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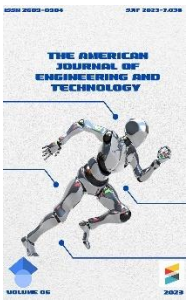

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Research Article

OPTIMIZATION OF THE PARAMETERS OF THE SOIL MOVING KNIFE PLATES FOR TREATMENT OF SLOPES OF RIDGES

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ABSTRACT

The article presents the results of the optimal parameters of the soil-shifting plates mounted on knives for processing the slopes of the ridges for sowing seeds of gourds.

KEYWORDS

Treating soil ridges, knives, soil-moving plates, angle of the soil-moving plates, height of the soil-moving plates, number of soil-moving plates, parameter optimization.

INTRODUCTION

In the developed countries of the world, questions about energy- and resource-saving techniques and technologies have been relevant for several decades. Based on this in The "Scientific-Research Institute of Agricultural Mechanization" (SRIAM) of Uzbekistan developed a combined unit (Fig. 1) for pre-sowing tillage and sowing seeds of gourds on ridges [1].

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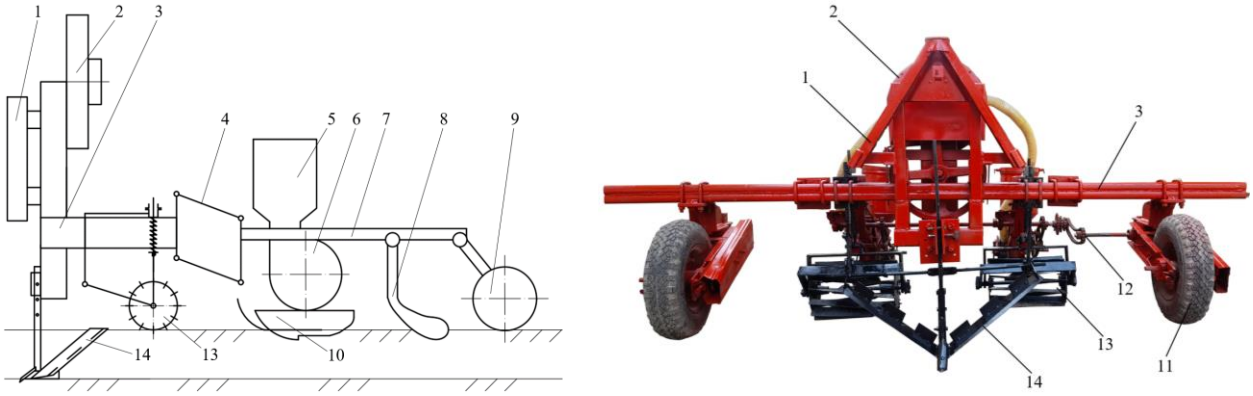

a) *b)*

1 – automatic coupler; 2 – exhauster; 3 – frame; 4 – parallelogram mechanicm

5 – seed hopper; 6 – pneumatic sowing machine;

7 – beds; 8 – harrower ; 9 – rolling ; 10 – skid opener;

11 – support wheel; 12 – chain drive; 13 – rotary ripper; 14 – knife

Figure - 1. Technological scheme *(a)* and general view *(b)* of the combined unit

The unit is designed to work in early spring on fields with cut ridges prepared in autumn.

The technological process of the unit operation is as follows: knives with soil-shifting plates process the bottom of the irrigation furrow and the slopes of the ridges to a depth of 4-6 cm, destroying weeds and destroying the soil crust, without disturbing the profile of the ridges. Rotary rippers installed behind the knives work the top of the ridges (sowing zone) to a depth of 4-6 cm, thereby destroying the soil crust, and prepare the seed layer for sowing seeds. Pneumatic sowing units installed behind the rotary cultivators precisely sow the seeds of melons and gourds on the prepared soil.

This article presents the results of multifactorial experiments to determine the optimal parameters of soil-shifting plates mounted on knives (Fig. 2).

One of the main requirements for the working bodies for processing the slopes of the ridges is the preservation of the shape (required height) of the ridges with minimal energy consumption. From the conducted theoretical studies and single-factor experiments, it follows that the main factors that have the greatest impact on these indicators are the angle γп of the installation of plates to the direction of movement of the unit, the height hп of ¬the plates, the number of nn plates on the knife and the speed V movement of the aggregate [2,3].

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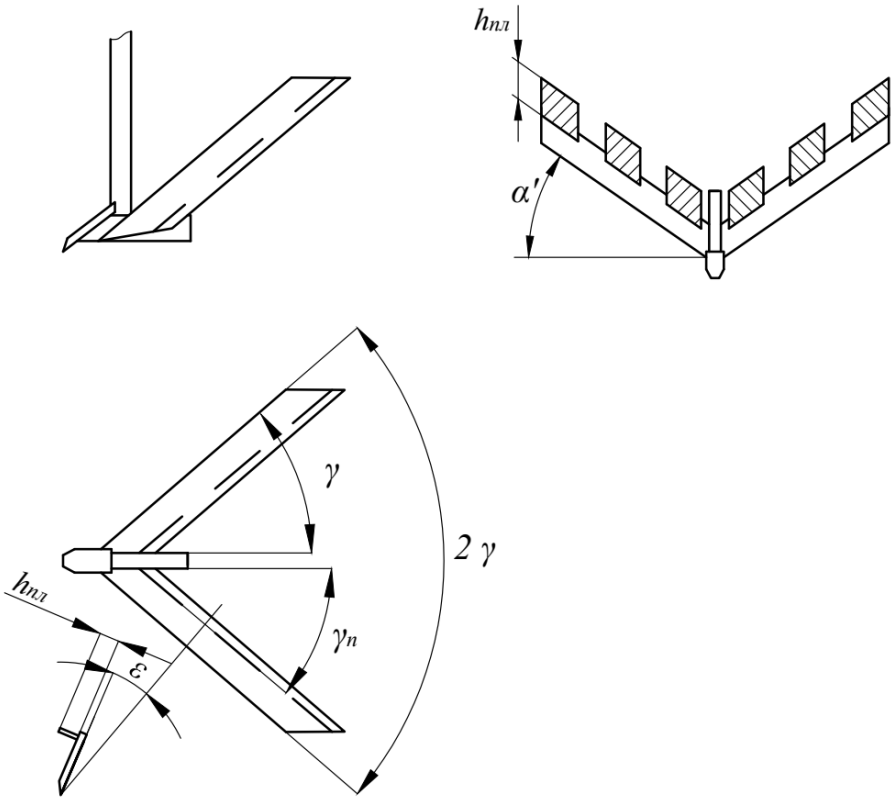

Figure - 2. Knife with soil-moving plates

In this case, the angles α = 18° and γ = 30° of the knife installation, respectively, to the horizon and direction of movement, the angle ε = 30° of the knife entering the soil and the length l = 65 cm of the knife are taken constant on the basis of theoretically obtained values.

In order to determine the rational values of these parameters, a four-factor experiment was implemented according to the Hartley-4 (Na 5) plan [4; 241-243-b., 5; 195-196-b.].

The levels and intervals of variation of the studied factors are shown in table 1.

The experiments were carried out on the fields of the experimental farm of the SRIAM.

Table 1

Levels of factors and intervals of their variation

Factors and their unit of measurement	Conventions	Variation intervals	Factor levels

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			lower (-1)	basic (0)	top (+1)
Angle γ_n of the installation of soil-moving plates to the direction of movement of the unit, grad	X_1	5	25	30	35
Plate height h_n, cm	X_2	1	7	8	9
Number of plates n_n, pcs.	X_3	1	2	3	4
The speed of movement of the unit V, km/h	X_4	1	6	7	8

The criteria for evaluating the quality of the work of the soil-shifting plates were the height of the ridge and the traction resistance of the working body when processing the slopes of the ridges.

As a result of processing experimental data on a PC using the

"Planexp" program developed in the experimental testing department of the SRIAM, the following regression equations were obtained that adequately describe:

- ridge height, cm:

$$Y1=18,92-0,505X1+1,052X2+0,563X3+0,716X4-0,701X12-$$
$$-0,123X1X4-0,641X22-1,000X32-0,319X3X4-0,531X42; \quad (1)$$

- traction resistance of the working body, N:

$$Y2=0,629-0,198X1+0,295X2+0,150X3+0,200X4+0,541X12+$$
$$+0,045X1X2+0,042X1X3+0,014X1X4-0,297X22+0,039X2X3-$$
$$-0,031X2X4-0,012X32-0,223,000X3X4+0,078X42; \quad (2)$$

To determine the optimal parameters of the soil-shifting plates, providing a ridge height in the range of 18 to 20 cm with a minimum traction resistance of the working body, equations (1) and (2) were solved by the method of "penalty" functions at given values of the forward speed of the unit [4,5]. The results are shown in table 2.

Table 2

Rational parameter values

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X_4		X_1		X_2		X_3	
encoder.	nature.	encoder.	nature.	encoder.	nature.	encoder.	nature.
1	8	-0,0532	29,7342	-0,1756	7,8244	-0,0614	2,9386
0	7	-0,0011	29,9944	-0,4521	7,5479	-0,1682	2,8318
-1	6	0,0461	30,2305	-0,1669	7,8331	-0,1517	2,8483

Thus, it has been established that at the speeds of movement of the unit

6-8 km/h to ensure the height of the ridges in the range from 18 to 20 cm with a minimum traction resistance of the working body, the angle of installation of the plates to the direction of movement of the unit should be in the range from 29°44' to 30°14', the height of the plates from 7,55 to 7,83 cm and the number of plates from 2,83 to 2,94 pcs. Given that the number of plates must be an integer, we re-optimize it, taking X3 = 3 pcs. at machine speeds of 6-8 km/h, and obtain the following results (table 3).

Table 3

Rational parameter values

X_4		X_1		X_2		X_3	
encoder.	nature.	encoder.	nature.	encoder.	nature.	encoder.	nature.
1	8	-0.0515	29.7426	0.0895	8.0895	0.0000	3.0000
0	7	0.0018	30.0092	-0.5451	7.4549	0.0000	3.0000
-1	6	0.0500	30.2501	-0.1996	7.8004	0.0000	3.0000

Therefore, with the number of soil-moving plates equal to 3, at unit speeds of 6-8 km/h, the angle of installation of the plates to the direction of movement should be in the aisles from 29°45' to 30°15', and the height of the plates should be from 7,45 to 8,09cm. Assuming the following parameter values: α = 30°, h = 8 mm and

n = 3 pcs.

CONCLUSION

Thus, the following conclusion can be drawn from the results of the multifactorial experiments: a combined

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unit for pre-sowing tillage and sowing of gourds on ridges, equipped with a knife with soil- moving plates of 3 pieces on each knife wing, with a plate height of 8 cm and an angle of their installation to the direction movement of the unit 30°, will provide high-quality surface treatment of the slopes of the ridges with minimal energy consumption.

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