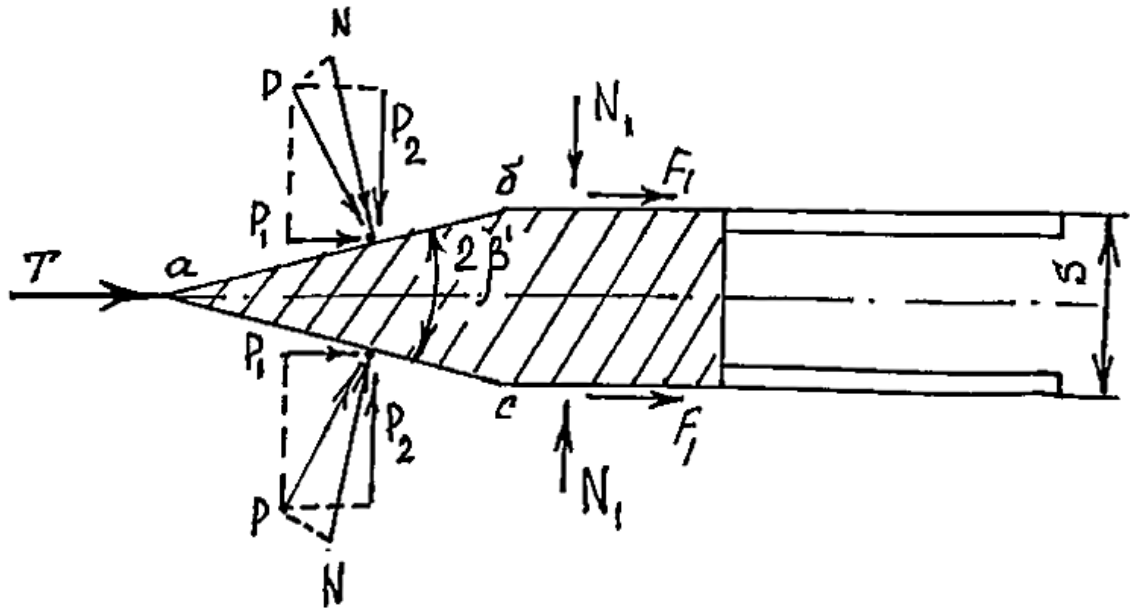


Figure 4. Forces resisting the motion of the two

During the movement, the necks of the axle (ab and as) are acted upon by the normal force N resulting from the crushing of the soil. This results in a force R , the horizontal component of which, R_1 , resists the movement. Its value is determined by the following expression.

$$P_1 = N \frac{\sin(\beta^1 + \varphi_T)}{\cos\varphi} \quad (3)$$

The normal force N acting on the blade neck should be determined taking into account the speed of the aggregate depending on the coefficient of resistance to volumetric compaction of the soil q_v [18]. However, since the shear strength of the coulter is high, its sides do not lead to the occurrence of volumetric compaction of the soil. They only slightly compress the soil in both directions by the coulter necks, opening the way for the coulter to pass. Therefore, based on the condition that the force N due to the pressure of the soil on the coulter necks is the result of the compressive resistance σ_c , we accept the following expression, i.e.

$$N = \sigma_c \cdot 0,5S L_{muz} \quad (4)$$

Here S is the thickness of the shell, m;

L_{muz} – the length of the tig at a distance of h_o from the two poles, m.

σ_c – the resistance of the soil to compression at the point of contact with the planter's neck, N/m^2

Taking into account the magnitude of the radius of curvature of the curve, we conditionally accept it as a straight line. In this case,

$$L_{muz} = \frac{h_o}{\sin \alpha} \quad (5)$$

Taking into account expressions (15) and (14), expression (13) can be written as follows

$$P_1 = \sigma_c \cdot 0,5 \cdot S \cdot \frac{h_o}{\sin \alpha} \cdot \frac{\sin(\beta^1 + \varphi_T)}{\cos \varphi} \quad (6)$$

Since the soil is compressed by the neck of the ploughshare, this compression also continues on its sides. As a result, pressure is created on the side of the ploughshare, the normal force N_1 of which is equal to:

$$N_1 = \sigma_c \cdot S_{\ddot{e}H} \quad \text{or } S_{side} = h_o \cdot L, m^2 \quad (7)$$

Here: S is the area of the side of the second side, m^2 .

L – length of the two-piece, m.

In that case

$$N_1 = \sigma_c \cdot h_o \cdot L \quad (8)$$

The friction force that produces this force on the side of the wheel is:

$$F_1 = f_1 \cdot \sigma_c \cdot h_o \cdot L \quad (9)$$

When we substitute the obtained expressions (11), (17), and (20) into expression (11), we obtain the expression for the drag resistance of both.

$$R_s = 2q_m \delta \cdot h_o (ctg \beta^1 \cdot tg \varphi_T + 1) + 2\sigma_c \cdot 0,5 \cdot S \frac{h_o}{\sin \alpha} \frac{\sin(\beta^1 + \varphi_T)}{\cos \varphi} + f \cdot \sigma_c \cdot h_o \cdot L \quad (10)$$

Substituting the following quantities into this expression: $q_m = 45000 \text{ n/m}^2$, $\delta = 0.001 \text{ m}$, $h_o = 0.04$, $\varphi_t = 30^\circ$, $\beta^1 = 20^\circ$, $\sigma_s = 750 \text{ N/m}^2$, $S = 0.11 \text{ m}$, $\alpha = 30^\circ$, $\varphi = 30^\circ$, $L = 0.2 \text{ m}$, $f = 0.7$, we find that the drag resistance of the seeder is 13.78 N.

Conclusion.

1. It was determined that the parameters of the seeder, namely the angle of immersion of the blade in the soil $\alpha > 120^\circ$, the radius of curvature $R = 28.5 \text{ cm}$, and the sharpening angle of the nozzle blade is 2 It was assumed that $\beta^1 = 34^\circ \dots 50^\circ$.
2. Considering that the self-weight force ($Q_e = 3.2 \text{ N}$) is less than the required force ($R_s = 25 \text{ N}$) when lowering the seeder to the planting depth, it was found that it is advisable to use the weight of the seeder section as an additional force.
3. The drag resistance of the two blades was determined to be 13.78 N, and it is appropriate to compare this value with the results obtained based on experimental studies.

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