Creating energy and resource saving longitudinal pawls forming device between cotton rows

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Abstract: The article describes the technological process of forming a longitudinal pawl between the rows of cotton and the basic requirements for the implementation of equipment. The results of scientific research on the development of energy and resource-saving devices for the formation of longitudinal pawls between the rows of cotton and their introduction into agricultural production are described.

1. Introduction

Today, the cluster method, which specializes in the production of finished products, rather than raw cotton, is being introduced in the country. This, in turn, covers the entire process, from preparing the land for sowing to the production of finished cotton. Therefore, first of all, increasing the productivity of land, growing cotton seedlings in accordance with agro-technical requirements requires mechanization of these technological processes due to the natural climatic conditions of the region. It is known that irrigated lands in cotton-growing areas are divided into three zones according to natural-climatic and soil conditions, mechanical composition of soil, tillage technology, types of machines and agro-technical requirements [1].

2. Materials and methods

Usually the work done during the period of sowing and care of cotton is almost the same everywhere, only depending on the reclamation condition of the soil, the number and duration of irrigation of cotton, mainly the preparation of land for planting and watering cotton. It differs in the variety of work performed in the harvest. For example, in cotton-growing areas in the third zone, longitudinal and transverse pawls are used between rows to irrigate cotton before the first irrigation during the growing season due to the slope and unevenness of the field. The relative unevenness of the cotton fields prevents even irrigation of the field, leading to some rows of cotton seedlings becoming waterlogged or not irrigated at all. The best way to prevent this is to create a sufficient amount of longitudinal and transverse pawl space between the rows of cotton, taking into account the unevenness of the field.
Longitudinal and transverse pawls are formed between rows of cotton and irrigated field. These pawls significantly reduce water consumption when irrigating cotton and ensure reliable execution of the irrigation process. Irrigation of cotton facilitates the work of irrigators and ensures a smooth and saturated irrigation of cotton seedlings. In particular, it is important to ensure that the longitudinal pawls are formed before the first irrigation of cotton and used in subsequent irrigations until the end of the growing season, so that it is formed on the basis of established agro-technical requirements.

3. Procedure of research

The height of the pawl and the cross-sectional area formed between the rows of cotton are the main indicators. These indicators can be determined using the following scheme.

According to the data given in the literature, if we assume the angle of natural shedding of the soil $\varphi_t = 35-40^\circ$, it turns out that the height of the pawl is at most $h_p = 25.2$ cm. The cross-sectional area of the pawl is the sum of the two surfaces, viz

$$S_{\text{sum}} = S_p + S_e$$

where $S_p$ – is the face of the upper triangular part of the pawl;
$S_e$ – is the face of the lower edge of the pawl.

Cotton showed that the surface area of the longitudinal pawl cross-section was $S_{\text{sum}} = 0.106$ m$^2$ (1055 cm$^2$) when the width of the row spacing was 0.6 m and the depth of the ridge was 0.10 m. These calculations show that in order for the dimensions of the longitudinal pawl to meet the agro-technical requirements, it is necessary to move the soil pile with a cross-sectional area of 1055 cm$^2$ on both sides from the side edges to the middle edge [6, 7].

Based on the above information, it is necessary to carry out this technological process through pawl-forming devices that meet the established agro-technical requirements.

It is known from agricultural practice that 1-2 transverse pawls are formed on 1 hectare, and 3-4
longitudinal pawls are formed. Therefore, given the relative unevenness of the crop area, 30-40% of this process is devoted to the formation of transverse pawls, and 60-75% to the formation of longitudinal pawls [2, 3].

The following basic requirements apply to the process of forming longitudinal pawls between rows of cotton:
- The roots of the cotton seedlings in the side rows from which the soil is removed during the formation of the pawls are not damaged and the root system is not exposed;
- The existing cotton seedlings on both sides of the row are not damaged and are not buried in the soil;
- Ensuring that the longitudinal pawl is on sufficient size to hold it well and be strong;
- Longitudinal pawl should not be lined with large lumps (in order to prevent the formation of water washes during irrigation);
- Depth of soil taken from pawls by ploughshare should be less than the depth made by cultivator.

When carrying out the technological process of longitudinal pawling between rows of cotton with the help of mechanisms, the technical means of pawling must meet the above requirements. At the same time, the equipment used for pawling should ensure low labor costs and high productivity during the pawling process and, most importantly, should be integrated into the mower tractor used for intercropping. The analysis of the technological process of pawl formation between the rows of cotton, and the main task was to raise the soil to the desired height without damaging the cotton seedlings and align it to the side row, as it is possible. Ensuring this process with existing machines were analyzed. The following requirements were considered in their analysis.
- The body and roots of cotton seedlings must not be damaged during the work;
- Ensuring a smooth working process of the machine in accordance with the requirements of a smooth, high-quality pawl;
- Aggregation on a tractor designed to work between the rows;
- Constructive simplicity;
- No environmental damage during working process;
- Easy technical service;
- The process of forming a longitudinal pawl is carried out in one passing between the rows.

Taking into account the above, in order to create a longitudinal pawl between the rows of cotton in accordance with the agro-technical requirements, the design of the device for forming the longitudinal pawl between the rows of cotton in one pass of the aggregate consisting of rolling surfaces was reviewed (3-picture). By performing this technological process in one passing between the rows, it is possible to increase the efficiency of the unit, ensure energy and resource savings [5].

The longitudinal pawl forming device at one passing between the rows of cotton is adapted for mounting on the suspension of a universal mowing tractor, located right and opposite to each other at a certain angle to the direction of movement, consists of left-handed working bodies, equipped with sheaths that protect the cotton seedlings from being buried by a pile of soil thrown from the upside-down surface and grinding-compaction skis on the sides of the formed pawl.
Figure 3. The general scheme of the device for creating a longitudinal pawl between the rows of cotton

1- Tie, 2-frame, 3, 4- right and left overturned hulls, 5- protective sheaths, 6- grinding-compression skis

When the device moves along the pawl with the help of a tractor, the soil on the two side pawls rises upwards along the right and left tilting surface bodies, and the cotton seedlings are lifted over the sheaths protecting the soil from the tilting surface, overturned into the middle branch to be formed.

4. Conclusion.

The two sides of the pawl are sanded and compacted to prevent the soil from leaking on both sides of the pawl. As a result, the longitudinal pawl is formed in one pass of the unit. In one passing, it is possible to reduce fuel consumption by up to 50% and increase productivity by 2% compared to the existing technology of pawl formation with the help of a longitudinal pawl forming device between the rows of cotton. In the implementation of the technological process of longitudinal pawling between the rows of cotton with the help of mechanisms, the technical means of pawling meet the agro-technical requirements, as well as low labor costs, energy and resource-saving and labor productivity in the process of pawling should be high.

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