Development of the design of a rotary tool for combing weeds with loosening the soil

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Abstract. This paper presents the results of research, an approximate model of the design of a rotary tool for combing weeds with loosening the soil, as well as its working bodies. The relevance of carrying out scientific research work is described, allowing to find the latest methods and means of increasing the efficiency of agricultural production in the cultivation of cultivated plants. A diagram of a laboratory sample of a rotary tool is presented, its design and workflow are described. The design and purpose of the main working units of the rotary tool for combing out weeds with loosening the soil has been substantiated.

1. Introduction
Obtaining a stable yield of agricultural crops and the production of high quality products cannot be achieved without the introduction of modern methods and technical means, the use of which contributes to an increase in the efficiency of cultivation of cultivated plants. In such conditions, machines and units that reduce the cost of producing crop products attract the greatest interest. At the same time, special attention should be paid to tillage implements designed for the preparation and care of crops of agricultural crops. This is because these agro technical measures are the most responsible. Carrying out them at a high technological level makes it possible to create the best conditions for the growth and development of cultivated plants, which will have a positive effect on the yield and quality of products.

2. Materials and methods
It is known that today, scientific and technological progress is developing quite rapidly. The technical advances in this process have become widespread in all industries. The country's agricultural sector is no exception. New machines and hardware systems are being introduced into the production process of the crop industry. The designs of the aggregates, their working bodies, as well as the technologies for the cultivation of agricultural crops are constantly being improved.

The use of modern technology is most relevant in those soil and climatic zones of our country where the cultivation of agricultural crops cannot be carried out without additional material and technical costs caused by various risks. These risks, in particular, include a moisture deficit, low fertility of soil resources, as well as a high degree of probability of the development of all kinds of soil erosion processes. The constant lack of moisture, combined with a deficiency and low content of nutrients in the surface layers of the soil, is not only the reason for obtaining low yields, but also later unfriendly seedlings, moreover, all of these factors, under certain conditions, can contribute to the death of crops.
In other words, the working bodies of tillage machines when moving in the soil should prevent the removal of soil moisture from the lower moisture layers. The influence of the negative impact of the factors considered can be minimized. To do this, it is necessary to create such conditions for the implementation of the technological process of soil cultivation, which will be able to provide high-quality loosening of the surface layer of the soil, the destruction of weeds along with the root and obtaining the soil structure optimal in its granulometric composition.

The considered zones of risky farming include the Volgograd region. In such conditions, it is necessary to organize the technological processes of growing agricultural crops in such a way as to reduce the harmful effect of the movers of energy resources on the soil, to reduce the number of passes through the field and to ensure the highest quality tillage.

All this is possible due to the application of the latest achievements of science and technology in the production processes of the country's agricultural sector. The main of these means are the working bodies of machines and mechanisms for surface tillage. The scientifically grounded development and application of new agricultural machines in crop production makes it possible to increase the efficiency of crop cultivation and reduce the cost of production.

3. Results
In the course of a preliminary analysis of the structures, working bodies and technological processes of modern tillage machines, the required design and technological parameters of agricultural implements were determined, the use of which will have a positive effect on the growth and development of cultivated plants. In addition, a distinctive feature of this weapon will be the ability to reduce energy and material costs.

An analysis of the results of a preliminary study on this topic made it possible to reveal that today in the modern system of machines, units, the use of which would fully achieve the indicated results and meet all the basic requirements of a modern agricultural producer - no.

Based on this, a design of a tillage tool with rotary-type working bodies is proposed. The purpose of this tool is the complete destruction of weeds by combing out during the preparation and care of crops with simultaneous high quality loosening of the surface layer of the soil.

This tool will certainly meet all the basic requirements for machines and units of this type, and the high scientific and technical level of its development will contribute to its effective use in soil cultivation and make it in demand among crop producers of all levels. The design of this tool will allow its use in various soil and climatic zones and with a wide range of contamination of agricultural land by various types of weeds.

4. Discussion
The scientific and technical novelty of this project lies in the development and study of a new method and method of combing out weeds, as well as the design of a rotary tool for better removal of weeds from the soil, theoretical and experimental substantiation of its design and kinematic parameters.

The design of a rotary tool for combing weeds with loosening the soil and its working bodies is shown in figure 1.

The design of the rotary tool includes the following components. The supporting structure of the tool is the frame 1, on which the front 2 and rear 3 rotor disks are mounted for rotation. In turn, each rotor disk consists of a disk 4, on which knives 5 are installed. The knives of the rotor disks 5 are made of metal plates of rectangular cross-section. Also, drive sprockets 6 and 7 are rigidly fixed on the front and rear rotor disks, respectively. The front and rear rotor disks are connected to each other by means of a chain-type transmission 8.

In order to ensure that the field relief is copied during operation with rotary disks, a four-link parallelogram type mechanism 9, with a wheel 10, is fixed to the implement frame. For leveling relative to the field surface, a screw-type clamping device 11 is installed in its upper part. For aggregation with the power tool, a beam 12 is mounted on the frame. On the front edges, 13 of the knives 5 there are blades with figured cutouts 14.
Figure 1. Diagram of a rotary weapon and the main elements of its design:

- a) a diagram of a rotary weapon;
- b) a diagram of the rotor disc knife;
- c) a diagram of the cut-out of the rotary disk knife:

1 - case; 2 - front rotor disc; 3 - rear rotor disc; 4 - disk; 5 - knife; 6 - an asterisk of the front rotor disk; 7 - an asterisk of the rear rotor disk; 8 - chain transmission; 9 - four-link mechanism of parallelogram type; 10 - wheel; 11 - screw-type clamping device; 12 - timber; 13 - the front edge of the knife; 14 - curly cut of the knife blade.

The working process of the rotary tool proceeds as follows.

During the movement of the tillage implement across the field, the rotor disc blades move at a certain depth in the surface layer of the soil. The front rotor disc, like the rear, has a drive sprocket. Moreover, the number of teeth on the sprockets of the rotor disc drive is different, so the sprocket of the front rotor has a greater number of teeth than the sprocket of the rear one, due to which it rotates more slowly.

5. Conclusion

The technological aspect of using a rotary tool for surface tillage is the creation of a complex technological process for the complete destruction of weeds by picking them up, holding them and laying them on the surface of the field while simultaneously loosening the soil to a certain depth. The creation of such conditions creates the possibility of increasing the level of agrotechnical measures for tillage, reducing the number of passes through the field, maintaining productivity and reducing the cost of cultivating crops, especially in areas of risky farming.

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