

Parameters of the comb-forming machine with elastic rods

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Abstract. The study aims to substantiate the design and parameters of the comb-forming device with elastic rods. The basic principles and methods of classical mechanics, mathematical analysis and statistics were used in this study. The authors proposed a comb-forming machine with elastic rods for sowing cotton on the combs. The main parameters of the comb-forming machine with elastic rods and the amount of vertical load on the working body are justified by experimental studies. It is established that with a diameter of 3 mm elastic rod, the number of elastic rods 64 pieces, a radius of 0.3 m disks and a width of 0.60 m device capture provides high-quality destruction of soil lumps and the formation of ridges of the required shape.

1 Introduction

In Uzbekistan, special attention is paid to the introduction of science, technology and best agriculture practices. To increase the productivity and sustainability of agriculture, technologies and technical means of tillage [1-18], sowing [19-20] and harvesting [21-26] of agricultural crops and their primary processing [27-33] have been developed and improved. An important reserve for increasing crop yields is creating optimal soil conditions for the development of the root system of plants [5-7, 19-20]. With the development of science and technology, scientists have developed many technological methods of cultivating agricultural crops. In the regions of our republic, the sown areas are mainly occupied for the cultivation of cotton. Usually, cotton is sown on flat prepared surfaces, but cotton seeds are sown on the upper part of the bed in some regions of the republic. Of course, for this, it is necessary to prepare this bed following the agrotechnical requirements. When forming beds with hills, beds with different sizes of lumps are formed. As a result, large lumps are formed that do not meet the agrotechnical requirements. These lumps negatively affect the germination of seedlings, the preservation of moisture and the uniformity of sowing. To solve this problem, the authors have developed many variants of designs. After studying the cause of the appearance of solid soil lumps of large sizes and analyzing the designs of the working bodies of machines for pre-sowing treatment created earlier by the authors, we developed a herb-forming device whose main working bodies are

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elastic rods (a cable with a 3 mm diameter). In studying the design, special attention is paid to the dependence of the traction resistance on the speed of movement, vertical load and coverage width. These dependencies seriously affect the result of obtaining a high energy effect.

The study aims to substantiate the design and parameters of the comb-forming device with elastic rods.

2 Methods

The basic principles and methods of classical mechanics, mathematical analysis and statistics were used in this study. We have developed a working body with elastic rods (Fig.1) and the comb-maker (fig.2) as an elastic bar; we adopted a steel rope of the spiral type TC with diameters of 3, 4 and 5 mm, made of high-carbon cold-stretched wire with a tensile strength of 170-220 MPa. During the experiments, a device was used with a gripping width of 0.6 m, the diameter of the disks on which the elastic bars are located, 0.5 m, and the diameter of the clump-breaking roller of 0.6 m.



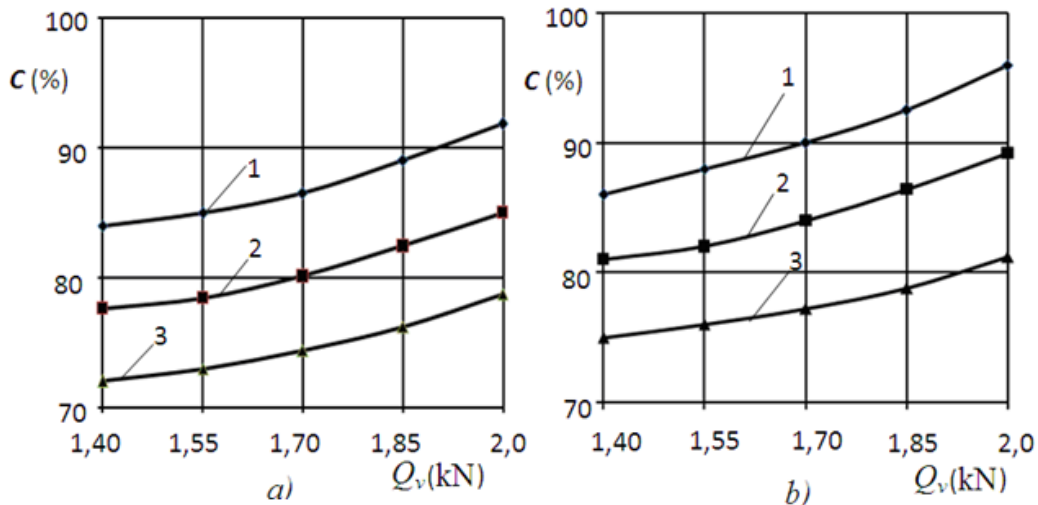
Fig. 1. General view of the working body of the comb-forming machine with elastic rods



Fig. 2. Working process of the comb maker

3 Results and Discussion

In experimental studies, the influence of the load of the comb-forming agent on the degree of destruction of soil lumps of a cotton bed was studied. The results of the studies are shown in Fig. 3. The experiments were carried out at different humidity of the lumps: 9-10 %, 13-14% and 16-17%. The speed of the installation was 1.0 m/s. The analysis of the obtained data shows that with an increase in the vertical load on the working body, the degree of destruction of soil lumps increases, and with an increase in the diameter of elastic rods and a decrease in the humidity of soil lumps, the degree of destruction decreases.



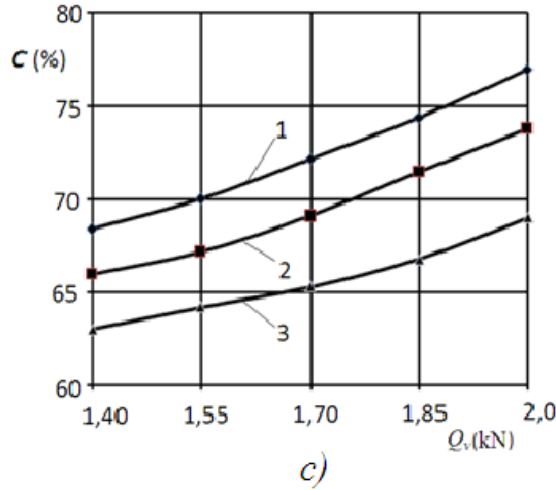


Fig. 3. The dependence of the degree of destruction of soil clumps on the vertical load and the diameter of the elastic bars of the comb-forming machine: a) $W=16-17\%$; b) $W=13-14\%$; c) $W=9-10\%$: 1, 2, 3 are, respectively, the diameters of the elastic bars of 3, 4 and 5 mm

Thus, at a vertical load of 1400 N, the degree of destruction of soil lumps with a moisture content of 16-17% with elastic rods of 3, 4 and 5 mm, respectively, was 86.6, 81.5, 75.1 %, and at a vertical load of 2000 N-94.4, 89.2, 81.2%, respectively. At the same loads, the degree of destruction of lumps with a humidity of 13-14 %, respectively, was 84,1, 77,6, 72,3, 91,8, 85, 78,7 %, and with a humidity of 9-10 %, respectively 68,2, 66,4 63,1, 77,0, 73,8, 68,9 %. The influence of the load on the degree of destruction of soil lumps can be expressed by the following empirical formulas:

at a humidity of $W=16-17\%$ and a diameter of elastic bars of 3 mm, 4 mm, 5 mm

$$C = 0,002Q_v^2 + 0,03Q_v + 84,08, R^2 = 0.9894; \quad (1)$$

$$C = 0,002Q_v^2 - 0,1063Q_v + 81,15, R^2 = 0.9855; \quad (2)$$

$$C = 0,002Q_v^2 - 0,099Q_v + 75,73, R^2 = 0.9985; \quad (3)$$

at a humidity of $W=13-14\%$ and a diameter of elastic bars of 3 mm, 4 mm, 5 mm

$$C = 0,003Q_v^2 - 0,165Q_v + 85,76, R^2 = 0.9901; \quad (4)$$

$$C = 0,003Q_v^2 - 0,142Q_v + 78,83, R^2 = 0.9913; \quad (5)$$

$$C = 0,002Q_v^2 - 0,101Q_v + 72,59, R^2 = 0.9980; \quad (6)$$

at a humidity of $W=9-10\%$ and a diameter of elastic bars of 3 mm, 4 mm, 5 mm

$$C = 0,001Q_v^2 + 0,058Q_v + 64,55, R^2 = 0.9907; \quad (7)$$

$$C = 0,001Q_v^2 - 0,013Q_v + 64,02, R^2 = 0.9984; \quad (8)$$

$$C = 0,001Q_v^2 - 0,042Q_v + 62,47, R^2 = 0.997. \quad (9)$$

The obtained data show that the greatest degree of destruction of soil lumps is provided by elastic rods with a 3.0-4.0 mm diameter, and it is about 80-95%.

We have studied the influence of the speed of movement on the degree of destruction of soil lumps. The results of the experiments are shown in Fig.4. During the experiments, the number of elastic rods was 64 pieces, the radius of the disks $R=0.3$ m, the width of the device - 0.60 m.

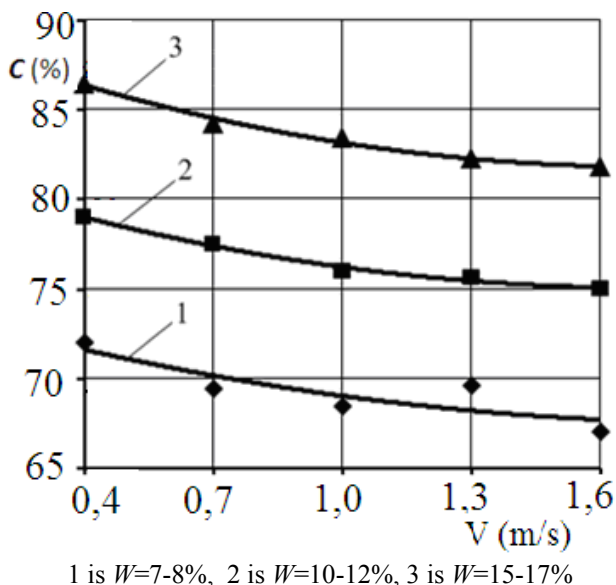


Fig. 4. Dependence of the degree of destruction of soil lumps on the speed of movement of the comb-forming machine

From the graphs, it can be seen that with an increase in the speed of movement, with all the humidity of the soil lumps, the degree of their destruction decreases. Thus, at a speed of 0.4 m/s and soil moisture of 7-8, 10-12, 15-17%, the degree of destruction of soil clumps of the comb-forming agent was 72.4, 79.2, 86%, respectively, and at a speed of 1.6 m/s is 67.1, 75.6, 82.3%, respectively.

This is mainly due to the reduction of the impact time of the elastic rods on the clumps of soil. The degree of destruction of soil clumps at different speeds of the experimental comb-forming machine varies between 67-86 %.

Thus, the research results allow us to conclude that the use of an experimental comb-forming agent provides sufficient destruction of soil lumps.

4 Conclusions

1. For the high-quality preparation of combs for sowing cotton, the qualitative destruction of soil lumps and loosening of the bed's soil is of exceptional importance, which can be ensured by the use of a comb-forming agent with elastic rods.
2. It is established that the rational parameters of the comb-forming device are the diameter of the elastic bar 3 mm, the number of elastic bars 64 pieces, the radius of the disks 0.3 m, the width of the device's girth 0.60 m.

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