Roller-combing machine for preparation of combs

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Abstract. In southern zone of cotton growing with insufficient moisture, one of the leading places is occupied by develop tools which simultaneously execute the technology trial of forming ridges and prepare them to display cotton. The purpose of research confirms design and the width gripper roller with elastic stems. Constructive scheme of the comb-maker with the roller-comb-makers is given. The proposed design scheme of the machine includes sequentially installed comb-makers and rollers-comb-makers. Analytic dependencies and mathematic patterns were obtained to define the width gripping roller of comb-forming machine. Theoretical and experimental studies have established that to ensure that the soil is prepared for sowing cotton on the ridges with minimum power consumption, width the gripping roller of the comb-forming machine should be at least 60 cm.

1 Introduction

To date, number investigate had been conducted aimed at creation and formation machines and their working bodies for the forming of rib with concurrent preparation for sowing, justification of technological processes and parameters. Studies on the development and application of ridge-forming rollers and the rationale of options and study the trial of cooperation working parts in the soil conducted by Z. Batirov [1-3], R. Norchaev [4], A. Kiyamov [6, 7], T. Razzakov [3, 7], F. Mamatov [3, 8, 10, 12, 13, 15, 19-24, 27-30], N. Aldoshin [7, 12, 24, 30], B. Mirzaev [20, 21, 23], H. Ravshanov [24], S. Gapparov [25], on the development and application of ridge-forming rollers. Nevertheless, these explore has not quite studied problems developing comb-forming roller with elastic stems mounted a comb-making machine, which provides good quality preparation ridges to cotton crop. Regard, particular attention repaid development comb-forming roller with elastic rods, which processes combs formed by comb-makers, as well as the justification of its technological process and parameters.

2 Materials and methods

Developed comb-making machine with a comb-forming roller consists of a frame, five comb-making machines, a comb-forming roller, processing, respectively, the slopes and tops of the

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ridges to a depth of 9-15 cm. The comb-making machines of the developed tool are mounted rigidly on the frame, and the comb-forming rollers are pivotally, by means of traction.

The working process of the developed comb-forming roller for the preparation of ridges is as follows: 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, grinds soil lumps and completely loosen it along the entire perimeter of the ridge section, that is, its top and slope.

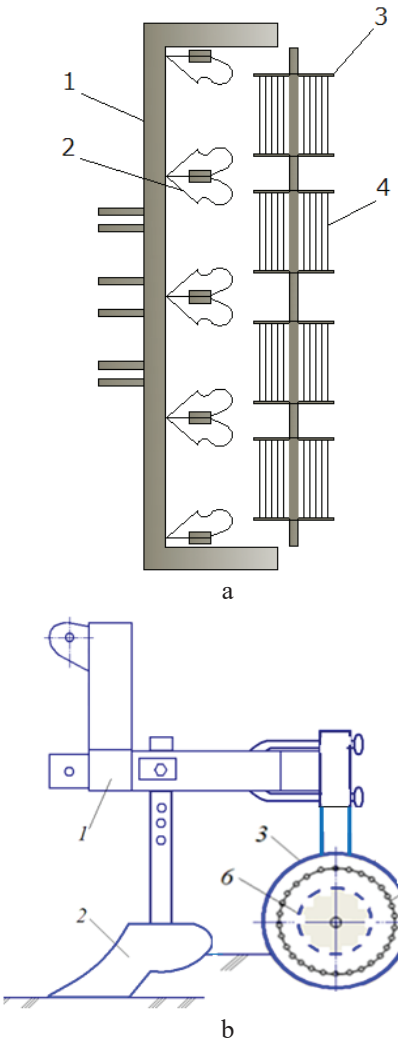


Fig. 1. The scheme of the comb-maker with a roller-comb-maker: *a* – top view, *b* – side view 1 – frame; 2 – comb-maker; 3 and 6 – discs; 4-5 – elastic rods.

The width of the B_k (Figure 3) of the comb-forming roller is determined depending on the height of the comb surface being processed. At the same time, based on numerous studies [11, 17], we accept that the external shape of the ridge irregularities at a given row spacing width differ slightly and are described as a sine wave

$$Y = h_{cp} \sin(x \pm e), \tag{1}$$

where h_{cp} – is the amplitude of the sinusoid, depending on the depth of the irrigation furrows; H_{cp} – is the average ordinate of the field irregularities; e – stage change of sinusoid; x – is change in abscissa of the sinusoidal.

It is known that to the high part is h ridge crest should be 160-170 mm. In the process of sowing, the tops of the ridges are cut off, after that the ridge profile takes the form of an isosceles trapezoid (Figure 3).

From Figure 3 we determine the height of the aligned part of the ridge

$$H_1 = H_{gr} - H_3. \tag{2}$$

Then the height of the ridge H_3 after alignment will be equal to

$$Y_3 = H_3 = H_{gr} \sin \frac{b_s \pi}{B_M}. \tag{3}$$

From Figure 3 we have

$$AB = b_s \tag{4}$$

where B_M – is the width of the aisle

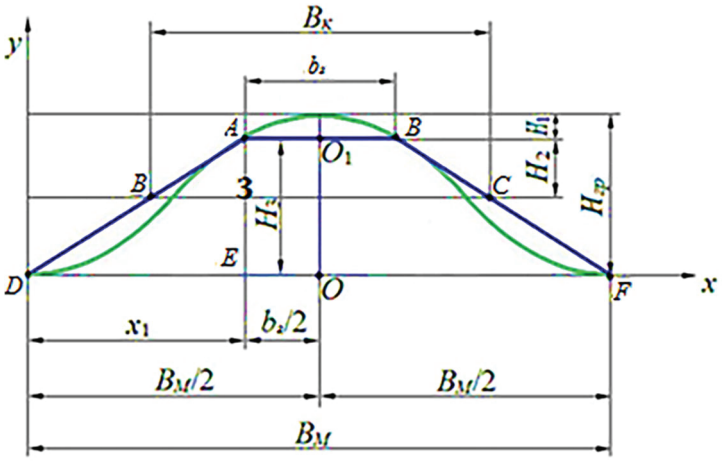


Fig. 2. Circuit determination width of grip of B_k comb-forming roller.

Substitute the worth of b_i by express (4) to express (3) have

$$H_3 = H_{gr} \sin\{b_s \frac{\pi}{B_M}\}. \tag{5}$$

To simplify calculations for determining the width of the processed part of the ridge with a roller-comb-forming machine, we take the section of the ridge in the form of a trapezoid. Considering that the roller processes the upper part of the ridge to a height of H_2 from the *ABDE* trapezoid (Figure 3), we find

$$B_k = b_s + 2B3 = b_s + 2H_2 ctg\beta. \tag{6}$$

From Figure 3 we have

$$ctg\beta = \frac{x_1}{AE} = \frac{x_1}{H_3}. \tag{7}$$

Substituting the values of x_1 and H_3 by expressions (4) and (5) into expression (7) we have

$$ctg\beta = \frac{b_s}{H_{gr}\sin[(b_s / B_m]\pi}, \quad (8)$$

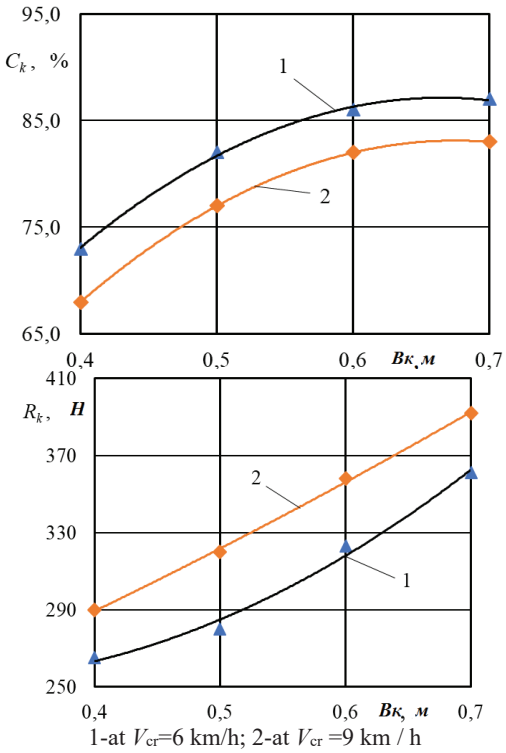
then

$$B_k = b_s + 2H_2 \frac{b_s}{H_{gr}\sin[b_s / B_M]\pi}. \quad (9)$$

When B_M=90 cm, b_s=16cm, H_2=12-15cm according to expression (9), the width of the gripper roller is B_k=50-60 cm.

3 Results and discussion

In instruction to determine changes in quality energy performance comb-forming roller depending on its width of capture, testing studies were performed. Experiments, width grip the comb-forming roller was changed from 0.4 to 0.7 m every 0.1 m, the movement speeds were in the range of 6-9 km/h.



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

Fig. 3. Graphs the dependences extent damage of land lumps and traction resistance width gripper roller.

Graphs that with increasing speed of movement and the width of grip ridge-forming roller, the extent of extermination of land lumps increasing with entire width its grip (Figure 4). With a machine rate 6 km / h, grip width 0.4; 0.5; 0.6; and 0.7 m comb formation roller, the extent of collapse was 73; 82; 86 and 87%, respectively, and with a speed of 9 km/h, 70;

77; 81 and 84%, respectively. The reason for the increase in lumps is increase in width grip of the ridge formation roller. The rate of motion and the width of gripper roller can be further followed by the following experiential formula given below:

– the speed movement V_{cr} =6 km/h

$$R_m = -200n^2 + 266\,n - 1{,}3;\ R_I = 0{,}9984; \quad (10)$$

– at the speed of movement V_{cr} =9 km/h

$$R_m = -200\,n^2 + 270\,n - 8;\ R_I = 0{,}999. \quad (11)$$

In the range of operating speeds from 6 to 9 km/h, was in range 83%-74%.

According to the method described above, strain measurement was carried out for the energy evaluation of the developed ridge-forming roller. Figure 3 shows the results of the data obtained from the study of dependency traction force comb-forming roller speed movement of machine with a vertical load Q_v=0,9 kN and the width of the device B=0,4; 0,5; 0,6 и 0,7 м. The change in roller was made in the range of 6-9 km/h.

From the graphs the width grip, traction resistance the ridge-forming roller increases according to the law parabola. Machine operating speed 6 km / h grip width 0.4; 0.5; 0.6 and 0.7 m, the traction resistance of the comb-forming roller was 276; 280; 323 and 361 N, respectively, and at a speed of 9 km/h, respectively, 290; 320; 358 and 392 N.

The reason for the ridge-forming roller speed movement and width of the grip is mainly an increase in the inertia force of the volume of the cultivated soil. The impact of performance motion and width grip on the traction resistance of the comb-forming roller may be express by next experiential formul given below:

the width the grip B=0,6 m and V_{cr}=6 km/h

$$R_m = 575\,B^2 - 301{,}5\,B + 291{,}95; \qquad R_I = 0{,}9904; \quad (12)$$

at the width of the grip B=0,6 m and V_{cr}=9 km/h

$$R_m = 100\,B^2 + 234\,B + 179{,}8; \qquad R_I = 0{,}9988. \quad (13)$$

4 Conclusions

The proposed design scheme of the machine includes sequentially installed comb-makers and comb-forming rollers, which carry out good quality preparing of manifold for cotton. Based on research, analytical dependencies mathematic model obtained to stipulate width gripping roller-comb-forming device. It is existing in order to guarantee preparing of land for crops cotton crest minimum power expense, width the grip comb-forming roller must be at least 60 cm.

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