Comb-forming roller with elastic rods

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Abstract. A design diagram of comb formation roller in resilient stems is given. Comb-forming roller consists of support and small discs, as well as elastic rods. Elastic rods are installed along the perimeter of the diameter of the disks through their holes. Analytical dependences and mathematical models are obtained for determining the distance between disks, the diameter of disks, the diameter, length and number of elastic rods. One-factor experiments were carried out to substantiate the diameter of the disks and the number of rods. It was found that with the length of the elastic rods of the comb-forming roller 65-75 cm, the diameters of large, medium and small discs, respectively, at least 600mm, 550 mm and 200 mm, the angle of sharpening of the discs within 55-650, the issue of stems within 64 - 69 trimming and diameter bars 3 mm, intensive defeat of chunk and high-quality creation of ridges is ensured.

1 Introduction

Comb-forming rollers are widely used to form ridges and prepare them for sowing. Scientists and researchers have developed various designs of ridge-forming rollers. These include a comb-forming roller in the form of spherical disks, a comb-forming roller made in the form of a spiral representing the surface of a ball segment, a rotary cordless working organ for processing combs, a slatted rotary-reactive working organ and others. These devices do not sufficiently crush lumps and poorly form ridges when prepare ourselves for cotton seed. Studies on development ridge-forming rollers and the validity their setting and the research the handling of interaction operating parts the conducted Z. Batirov [1-3, 5], A. R Norchaev [4], Kiyamov [6, 7], T. Razzakov [1, 6], F. Mamatov [8, 10-16, 20, 21, 23-30], K. Ravshanov [11, 18], N. Rashidov [11, 19], B. Mirzaev [8-12, 19-22, 24-26], I. Ismailov [15, 27], U. Kodirov [28, 30], and others. As though, research include not considered the problem of justifying indicator comb formation rollers with elasticity wire rods.

2 Materials and methods

Comb-forming roller (Figure 1) consists of the following components: two disks 1 are mounted on the steel axis 4 with the help of a sleeve 3, which are welded into the hole of the disks.

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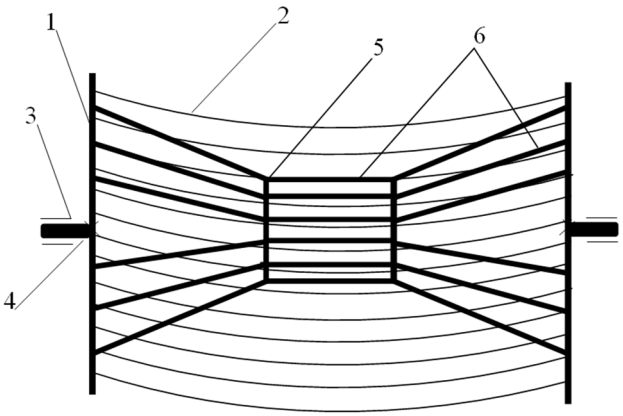


Fig. 1. The scheme of the comb-forming roller for the preparation of the comb: 1 – support discs; 2 – elastic bars; 3 – bushing; 4 – axis; 5 – small discs; 6 – rigid bars.

In the middle, at a certain distance, two small disks 5 are installed symmetrically to each other, freely located relative to the axis. Small disks are connected to each other and large disks by a welded joint using rigid rods 6, while between small and large disks rigid rods are welded, forming the shape of a truncated cone. Elastic bars 2 are passed through the holes along the perimeter of the D_{ok} diameter.

During the movement of the comb-forming roller, the discs are immersed in the lateral parts of the ridge to a certain depth, while the elastic rods are also immersed in the ridge layer. Elastic rods installed along the rim of the disk, during rotational movement along the ridge, crush the soil lumps and completely loosen it along the entire perimeter of the ridge section, i.e. its top and slope.

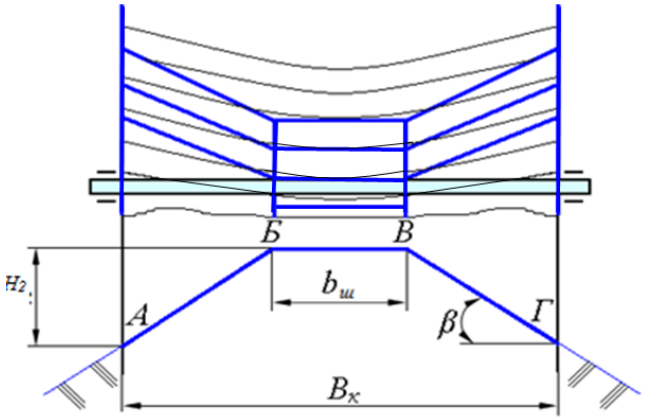


Fig. 2. Chart for stipulate length elastic rods.

The main parameters of the ridge-forming roller include the following: $B_к$ – the distance between the discs, m; b_t – the thickness of the disc, m; γ – the angle of sharpening of the support discs, deg; D_{cp} – the diameter of the middle part, m; $D_{ок}$ – diameter of the disc, along the circumference of which the elasticity rods are arranged, m; D_d –largest diameter disc, m; L_n – length of bars, m; n – number of elastic bars, pcs; d_n – diameter of elastic bars, m.

According to the scheme shown in Figure 3, the length of the L_n elastic bars comb definable from the further formula

$$L_n = b_{sh} + [2H_3]/\sin\beta. \quad (1)$$

Substituting the value β by expression (1) we have

$$L_n = b_{sh} + [2H_3] / \{\sin arcctg \frac{b_{sh}}{H_{gr} \sin[b_{sh}]\pi}\}. \quad (2)$$

From this expression it can be seen that the length of the elastic bars is influenced by consecutive interval, the height of processed part ridge H3 (Figure 2).

At B_M=90 cm, b_g=16 cm, H_3=22-25 cm according to expression (2), the length roller is L_n = 65-70 cm.

Comb-forming roller is characterized subsequent parameters (Figure 2): the middle part D_{cp}, outer diameter D_d, the diameter $D_{ок}$, along the perimeter of which elastic bars are located on the disc, and the small diameter D_m, b_t the thickness of the discs and L_k the length of the rigid bars installed at an angle to the horizontal axis of the rink.

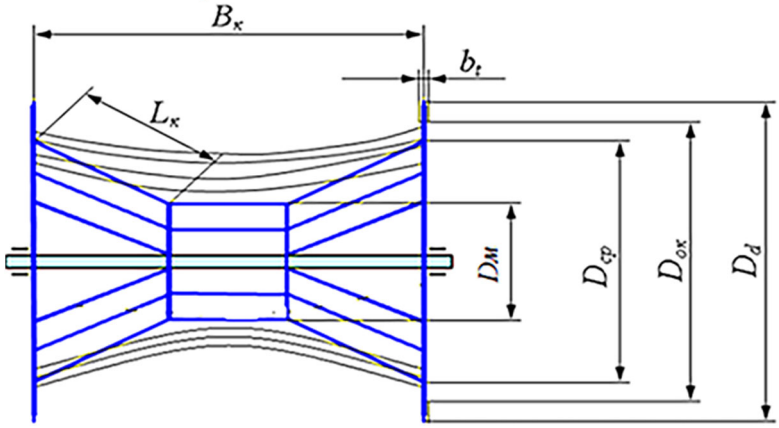


Fig. 3. Schema for set the diameters roller-combing machine.

First, we determine the diameter of the middle part of the ridge-forming roller interacting with the ridge. We determine this diameter from the condition of easy rolling of the elastic bars of the roller along the lumps located on the surface of the ridge, i.e. at the same time, due to the specific pressure of the elastic bars on the lumps, they are destroyed. It is known [4] that diameter middle part roller is determined by the following formula

$$D_{cp} \geq hctg^2 \frac{\varphi_1 + \varphi_2}{2}, \quad (3)$$

where h – is the overall size of the lump, cm; φ_1, φ_2 – are perspective of dispute lump on the rod and the soil [4].

According to Figure 3, the diameter of the circle D_{ok} is determined by the following formula [5, 6, 8]

$$D_{ok} \geq hctg^2 \frac{\varphi_1 + \varphi_2}{2} + \frac{0{,}5(B_k - b_{uu})}{ctg\beta}. \quad (4)$$

The diameter disc is definable by the pursue formul

$$D_o \geq hctg^2 \frac{\varphi_1 + \varphi_2}{2} + \frac{0{,}5(B_k - b_{uu})}{ctg\beta} + 2h_{nep}, \quad (5)$$

where h_{nep} – thickness of submersion disks, determined experimentally, mm.

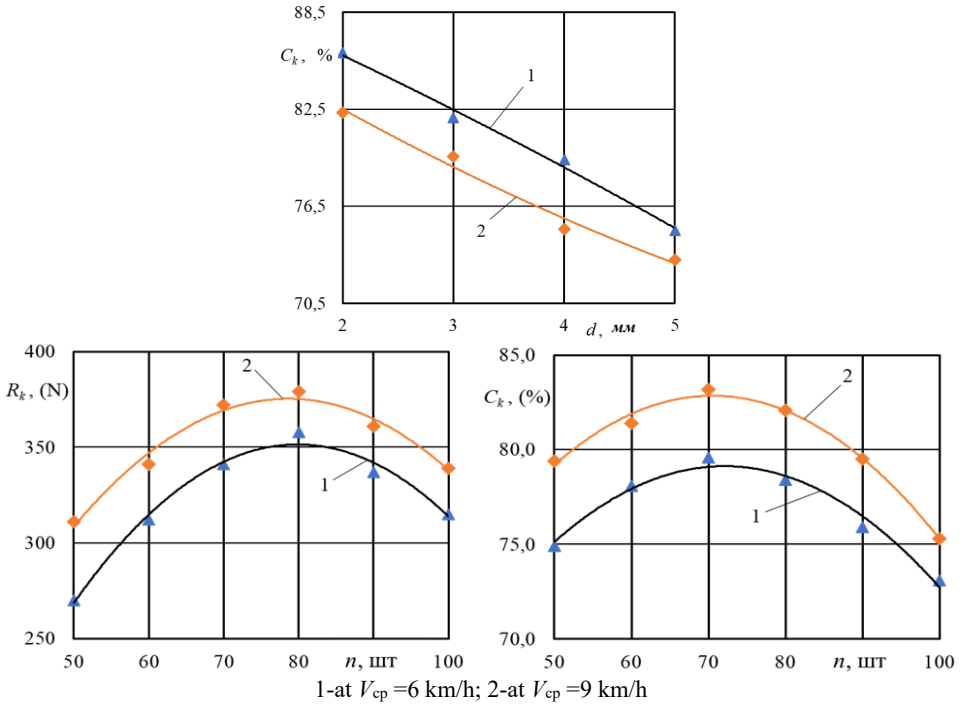
From the analysis of expressions (4) and (5) it follows that the diameters D_{cp}, D_{ok} and D_o depend on the width of the V_c, the size of the lumps h, their angles of external and internal friction φ_1, φ_2 the width of the top crest b_s and corner of slope its slopes to the horizon φ_g.

When φ_1=30°, φ_2=40° h=100 mm, b_{sh}=160 mm, H_g=270 mm and φ_g=40°, h_{pgr}=100 mm and also substituting the above value of B to expressions (4) and (5), we get that D_m=200 mm D_{ok} =550 mm.

3 Results and discussion

To determine changes in quality energy performance roller-combing machine depending on the parameters of its working bodies experimental studies were conducted.

The graph (Figure 4) display that increasing and diameter elastic rods, degree their destruction decreases, the reason for this is a decrease in the time of impact of elastic rods on soil lumps and a decrease in their specific pressure



1-at V_{cp} =6 km/h; 2-at V_{cp} =9 km/h

Fig. 4. Diagram dependences degree destruction of lumps, tractive stability (R_k) on diameter and number of elastic rods of the comb-forming roller.

The effect of the roller of extermination of ground clods be express by further experiential formul:

speed V_{cr}= 6 km/h

$$C = 0{,}1\ d^2 - 2{,}86\ d + 91{,}96; \qquad R^2 = 0{,}992; \tag{7}$$

at speed V_{cp} =9 km/h

$$C = 0{,}2\ d^2 - 4{,}58\ d + 90{,}88; \qquad R^2 = 0{,}9813. \tag{8}$$

To provide the desired quality assurance of activity with minimum possible power intake, diameter elastic bars 0.003 m.

From the results obtained (Figure 4) elastic bars of roller-comb-forming machine from 50 to 70 pcs, the traction resistance of destruction increasing in accordance law of the parabol, starting from 70 pcs, the traction resistance and the degree of destruction decreases, explainable by the reality that an growth elastic bars, roller-comb-forming machine gradually

passes into a solid roller with a cylindrical surface and at the same time the roller is displaced from the soil layer and compacts only the surface of the ridge. From the above data it can be seen that in order to ensure the required traction resistance and the hail of collapse soil mixs with minimum possible expense, number elastic rods comb-forming roller 65 to 70 pcs.

4 Conclusions

A comb-forming roller is proposed to prepare the combs for sowing cotton. Analytical dependences and mathematical models are obtained for determining the distance between disks, the diameter of disks, the diameter, length and number of elastic rods. It was found that with the length of the elastic rods of the comb-forming roller 65-75 cm, large, medium and small diameters, respectively, at least 600mm, 550 mm and 200mm, the angle of sharpening of the discs within 55-65º, the serial of wire rod within 64 -69 fragment and diameter rods 3 mm, good-quality registration combs cotton is secured.

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