INTERNATIONAL CONFERENCE **Dehli, India, 2026**
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SUBSTANTIATION OF THE PARAMETERS OF A RIBBED DISK WORKING BODY SECTION FOR INTER-ROW TILLAGE OF COTTON FIELDS BEFORE WINTER WHEAT SOWING

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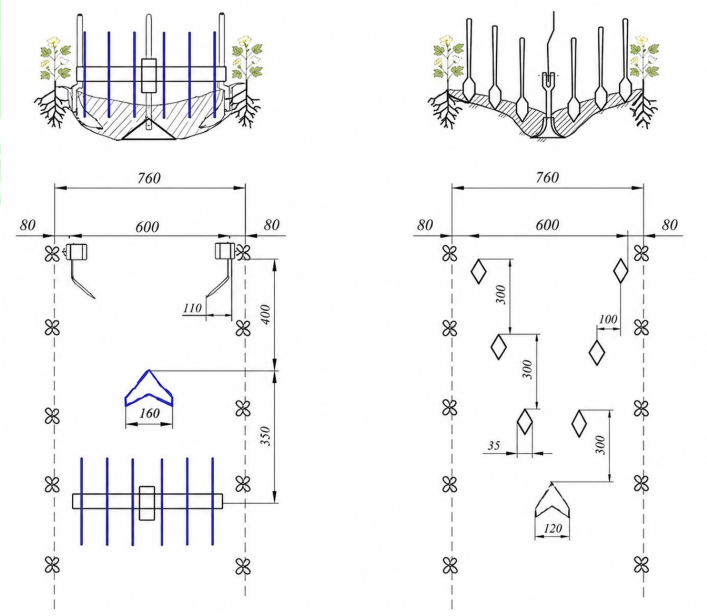
https://doi.org/10.5281/zenodo.20329924

Abstract. The article presents the results of experimental studies on substantiating the parameters of a cultivator section equipped with a ribbed disk working body for inter-row tillage before winter wheat sowing in cotton fields. The influence of disk type, diameter and spacing on soil crumbling quality and draft resistance was investigated under field conditions. The results showed that the ribbed disk working body provided better soil pulverization compared to conventional disks. Rational parameters of the working body ensuring improved agrotechnical and energy performance were determined.

Keywords: ribbed disk, cultivator section, inter-row tillage, soil crumbling, draft resistance, winter wheat, cotton field.

Introduction. Efficient preparation of cotton inter-row soil for winter wheat sowing is one of the important technological processes in agriculture. Existing cultivator sections do not always provide the required soil crumbling quality and often require repeated tillage operations, which increases energy consumption and negatively affects soil structure (figure 1).

Application of ribbed disk working bodies in cultivator sections allows improving soil pulverization and reducing draft resistance due to active interaction between the disks and soil layer. Therefore, substantiation of the optimal parameters of ribbed disk working bodies is an important scientific and practical task.

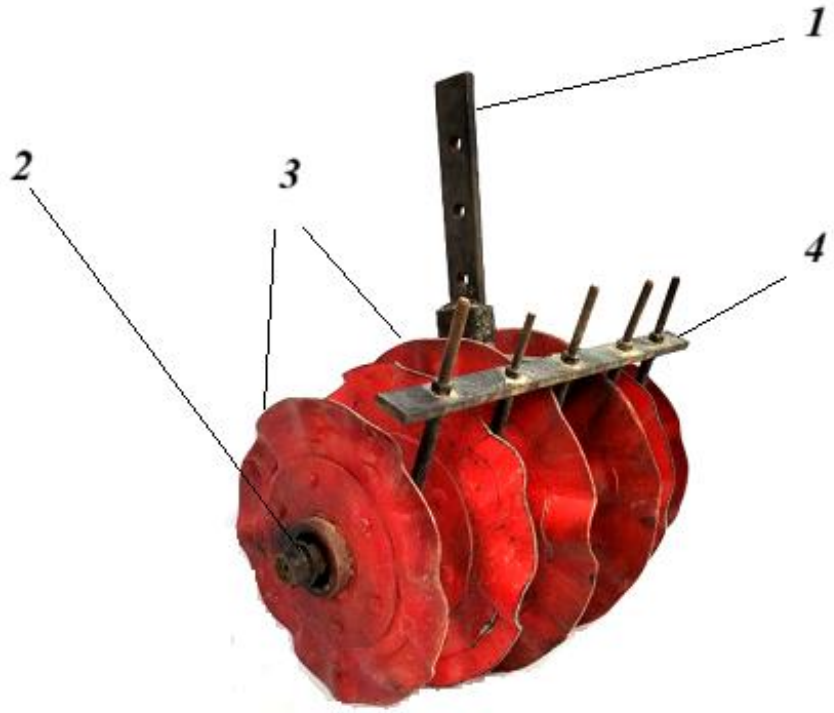


a) *b)*

a) section with a share-moldboard, a loosening share, and a ribbed disk working body; *b)* section of the KXU-4B cultivator.

Figure 1. Scheme of cultivator sections for soil tillage before winter wheat sowing in cotton inter-rows.

Materials and Methods. Experimental studies were conducted using a specially designed laboratory-field installation aggregated with an MTZ-80X tractor. Field experiments were carried out in cotton fields under medium loamy soil conditions.



1– post (tine); 2– axle (shaft); 3– ribbed disk knives of various diameters; 4– disk cleaner tooth.

Figure 2. General view of the experimental ribbed disk knife working body.

The following parameters were investigated:

— shape of disk working bodies;
— diameter of ribbed disks;
— spacing between disks;
— longitudinal distance between working bodies;
— installation angle of sweep shares;
— tillage depth;
— operating speed.

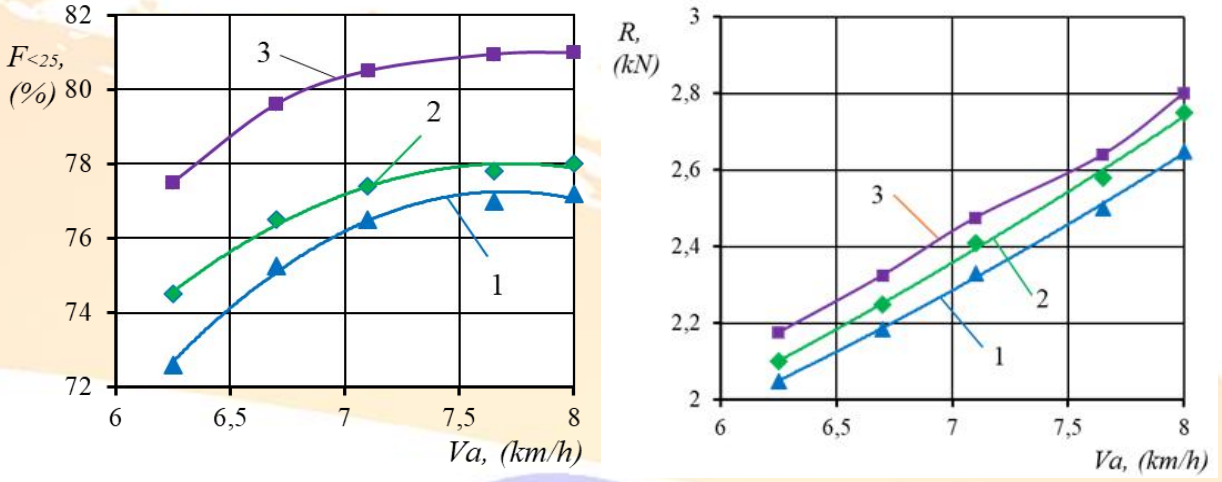
The soil crumbling quality was evaluated based on the amount of soil fractions smaller than 25 mm. Draft resistance was determined using strain gauge sensors calibrated with a DOSM-III-5 dinamometr.

Experimental data were processed using methods of mathematical statistics and regression analysis.

Results and Discussion. The conducted experiments showed that the ribbed disk working body section provided significantly better soil pulverization compared with the conventional KXU-4B

cultivator section. The proportion of soil fractions smaller than 25 mm increased by approximately 9.6%.

Comparative analysis of smooth, toothed and ribbed disks demonstrated that ribbed disks ensured the highest soil crumbling quality. At the same time, draft resistance remained within acceptable limits.



1 — smooth disk; 2 — toothed disk; 3 — ribbed disk.

Figure 3. Variation of soil crumbling degree (F < 25 mm) and draft resistance (R) of the implement depending on operating speed (Va) and disk type.

The studies also established that arrangement of disks with different diameters according to the furrow profile improved soil pulverization by about 4% while reducing draft resistance by nearly 5%.

Experimental results indicated that:

— the optimal diameter of the central disk was 400 mm;

— the optimal number of disks was 6;

— the optimal spacing between disks was about 120 mm;

— the longitudinal distance between the ribbed disk section and loosening share should be at least 35 cm;

— the longitudinal distance between sweep share and loosening share should be 45 cm;

— the installation angle of the sweep share should be 45°;

— the optimal sweep width was 11 cm;

— the recommended tillage depth was 10 cm.

The obtained parameters ensured stable operation of the working body, high soil crumbling quality and reduced energy consumption.

Conclusion. The experimental investigations confirmed the results obtained in theoretical studies and allowed substantiating the rational parameters of the ribbed disk working body section for inter-row tillage of cotton fields before winter wheat sowing.

The developed working body design improves soil pulverization quality, reduces draft resistance and creates favorable agrotechnical conditions for winter wheat sowing.

The proposed ribbed disk working body can be recommended for application in resource-saving cultivation technologies in cotton-growing regions.

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