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RESULTS OF MULTIFACTOR EXPERIMENTS CONDUCTED ON THE BASIS OF THE PARAMETERS OF THE DEVICE THAT CREATES TRANSVERSE PAWLS BETWEEN COTTON ROWS

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Abstract: The article presents the results of multifactorial experiments to substantiate the optimal values of the parameters of the device for adapting to a cotton cultivator for the formation of transverse pawls between cotton rows.
Key words: between cotton rows, device for the formation of transverse pawls, device parameters, optimal values of parameters, movement speed, height of soil stacker, horizon angle and its curved radius of working surface.

1 Introduction

The irrigated lands in the cotton-growing areas of republic of Uzbekistan are divided into three regions according to the natural-climate and soil conditions, the mechanical composition of the soil, the technologies of its processing and the types of machines used, as well as the agrotechnical requirements on them. In the Bukhara, Navoi, Khorezm regions and the Republic of Karakalpakstan with saline soils, which belong to the third region, during the period of cotton cultivation, longitudinal and transverse pawls are formed between cotton rows, the cultivated areas are divided into small pieces and irrigation by salt washing method. Because in these regions, it is possible to get a sufficient yield of cotton only by using this method. Otherwise, namely, if the cotton is not full watered, as a result of the rise of soil salinity to the surface of the field, the development of plants deteriorates (even cases of their drying are observed), and productivity decreases.

Longitudinal pawls are taken once before the first irrigation for the entire season, while transverse pawls are made before each irrigation and broken after irrigation before inter-row processing of cotton. Because if they are not damaged, the cultivator's working equipments will not be able to work stably according to the working depth, the load on the working equipments will increase, and as a result, their deformation and breakage will be observed. For this reason, after each watering, as soon as the soil is ready for cultivation, the transverse pawls are broken up, and then the rows are cultivated with a cultivator. Before the next watering, the transverse pawls are formed again. Until now, making and breaking of transverse pawls is not mechanized and is done by hand, and this causes an increase in the cost of production in cotton cultivation [1].

2 Research object and method

Based on the above, a device was made for the cotton cultivator to form transverse pawls between the rows of cotton in the Scientific-Research Institute of Agriculture Mechanization (SRIAM).

The device consists of five buckets (soil stackers) that making transverse pawls, which are installed on the grids of the cultivator sections after the working equipments (Fig. 1). The buckets are moved to the working position in the areas where the transverse pawls is formed with a special shaft, hydraulic cylinder and pullers installed on the frame of the cultivator and are lifted after the pawl is formed.

This article presents the results of multifactorial experiments conducted on the basis of the parameters of the device that formes transverse pawls between cotton rows.

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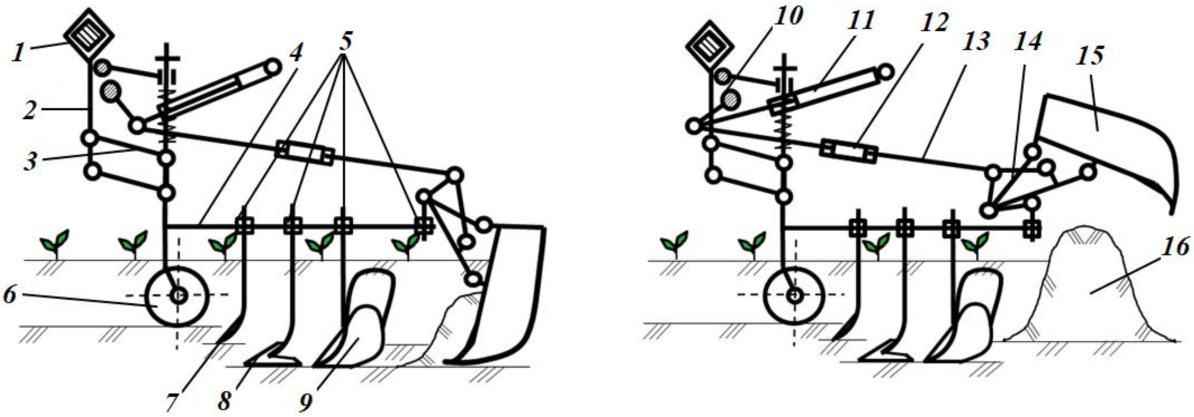
The optimal values of the parameters of the device that obtain the poles were determined using the method of mathematical planning of multifactorial experiments.



а) б)

a) the bucket is in working condition; b) in the raised position

1-cultivator frame; 2- reducer; 3-parallelogram mechanism; 4-beam; 5-hung locks; 6-support wheel, 7-shovel; 8-sweep; 9-hiller; 10-bucket lifting shaft; 11-device hydraulic cylinder; 12-bucket adjustment screw; 13-puller; 14-bucket lifting and lowering mechanism; 15-bucket; 16-transverse pawl.

Fig. 1 The scheme of the cultivator section in the position where the bucket is installed

In this case, it was considered that the effect of the factors on the evaluation criteria is fully explained by the second-order polynomial and the experiments were conducted according to the Hartley-4 (Ha_4) plan [2].

Table 1 lists the factors, their designations, change intervals and levels.

When conducting multi-factor experiments pawl height (Y_1, cm) and device traction resistance (Y_2, N) were accepted as evaluation criteria.

Table 1

Factors, their designations, change intervals and levels

Factors and their units of measurement	Conditional designation	Change interval	Levels		
			lower (–1)	main (0)	high (+1)
height of soil stacker *h, cm*	X_1	5	35	40	45
horizon angle of soil stacker *β, °*	X_2	15	45	60	75
curved radius of working surface of soil stacker, *R, cm*	X_3	15	20	35	50
Aggregate movement speed, *V, km/h*	X_4	1	5	6	7

In order to reduce the impact of uncontrollable factors on the evaluation criteria, the sequence of experiments was determined using a table of random numbers [3].

3 Analysis and results

The data obtained in the experiments were processed according to the "regression analysis" program created at the experimental testing department of the Scientific-Research Institute of Agriculture Mechanization [4] and the following regression equations were obtained that adequately represent the evaluation criteria:

- pawl height, *cm:*

$$Y_1 = 21,343 – 0,493\ X_1 + 1,318\ X_2 + 0,307\ X_3 –$$

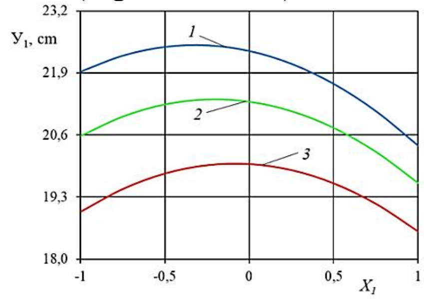
$$– 1,183\ X_4 – 1,205\ X_1X_1 – 0,516\ X_1X_2 + 0,284\ X_1X_4 – 1,255\ X_2^2 –$$

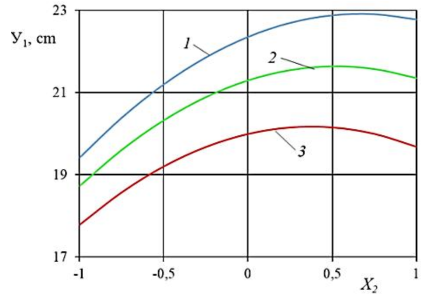
$$– 0,225\ X_2X_3 – 0,367\ X_2X_4 + 0,790\ X_3^2 – 0,375\ X_3X^4 – 0,126\ X_4^2; \qquad (1)$$

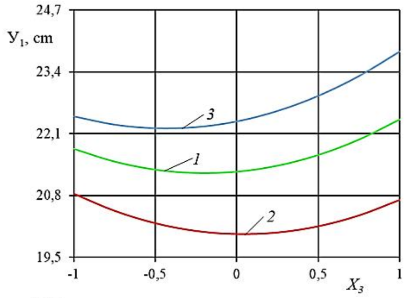
- device traction resistance, *N*:

$$Y_2 = 945,159 + 29,932\ X_1 – 50,050\ X_2 + 96,648\ X_3 +$$
$$+ 52,453\ X_4 – 29,901\ X_1^2 + 13,066\ X_1X_2 + 24,950\ X_1X_3 +$$
$$+ 10,552\ X_1X_4 – 121,822\ X_2^2 + 18,306\ X_2X_3 – 15,016\ X_2X_4 –$$
$$– 40,000\ X_3^2 – 20,838\ X_3X_4 + 79,738\ X_4^2; \qquad (2)$$

The analysis of regression equations (1) and (2) at the same time graphical connections built on them (Figures 2 and 3) shows that all factors had a significant impact on the evaluation criteria.



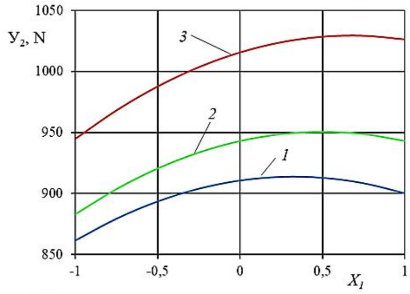


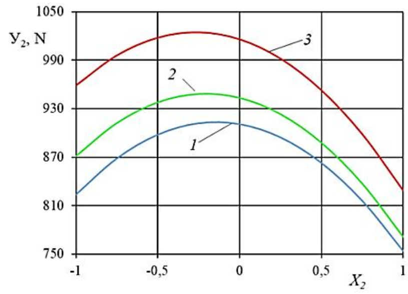


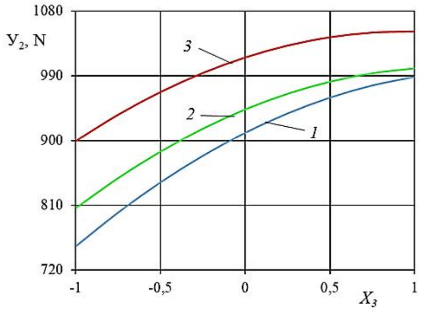
1,2 and 3 respectively X_4

When -1; 0 and 1

Fig. 2. Graphs of change of pawl height Y_1 depending on factors X_1, X_2, X_3 and X_4







1,2 and 3 respectively X_4

When -1; 0 and 1

Fig. 3. Graphs of change of device traction resistance Y_2 depending on factors X_1, X_2, X_3 and X_4

Regression equations (1) and (2) were solved from the conditions that the "Y_1" criterion, that is, the height of the pawl is in the range of 18-22 cm, and the "Y_2" criterion has a minimum value, and the following values of the factors ensuring the fulfillment of these conditions were determined (Table 2).

Table 2

Acceptable values of the device that receives the transverse pawls

X4		X1		X2		X3	
coded	real	coded	real	coded	real	coded	real
1	7	0,9946	44,97	0,2840	64,26	0,3915	40,87
0	6	0,8512	44,26	0,1274	61,91	0,6074	44,11
-1	5	0,7646	43,82	0,2384	63,58	0,7512	46,27

According to the given data, the height of the soil stacker is 44-45 cm, the angle of installation of the soil stacker relative to the horizon is 62-64 ° and the curved radius working surface of the soil stacker is 44-45 cm in order for the device to create a transverse pawl with low energy consumption at aggregate movement speeds of 5.0-7.0 km/h. curved radius of working surface of soil stacker should be between 40,87 – 46,27 cm.
At these values of the factors, the height of the transverse pawl is 18,73-22,26 cm, traction resistance of the device is 1040,18 – 1098,72 N.

4 Conclusions

According to the results of the conducted studies, in order to ensure the required height of the transverse pawl with low energy consumption, the height of the soil stacker should be 44-45 cm, the angle of installation of the soil stacker relative to the horizon should be 62-64 ° and curved radius working surface should be 41-46 cm.

REFERENCES

1. Tukhtakuziev A., Olimov Kh.Kh., Nuriddinov Kh., Sobirov K.S. Laboratory study of the technological process of the screw device for formation of longitudinal pawls between cotton rows and simulation of the obtained results. IOP Conference Series: Earth and Environmental Science, 2021, 868(1), 012065
2. Augambaev M., Ivanov A.Z., Terekhov Y.I. Fundamentals of planning a research experiment.//. – p. 336. – Tashkent: (1993)
3. B.A. Dospexov Methodology of field testing.//. – p. 416. - Moscow, (1979).
4. Vednyapin V.V. General methodology for experimental research and processing of experimental data. –p. 199. – Moscow: (1973).
5. Olimov Kh.Kh., Juraev A.N., Imomov S.J., Orziev S.S., Amrulloev T.O. Application of energy and resource engineering software in cotton fields. IOP Conference Series: Earth and Environmental Science, 2021, 868(1), 012067.
6. Olimov Kh., Juraev A., Ochilov M. Methods founding construction and parameters of longitudinal screw pawl-creating device. IOP Conference Series: Materials Science and Engineering, 2020, 883(1), 012170
7. Olimov Kh., Juraev A. Determining the cross profile of manmade pawl and furrow before creating longitudinal pawl between cotton rows. IOP Conference Series: Materials Science and Engineering, 2020, 883(1), 012171
8. Olimov Kh., Khasanov I., Imomov Sh. Mathematical modeling of the technological process of operation and parameters of the device for formation of longitudinal rollers (pawls) between cotton rows. E3S Web of Conferences, 2021, 264, 04070. https://doi.org/10.1051/e3sconf/202126404070
9. Ismatovna, T. D., Ikramovich, K. A., Djaxanovich, I. S., &Farhodovich, M. F. (2019). Dynamic Modeling of Vibrating System N-S Component Parts Which of That the Mobile Machines for Fast Acting Pneumatic Actuator with Self-Damping. In International Conference on Information Science and Communications Technologies: Applications, Trends and Opportunities, ICISCT (2019). Institute of Electrical and Electronics Engineers Inc. https://doi.org/10.1109/ICISCT47635. 2019.9012010.

10. Ermatova, D., Imomov, S., Matmurodov, F.Mathematical modeling of the interaction of the main parts of a wheel tractor and the numerical determination of the operator's seat oscillation IOP Conference Series: Earth and Environmental Science, 614 (1). (2020).
11. Vafoev, R., Vafoev, S., Akhmedov, S., Imomov, S.Method for sealing ground in trench closed drain IOP Conference Series: Earth and Environmental Science, 614 (1).(2020).
12. Marupov, I., Imomov, S., Ermatova, D., Majitov, J., Kholikova, N., Tagaev, V., Nuritov, I.Research of vertical forces for acting tractor unit IOP Conference Series: Earth and Environmental Science, 614), (2020).
13. Sharipov, L.A., Imomov, S.J., Majitov, J.A., Komilov, O.S., Sharipov, M.Z., Pulatova, F., Abdisamatov, O.S.Modeling of heat exchange processes in the Metanetka bioenergy plant for individual use IOP Conference Series: Earth and Environmental Science, 614 (1). (2020).
14. Imomov, S., Shodiev, E., Tagaev, V., Qayumov, T. Economic and statistical methods of frequency maintenance of biogas plants IOP Conference Series: Materials Science and Engineering, 883 (1). (2020).
15. O. Salimov, Sh. Imomov, Z. Mamadalieva. Methodology for assessing the reliability of biogas plants operating under rarefaction conditions/ / Irrigation and reclamation,pp. 106-110. (2018).