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Results of Experimental Studies on the Selection of the Optimal Ridger Type for the Combined Machine

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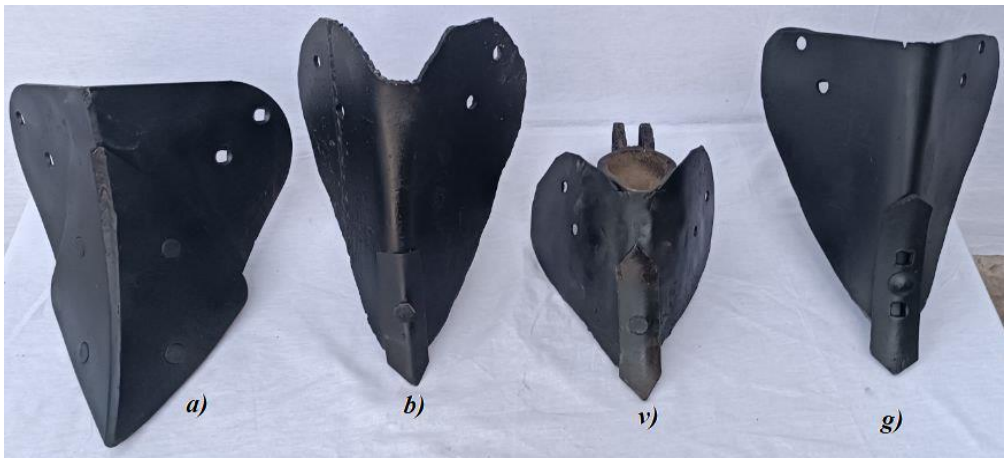
Annotation: The article presents the results of tests conducted to select the type of ridge former for a combined machine. As a result, the furrow opener of the KXM-4 cultivator was selected for ridge formation while ensuring minimal energy consumption and meeting the required performance criteria. The selected furrow opener was then improved and adopted for further research.

Keywords: Combined machine, ridge, ridge former, experiments, result, level, minimal energy, cultivator, furrow opener, research, optimal, comparison experiment.

For research aimed at determining the optimal type of ridge former for a combined machine, four different variants of ridge formers were developed (Figure 1) and subjected to comparative testing.

- In the first variant (Figure 1a), the furrow opener of the improved KXM-4 cultivator was utilized.

- In the second variant (Figure 1b), the furrow opener of the KXU-4 universal cotton cultivator was employed.
- In the third variant (Figure 1v), the furrow opener of the CKU-4A cultivator was used.
- In the fourth variant (Figure 1g), the working unit of the GX ridge former was applied.



a, b, v, and g correspond to the respective variants of the ridge former

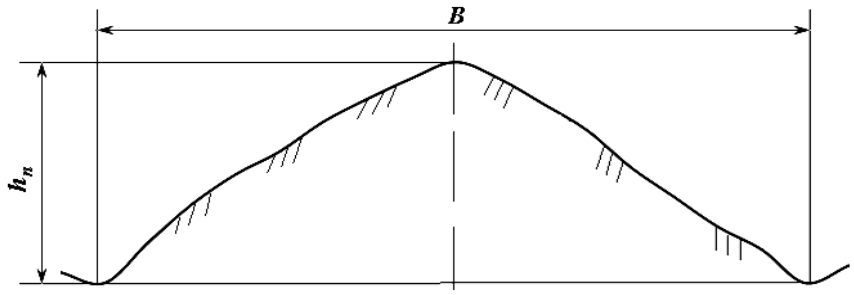
Figure 1. Variants of the Ridge Former

An experimental device was developed to conduct selection and comparative tests of the ridge former for the combined aggregate.

The experimental device (Figure 2) consists of the following components: frame (1), rotary loosener (2), ridge former (3), protective barrier preventing the dispersion of crushed soil (4), support wheel (5), tractor hitch mechanism (6), tractor (7), gearbox (8), and cardan shaft transmission (9).

Figure 2. Aggregation of the Experimental Device with the Tractor

The ridge height (h_n) was determined by measuring the distance from its peak to the bottom of the furrow with an accuracy of 0.1 cm (Figure 3). The height was measured at least 25 times for each variant to ensure accuracy.



B- ridge width; h_n- ridge height

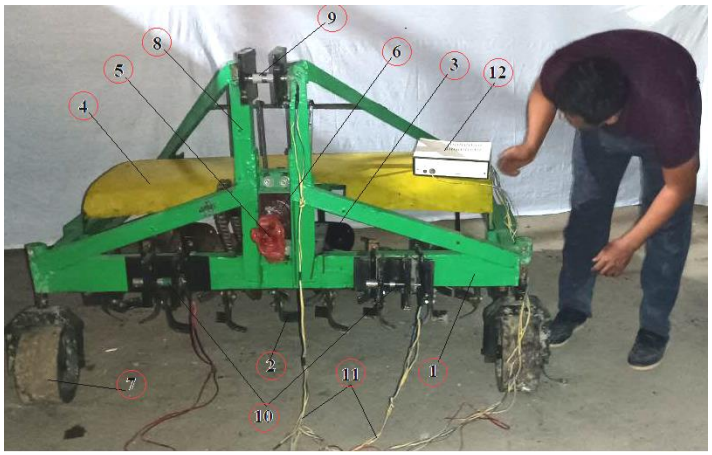
Figure 3. Diagram for Determining Ridge Height

Figure 4. Representation of the Transverse Profile of Ridges Formed During Operation with the Combined Aggregate

Figure 4. Determination of Ridge Height and Its Transverse Profile

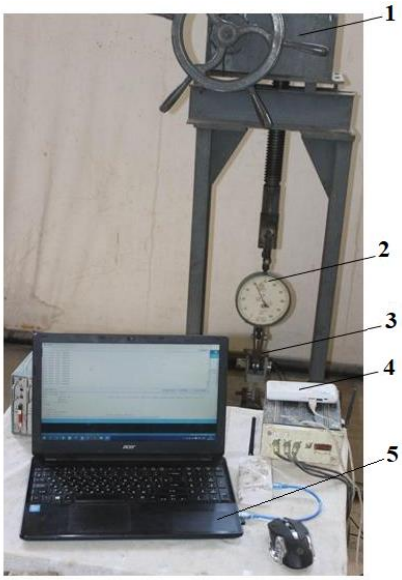
To determine the draft resistance of the ridge formers, a special strain gauge-based load reducer with attached strain sensors was used (Figure 5).

The strain sensors were connected to the load reducer in a bridge circuit configuration. Before and after the experiments, the load reducer was calibrated by applying forces ranging from 1 kN to 6 kN in 1 kN increments (Figure 6).



1 – Frame; 2 - Rotary loosener; 3 - Ridge former; 4 - Protective barrier preventing soil dispersion; 5 - Cardan shaft transmission; 6 – Gearbox; 7 - Support wheel; 8 - Tractor hitch mechanism; 9 - Central strain beam; 10 - Left and right strain beams; 11 - Connection wires

Figure 5. Experimental Device for Testing and Selecting the Type of Ridge Former with Installed Strain Gauges



1 - Calibration stand; 2 – Dynamometer; 3 - Strain gauge; 4 - IP-264BS measuring equipment; 5 – Laptop

Figure 7. Calibration Process of the Strain Gauges

Based on the results obtained during calibration, the calibration coefficient was determined. Then, the results from the experiment were multiplied by the calibration coefficient to calculate the actual value of the resistance force exerted on the working parts by the soil. The error in calibration was 1.6%.

Comparative tests for selecting the type of ridge former were conducted at the Saydulla Temirov farming enterprise, which specializes in forest seedling cultivation, located in the Pakhtabad district of Andijan region.

As evaluation criteria for the performance of the ridge former, the ridge height and draft resistance were used.

The experiments were carried out using an MTZ-80X tractor and the experimental device, with the aggregate speed set between 5-7 km/h.

The results obtained in the tests are presented in the following table.

Quality and Energy Performance Indicators of Ridge Formers

№	Types of Ridge Formers	Movement Speed of the Aggregate, km/h	ridge height, cm		Draft Resistance of the Working component, kN
			$M_{ўр}$	± σ	
1	Furrow Opener of the KXM-4 Cultivator	5,0	17,2	0,42	1,18
		7,0	16,4	0,57	1,28
2	Furrow Opener of the KXU-4 Universal Cultivator	5,0	16,8	0,48	1,23
		7,0	16,2	0,52	1,35
3	Furrow Opener of the CKU-4A Chisel Cultivator	5,0	14,5	0,42	1,08
		7,0	13,8	0,47	1,12
4	Working component of the GX Ridge Former	5,0	22,2	0,58	1,85
		7,0	20,4	0,45	2,05

Note: The draft resistance of the ridge formers was determined for a single working component.

The data presented in the table clearly show that, as ridge formers, the ridges formed by the ridge formers of variants 1, 2, and 4 met the agronomic requirements (16±2 cm), with heights ranging from 16.2 cm to 22.2 cm.

The draft resistance was found to be the lowest in the ridge former of variant 1. Therefore, to form ridges with minimal energy consumption while meeting the required standards, the furrow opener of the KXM-4 cultivator (variant 1) was selected, improved, and adopted for subsequent research.

Conclusion.

1. Four different variants of ridge formers were developed for research aimed at selecting the optimal type of ridge former for the combined machine, and their comparative tests were conducted.
2. In the experiments, the main criteria were accepted as ridge height and draft resistance.
3. To form ridges with minimal energy consumption while meeting the required standards, the furrow opener of the KXM-4 cultivator was selected, improved, and adopted for subsequent research.

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