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METHODS AND RESULTS OF EXPERIMENTAL STUDIES OF A COMBINED UNIT AND ITS ECONOMIC INDICATORS

Abdirahmonov Ravshanbek Amanullaevich

Candidate of Technical Sciences, Associate Professor, Department of Agricultural Technology and Organization of Technical Service, Andijan Institute of Agriculture and Agricultural Technologies

ravshanabdiraxmonov1970@mail.ru

Mamadaliev Makhammadzhan Khabibullaevich

Candidate of Technical Sciences, Associate Professor, Department of Agricultural Technology and Organization of Technical Service, Andijan Institute of Agriculture and Agricultural Technologies

mxmamadaliyev1969@gmail.com

Mamarasulova Manira Tursunboevna

Candidate of Technical Sciences (PhD), Associate Professor, Department of Agricultural Technology and Organization of Technical Service, Andijan Institute of Agriculture and Agricultural Technologies

manira2016@mail.ru

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ANNOTATION

The article presents the methods and conditions for conducting experiments, as well as the results of experiments conducted to substantiate the parameters and rational values of the operating mode of the ripper. For experimental studies, the design of a combined unit has been developed, as well as its prototype and rippers with different lengths, widths and working surfaces have been manufactured.

Keywords: ripper, working body, experiment, research, soil, formation, flat, concave, convex, crumbling, crushing, deformation, traction resistance, angle of entry, single-factor, multi-factor, block, combined unit

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Experimental studies were carried out on cotton fields with a row spacing of 90 cm, free from crops, with uprooted or crushed guza paya scattered across the field, as well as on a specially prepared background with prepared ridges and watering carried out several times. In the experiments, the criteria for assessing the performance indicators of the ripper were its traction resistance, the quality of soil crumbling, the width and depth of the loosened layer. In experimental studies, rippers with flat, concave and convex working surfaces were primarily studied at speeds of 6.0 and 8.0 km/h.

The results of experimental studies showed the correctness of the results of theoretical studies, that is, the traction resistance of a working body with a convex working surface is less than that of other working bodies, and the quality of soil crumbling is higher. This, as shown in theoretical studies, is due to the fact that under the influence of a working body with a convex working surface, the soil is not only compressed in the direction of movement, but also stretched in the transverse direction. This leads to a decrease in the traction resistance of the working body and an improvement in the quality of crumbling [1].

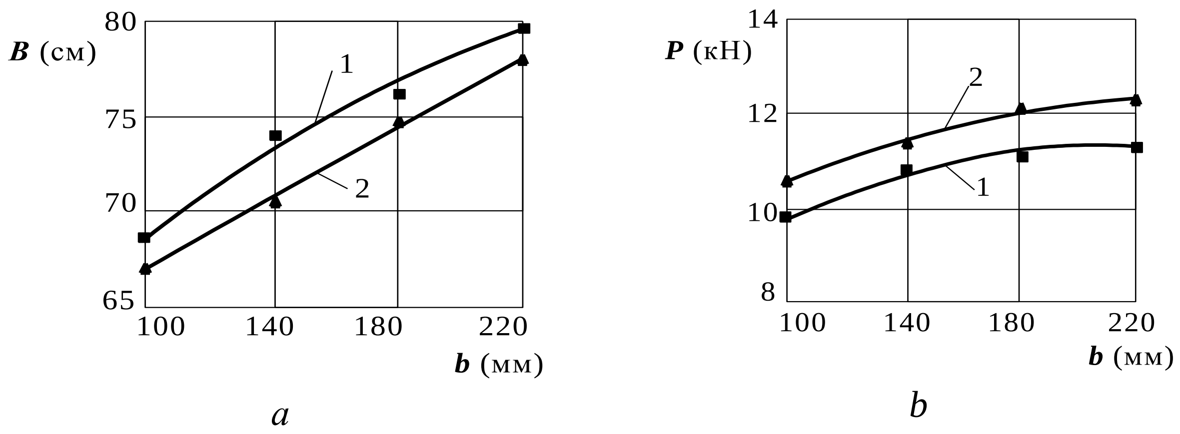
This means, based on the theoretical and experimental studies carried out, we can come to the decision that in order to achieve high-quality crushing of the soil with minimal energy consumption, the working surface of the ripper must be convex. In experiments to find the effect of the ripper width, it was changed from 100mm to 220mm with an interval of 40mm. The results of the experiments are presented in 1-table and 1-figure.

Performance indicators of rippers with different widths.

Table 1

Width ripper, mm	Operating speed, km/h	Number of fractions with the following sizes, (mm) %			Depth of loosened layer, cm	
		>100	100-50	< 50	M_{cp}	±σ
100	6,0	5,00	12,20	80,80	35,2	1,18
	8,0	7,48	7,85	84,67	34,0	1,09
140	6,0	7,89	10,51	81,60	35,4	1,42
	8,0	9,33	7,76	82,91	33,9	1,04
180	6,0	10,87	7,79	81,34	35,1	1,19
	8,0	11,19	6,23	82,58	34,3	1,42
220	6,0	11,19	12,86	75,94	35,2	1,08
	8,0	9,54	9,66	80,80	34,5	1,43

From the data in Table 1 it is clear that an increase in the width of the ripper leads to a deterioration in the quality of soil crumbling, that is, the amount of soil with a size greater than 100 mm and sizes between 100-50 mm increases, and fractions with sizes less than 50 mm decreases. This is explained by the fact that as the ripper width increases, the soil deformation zone increases, which can lead to large blocks breaking off.



1.2 - the speed of the unit is 6.0 and 8.0 km/h, respectively.
1-drawing. Graphs of changes in the width of the loosened layer (a) and the traction resistance of the ripper (b) depending on the width of the ripper.

Increasing the speed led to an improvement in the quality of soil crumbling. This can be explained by the fact that with increasing speed, the impact force of the working body on the ground increases.

Analysis of the data from table 1 showed that changing the width of the ripper from 100 mm to 200 mm did not have a significant effect on the depth of its penetration into the soil. With an increase in speed, this parameter for all options decreased within 0.5-0.8 cm. This is explained by the fact that with an increase in speed, the traction resistance of the ripper increases, leading to an increase in the moment pushing the unit out of the soil.

Experiments have shown that for high-quality loosening of the soil, the width of the ripper must be at least 140 mm, since at b = 100 mm the lower surface of the treated layer is incompletely loosened and a groove is formed with a width equal to the width of the ripper. And this cannot be allowed, since this, as mentioned above, will lead to a deterioration in the physical and mechanical properties of the soil and to wasteful energy consumption. From the data presented, it can be seen in Figure 1 that with an increase in the width of the ripper, its traction resistance and the width of the loosened layer increase, and with an increase in speed it leads to an increase in the first indicator and a decrease in the second [2]. If the increase in traction resistance and the width of the loosened layer with an increase in the width of the ripper is associated with an increase in the volume of deformed soil on the part of the working body, then the decrease in the width of the loosened layer with increasing speed can be explained by a decrease in the time of interaction of the working body with the soil. In experiments carried out to determine the influence of the angle of entry into the soil of the ripper on its performance, the angle of entry changed every 50, ranging from 200 to 400. In them, the height of the rise of the treated layer was constant and equal to 75 mm. The speed of the unit was assumed to be 6.0 and 8.0 km/h.

From the data in Table 2 it follows that at both speeds of movement, the quality of soil crumbling, depending on the angle of entry of the ripper into it, changes in the form of a convex parabola, that is, changing this angle from 30-350 leads to an improvement in the quality of crumbling, and at an angle of 400 this indicator is getting worse. This pattern of changes in the quality of soil crumbling can be explained by the pattern of changes in the distance “S” (path) traveled by the ripper, starting from soil compression to its fragmentation, depending on the angle α of the ripper’s entry into the soil. (Fig. 2-a, b). A decrease in this distance with an increase in angle α leads to an improvement in the quality of soil crumbling, and an increase leads to a deterioration. Changing the angle of entry of the ripper into the soil within the range of 20-400 has almost no effect on the depth of the loosened layer.

When the angle of entry of the ripper into the soil changed from 20 to 350, the width of the loosened layer (Fig. 2-a) at a working speed of 6.0 km/h increased from 66.3 cm to 73.5 cm, and at a speed of 8.0 km/h from 64.5cm to 71.9cm. When this angle changed from 350 to 400, the width of the loosened layer decreased, respectively, at 6.0 km/h by 1.7 cm, and at 8.0 km/h by 2.5 cm.

The results of the experiments are shown in Figure 2 and Table 2.

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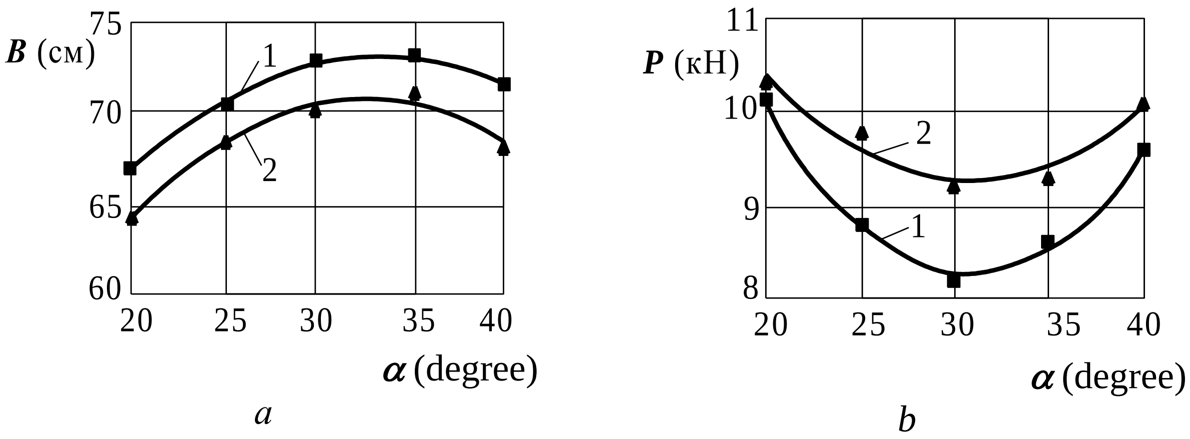
Changes in the performance indicators of the ripper depending on the angle of its entry into the soil

Table *2*

Entry angle ripper into the soil, degrees.	Working speed, km/h	Number of fractions with the following sizes. (mm) %			Depth of loosening layer, cm	
		>100	100-50	< 50	M_{cp}	±σ
20	6,0	11,90	13,87	74,94	34,9	1,08
	8,0	10,48	11,85	77,67	34,5	1,22
25	6,0	10,59	12,84	76,57	34,9	1,48
	8,0	9,98	11,63	78,39	31,1	1,07
30	6,0	9,75	12,08	78,17	35,3	1,19
	8,0	9,06	10,04	80,90	35,1	1,42
35	6,0	7,33	10,38	82,29	35,2	1,07
	8,0	4,43	11,40	84,17	34,9	1,42
40	6,0	9,20	12,24	78,56	35,4	1,24
	8,0	8,17	11,40	80,43	35,2	1,32

The increase in the width of the loosened layer within the specified limits is explained by a decrease in the angle of installation of the crushing plane (Fig. 2-3) that occurs under the influence of the ripper towards the direction of movement ψ and the appearance of a groove at the bottom of the treated layer. The traction resistance of the ripper changes depending on its angle of entry into the soil in the form of a concave parabola (Fig. 2-b), that is, it decreases within an angle of 20-350, and increases within an angle of 35-400.

The change in the traction resistance of the ripper according to this pattern, as stated above, can be explained by the pattern of changes in the distance “S” traveled by the ripper starting from soil compression to its crushing, depending on the angle of its entry into the soil..



1 and 2 – respectively at driving speeds of 6.0 and 8.0 km/h.
2 – drawing. Graphs of the dependence of the width of the loosened layer (a) and the traction resistance of the ripper (b) on the angle of its entry into the soil.

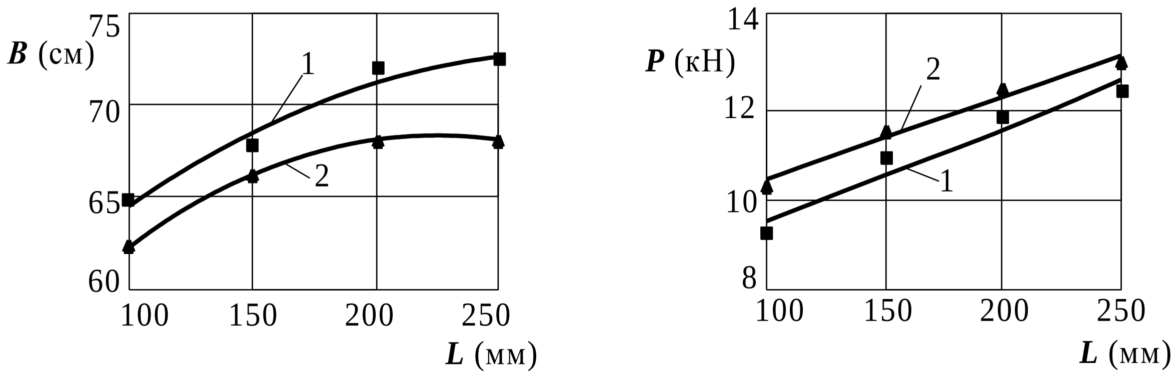
In experiments conducted to determine the influence of the length of the working surface of the ripper, it varied from 100 mm to 250 mm with an interval of 50 mm, while its width was 140 mm, and the speed of the unit was 6.0 and 8.0 km/h. The results of the experiments are shown in 3-table and 3-figure. From these results, first of all, it is clear that in order to ensure high-quality loosening of row spacing, the length of the working surface of the ripper must be at least 15 cm, since with smaller values, as shown in Table 3 and Figure 3, a groove with compacted walls. Secondly, increasing the length of the working surface of the ripper from 10 cm to 20 cm leads to an improvement in the quality of soil crumbling, an increase in the width of the loosened layer and the traction resistance of the working body. These indicators changed little when the length of the ripper working surface changed from 20 cm to 25 cm [3]. Based on these experiments, we can come to the conclusion that the length of the working surface of the ripper should be at least 150 mm. This is completely consistent with the results of theoretical studies. To determine the rational values of the ripper parameters studied in theoretical studies and single-factor experiments, multifactorial experiments were carried out using the method of mathematical planning.

Performance indicators of rippers with different working surface lengths.

Table 3

Ripper working surface length, mm	Operating speed km/h	Number of fractions, with the following dimensions, (mm), %			Loosened depth layer, cm	
		>100	100-50	< 50	M_{cp}	±σ
100	6,0	10,87	13,53	75,60	34,2	1,12
	8,0	8,86	13,56	77,58	35,3	1,08
150	6,0	8,42	14,64	76,84	33,4	1,22

	8,0	7,03	14,34	78,03	34,9	1,14
200	6,0	6,89	14,77	78,34	35,1	1,19
	8,0	6,33	13,76	79,91	36,3	1,42
250	6,0	6,50	14,70	78,80	34,2	1,28
	8,0	5,48	13,85	80,67	35,5	1,43



a b

1 and 2 - respectively at unit speeds of 6.0 and 8.0 km/h

3–figure. Graphs of changes in (a) the width of the loosened layer and (b) the traction resistance of the ripper depending on the length of the working surface.

In table-4. the levels of factors and intervals of their variation are given. They were determined based on the results of theoretical studies and single-factor experiments. When conducting a multifactorial experiment, the degree of soil crumbling, that is, the number of fractions smaller than 50 mm, the width of the soil deformation zone and the traction resistance force of the ripper, were selected as evaluation criteria.

Factors, their coded designation, intervals of their variation and factor levels.

Table 4

Factors	Unit of measurement	Coded designation of factors	Interval varied	Levels of factors		
				-1	0	+1
1.Width ripper	mm	X_1	40	100	140	180
2.Angle of entry of the ripper into the soil	degrees	X_2	10	20	30	40
3.Length of the ripper working surface	mm	X_3	50	150	200	250
4.Unit speed	km/h	X_4	0,5	1,5	2,0	2,5

Based on experimental data, regression levels were obtained that adequately describe the process by:

a) degree of soil crumbling (%)

b) $K=80,672-2,731X_1+2,392X_2+2,595X_3+1,870X_4;$ (1)

c) width of soil deformation zone (cm)

$$B=72,584+5,703X_1+2,785X_2+2,733X_3-1,746X_4-3,824X_2^2; \quad (2)$$

d) ripper traction resistance (kN)

$$P=10,744+2,428X_1+1,110X_3+2,302X_4+0,240X_1X_2+0,259X_1X_3+$$
$$+0,243X_1X_4-0,269X_2X_3-0,262X_2X_4-0,422X_3X_4-0,733X_1^2+$$
$$+0,861X_2^2+0,849X_4^2. \quad (3)$$

Solving the obtained regression equations, based on the condition that the values of the criterion “K” must be at least 80%, “B” is the maximum, “P” is the minimum, we obtain that when the unit speed is between 1.7-2.2 m/s, b □140mm, α and L should be in the range of 30-350 and 150-200 mm, respectively [6].

Based on the theoretical and experimental studies carried out, a combined unit was developed, a prototype was manufactured and tested.

The tests were carried out in the Kurgantepe district of the Andijan region and in the educational farm of the Research Institute of Agriculture, on fields cleared of goose-pai with a row spacing of 90 cm. The test results are shown in Table-5.

Results of experimental tests of the combined unit

5-table

№	Name of indicators	Values of indicators	
		According to agrotechnical requirements	According to the results of experiments
1.	Travel speed unit, km/h	6-8	7,2
2.	Unit working width, cm M_{cp} ±σ	 180 -	 182,4 1,68
3.	Processing depth bottom of the furrow, cm: $M_{ўр}$ ±σ	 30-40 -	 35,7 1,26
4.	Height of ridges, cm $M_{ўр}$ ±σ	 24±3 -	 29,8 0,93

5.	Soil crumbling quality, %: Fraction sizes, mm More than 100 100-50 Less than 50	 10 80 No less 75%	 9,91 8,31 82,4
6.	Depth of loosened zones: M_{cp},cm ±σ,cm υ, %	 55-60 - No less 10%	 62,5 1,59 7,2
7.	Productivity per hour, ha shift time Operating time	 1,08-1,62 0,97-1,46	 1,31 1,18

As can be seen from the data, in Table 5 the performance indicators of the combined unit fully comply with the agrotechnical requirements for it [4]. The depth of processing of the loosened bottom of the furrow is 35.5 cm (according to agricultural requirements 30-40 cm) and the height of the fermented ridges is 25.6 cm (according to agricultural requirements 24 ± 3 cm). The quality of soil crumbling for fractions smaller than 50 mm is 82.4-84.3% (according to agricultural requirements, this figure should be no less than 75%), the coefficient of variation in the depth of loosened zones is 7.2% (according to agricultural requirements, no more than 10%).

Calculations based on the initial data showed that the use of new combined units when cultivating soil reduces operating costs per 1 hectare and amounts to 12.7%, the annual economic effect from one unit is 32,082,970 soums.

Conclusion

1. Existing technologies for preparing soil for sowing seeds consist of a variety of agrotechnical activities, such as spreading fertilizers, plowing, harrowing, chiseling, mulching and forming ridges, carried out separately, which leads to an increase in labor costs, fuel and other material costs, destruction of the structure and changes in soil compaction.
2. When preparing the soil for sowing, a reduction in fuel consumption and other costs, as well as the negative impact on the soil from agricultural machinery and an increase in cotton yield can be achieved using a combined unit that performs the technology of simultaneous fertilizer sowing and strip loosening of the soil and the formation of ridges on these ridges.
3. As studies conducted in the Kurgantepe district of the Andijan region together with the Andijan branch of the Uzbek Research Institute of Cotton Growing show, the use of a combined unit ensures an increase in cotton yield and a reduction in water consumption.
4. Calculations based on the initial data showed that the use of a new combined unit for soil cultivation reduces operating costs per 1 hectare by 12.7%, the annual economic effect per unit is 32,082,970 soums.

REFERENCES:

1.Худоёров А., Мамадалиев М. Теоретическое обоснование параметров рыхлителя комбинированного агрегата // Техника в сельском хозяйстве.– Москва, 2009. - №2.-С.9-11.

2. Худоёров А.Н., Мамадалиев М.Х., Муродов Р.Х. Motivation of the geometric form of loosseners working surface of multifunction unit // European Science Review.- Austria, Vienna, 2016- С.138-140.

3.M.T.Mamarasulova, M.Kh.Mamadaliyev, R.A.Abdirkhmonov. Theory and experimental results of surveys to determine the diameter of teeth plank. International Journal of Mechanical Enjineering. Vol. 7 No. 3 March, 2022, 578-581.

4.M.T.Mamarasulova, M.Kh.Mamadaliyev, R.A.Abdirkhmonov. Methodsand Results of Experimental Investigations. Jundishapur Journal of Microbiology. Vol 15, No.1 (2022), 1843-1849.

5.M.Kh.Mamadaliyev,M.M. Halilov, M.A.Rozimatov, X.N.Raxmonov. Cotton stalk remover //ACADEMICIA: An International Multidisciplinary Research Journal. Vol 11, Iss 9.(2021), 515-519.

6.М.Т.Мамарасулова, М.Х.Мамадалиев, Р.А.Абдирахмонов. Результаты проведенных экспериментальных исследований комбинированного дискового машины. // Экономика и социум. №2(93) 2- часть, февраль 2022, 739-742 стр.

7. Р.А.Абдирахмонов, Н.Н.Ғаниева. Изучение рабочие показателей глубокорыхлителя в зависимости на его длины. // UNIVERSUM: ТЕХНИЧЕСКИЕ НАУКИ, 2021 апрель, 4(85) част 1, 41-43стр.