The working organ of the cultivator KPS – 4 with a needle disk for weed control

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Abstract. Weed control is an important technological operation in the cultivation of all types of agricultural crops, especially row crops, vegetables and grains. Since weeds have an increased ability to grow and develop at low temperatures in early agrotechnical terms. Then the fight against them in the preparation of the soil before sowing is a necessary condition for maintaining moisture and obtaining consistently high crop yields. When carrying out agrotechnical measures aimed at weed control, cultivators for continuous tillage are used, which are used for tillage before sowing and when caring for fallows. But when cultivating, the cut weeds overhang on the rack of the working body of the cultivator. This violates the agrotechnical requirements for tillage and reduces the productivity of the unit during cultivation. To eliminate these shortcomings, a device has been developed that provides protection for the cultivator leg rack from overhanging cut weeds during cultivation. The created working body can be installed on the existing frame structure of the steam cultivator without its modification. The operation of a steam cultivator with an improved working body allows you to increase the productivity of work on cultivation by 15%.

1 Introduction

A complex of agrotechnical measures aimed at weed control is part of the technological process of crop production. For the extermination of weeds, chemical, biological and mechanical methods are used. The destruction of weeds using a mechanical method is carried out by steam cultivators equipped with a working body with a lancet share [1-2].

When preparing the soil for sowing in the early agrotechnical terms, the mechanical method of weed control is more effective because at the same time the soil is leveled and loosened, and moisture is closed. But surface tillage with the use of tilled cultivators in fields with increased weediness often leads to violation of agrotechnical requirements [5-6]. The operation of the unit with tractors of increased power, at high speeds, raises the wet layer to the surface, without providing the required row size and depth of tillage. When the unit is moving at high speed, cut weeds do not have time to be thrown aside and stick together with the soil on the rack of the working body, reducing the quality of the...
cultivation process. Operation in such conditions leads to an increase in traction resistance and long downtime of the unit for cleaning the working bodies [3-4].

One of the directions for improving the agro-economic indicators of surface tillage is the improvement of existing designs of cultivators and working bodies for them, through the use of mechanisms that prevent the overhang of cut weeds during cultivation on the working body.

2 Materials and methods

The technological process of the working body of the cultivator implies direct contact with weeds. When studying the design of a self-cleaning working body of a steam cultivator, a comprehensive study and study of the morphological and biological properties of weeds and their effect on crop yields should be carried out [7-9]. These studies will allow assessing the possibilities and ways of finding a technical solution to achieve the goal. Which will be carried out on the basis of the created experimental research program containing the following items:

- Creation of a plan for conducting experiments.
- Use the parameters of weeds available in the experimental field to determine the size and mass characteristics.
- To determine the coefficients of friction of the root system of weeds on the working surface of the lancet paw.
- Assess the degree of influence of soil moisture on the quality of cutting weeds by the working body.
- To determine the optimal angle of installation of the needle disk in front of the rack.

In the course of the research work, modern measuring and recording complexes were used.

3 Results and Discussion

We have improved the working body of the cultivator (Figure 1) for continuous tillage and fallow care, which is mounted on the existing design of the cultivator [10].

Fig. 1. The working body of the cultivator of improved design.
The cultivator, equipped with a working body of a new design, works as follows. Lance share 2 mounted on stand 1 cuts the soil layer to the depth "h" specified by agrotechnical requirements. When the working body of the cultivator moves, the roots of cut weeds and other plant residues hang on a rack located above the soil surface. To protect the paw stand from hanging cut plants, a needle disk 7 is installed in front of the stand, at an angle of attack α (Figure 2) to the direction of movement V.

![Figure 2. The location of the needle disk on the rack.](image)

Disc 7, in contact with the soil, begins to rotate, providing loosening of the top layer of soil, as well as cutting weeds located in the zone of movement of the rack 1. When the needle disc 7 moves, a protective strip of cultivated soil with a width "a" (Figure 3) without weeds is formed, loosened on depth "b" in front of the post.

![Figure 3. Needle disc treatment zone.](image)

Preventing clogging and overhanging of weed plant residues on the rack of the working body, the copying device having a spring 5, it allows the disk 7 to work at a depth corresponding to agrotechnical requirements and copying the unevenness of the field surface ensuring the movement of the teeth of the disk 7 in a vertical plane.

The work of the cultivator with an improved design of the working body showed that the cut weeds do not hang on the paw stand. A large number of weeds hangs on the rectangular stand of the serial share and ranges from 60 to 100%.

The results of theoretical and experimental studies of the traction resistance of the improved design of the working body correspond to 489.6 and 456.3 N. The traction resistance of the serial worker is 669.1 N, which is 41.6% more than that of the new design of the working body.
It should be noted that the improved working body of the cultivator eliminates the overhang of plant residues of cut weeds on the rack of the lancet share, providing an increase in the productivity of the unit and the quality of tillage by reducing the traction resistance of the unit. It can be assumed that the new working body is more efficient than the serial one.

Fig. 4. Traction resistance of serial and experimental working bodies.

4 Conclusion

The operation of a machine-tractor unit with an improved design cultivator in preparing the soil for sowing and caring for fallows allows:

- Keep moisture reserves in the soil. Evaporation of which is protected by the upper (0…3 cm) finely cloddy loosened soil layer. It destroys the capillary movement of water from the lower layers of the soil and provides an effective accumulation of moisture from precipitation. The physical evaporation of moisture is reduced by almost 2 times in comparison with a serial working body.
- Kill weeds by 93%. Using the effect of undercutting with a paw and combing out with a needle disc of all types of weeds, including root shoots. When caring for fallows, it is possible to reduce the number of cultivations (2…3 instead of 3…4 with current technology) with greater efficiency.
- Create a level field surface. Due to the loosening of the soil with needle discs, during the season of cultivation, a flat field surface is created that meets the agrotechnical requirements for high-quality sowing.
- The proposed working body with protection of the rack from hanging cut weeds allows you to increase the productivity of work on cultivation by 15% by reducing the traction resistance of the unit and eliminating downtime for cleaning the working bodies.

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