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OPTIMIZATION OF THE PARAMETERS OF THE DEVICE FOR HARVESTING AND PILING CUNJUT TUPLES

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Abstract. This article presents the results of multifactorial experiments conducted according to the Hartley-3 (Ha3) plan to verify the values obtained in theoretical and single-factor experimental studies for determining the parameters of a device that cuts and piles sesame plants, as well as to establish their optimal values.

Experiments were conducted on the harvesting of the local sesame variety "Tashkent-112" for the 2025 harvest. As a result of the research, it was established that to ensure the reaping and piling of sesame bushes at the required level, the speed of the unit should be 7.2-9.6 km/h, and the installation angles of the piler relative to the direction of movement and the vertical should be 35° and 10°, respectively.

Keywords: Sesame, mowing, stacker, installation angle.

1. INTRODUCTION

In many sesame-growing countries of the world, a large part of the harvest is harvested by manual labor, which accounts for about 80 percent of the total costs of sesame cultivation. Therefore, reducing manual labor during sesame harvesting and minimizing costs and grain losses remains one of the pressing issues [1].

In our republic, comprehensive measures are being implemented to reduce labor and energy consumption in agricultural production, conserve resources, cultivate agricultural crops based on advanced technologies, and develop high-performance agricultural machinery, including special attention being paid to the production of technical means that ensure high-quality execution of technological work processes with minimal energy consumption [2,3,4].

To ensure the quality of the technological harvesting process at the required level, when creating promising high-efficiency harvesting devices for sesame harvesting, it is advisable to optimize the device parameters, determine the patterns of sesame bush stacking depending on the speed of the unit's movement, the stacker's installation angles relative to the vertical, and the direction of movement.

Based on the above, a device for mowing sesame bushes was developed at KKhMITI [5,6]. The device is a mounted one, aggregated with 0.6 class mini-tractors, and consists of the following main components: frame 1, mounted device 2, cutting apparatus 3 and its drive 8, inner 7 and outer 4 shoes, right 5 and left 6 working organs forming shafts (Figure 1).

To process the results of theoretical and single-factor experimental studies of a sesame bush harvesting device and determine their optimal values, multi-factor experiments were conducted according to the Hartley-3 (Ha3) plan.

Figure 1. Rear view of the harvesting device in the aggregated state

The following factors were taken as the factors that had the greatest impact on the device's performance indicators: X1-the angle of installation of the plant stem guide relative to the direction of movement, X2-the speed of the unit's movement, and X3-the angle of installation of the plant stem guide relative to the vertical (Table 1).

Table 1. Factor designations, levels, and variation intervals

	Factors and their units of measurement	Condi-tional designa-tion	Range of variation	Factor le…	
				-1	0
1	Angle of installation of the stacker relative to the direction of movement, deg.	X_1	5	30	35
2	Unit movement speed, km/h	X_2	1.2	7.2	8.4
3	Angle of installation of the stacker relative to the vertical, deg.	X_3	5	5	10

The results of the experiment were processed in the prescribed manner, and the following regression equations were obtained, adequately expressing the evaluation criteria:

Average width of stacks, mm

$$Y_1 = +39{,}565217 - 2{,}500000\,X_1 - 1{,}277778\,X_2 - 0{,}833333\,X_3 + 3{,}876812\,X_1^2 + 2{,}083333\,X_1X_2 + 2{,}876812\,X_2^2 - 1{,}289855\,X_3^2. \quad (1)$$

Distance of stem displacement from the cut place, mm

$$Y_2 = +69{,}681159 + 13{,}944444\,X_1 - 1{,}500000\,X_2 + 6{,}398551\,X_1^2 + 3{,}416667 + X_1X_3 + 3{,}231884\,X_2^2 - 1{,}101449\,X_3^2. \quad (2)$$

Analysis of the obtained regression equations and graphs constructed based on them (Figures 2 and 3) shows that all factors had a significant impact on the evaluation criteria. The obtained regression equations (1) and (2) were solved together using MS Excel and PLANEXR programs from the conditions that the Y1 criterion should be 400 mm or less, and the Y2 criterion should tend to a minimum. The obtained results showed that at the unit's speed values of 7.2-9.6 km/h, to ensure the harvesting of sesame stalks at the required level, the stacker's installation angles relative to the movement direction and vertical should be 35° and 10°, respectively (Table 2). At these values, the

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average roll width and the distance of stem movement from the cutting point were 350 mm and 500 mm, respectively, which ensured the high-quality execution of the technological process.

Table 2. Optimal values of the parameters of the device for harvesting and piling

X_2		X_1		X_3	
Encoded	Natural	Encoded	Natural	Encoded	Natural
– 1	7,2	0,19	36	-0,54	7,3
0	8,4	0,02	34,9	-0,1	9,5
+1	9,6	0,007	35	1	10

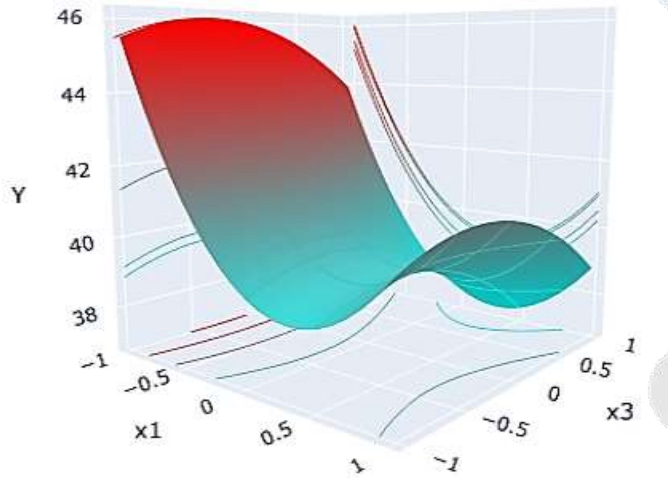

Figure 2. Change in the width of the heap depending on factors X_1 and X_3 at X_2 - 0

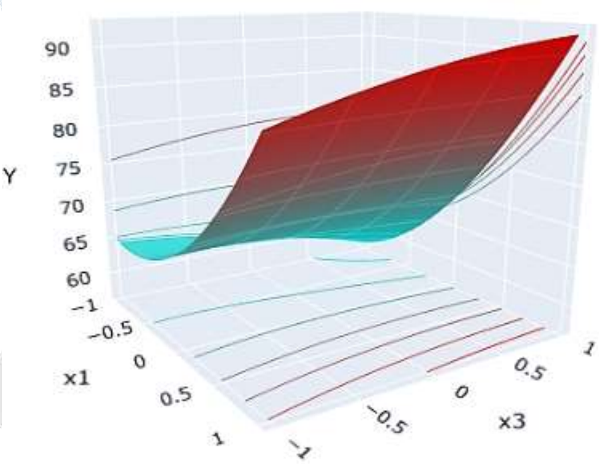

Figure 3. Change in stem displacement distance depending on factors X_1 and X_3 at X_2-0.

Conclusion

To minimize grain loss during harvesting, it is necessary to ensure that sesame stems are not crushed by the unit's wheels and are moved at minimal distances. The high-quality execution of the technological process was ensured when the installation angles of the stackers relative to the direction of movement and vertical were 35° and 10°, respectively, and the unit's movement speed was within 7.2-9.6 km/h, while the average distance of stem movement was 500 mm, and the stack width was 350 mm.

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