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TILLAGE IMPLEMENTS FOR MELON CULTIVATION UNDER THE FILM

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Abstract: The aim of the study is to develop a machine for preparing the soil for sowing melons under a tunnel film. The authors have developed a machine for preparing the soil for sowing melons under a tunnel film, which is equipped with deep-diggers with an inclined stand of the "paraglaw" type, a furrow maker and rotary working bodies. When using the developed machine for preparing the soil for sowing melons under the film, the direct cost of processing one hectare of area is reduced by 32.4%.

1.Introduction

Navadays, the preparation of fields for sowing melons, consisting of plowing, harrowing and cutting of irrigation furrows, is carried out by separate units, which in turn leads to the loss of soil moisture, delaying the sowing period and increasing operating costs [1-7].

Research on the creation of machines for preparing the soil for sowing melons, justification and improvement of technological processes of their working bodies and parameters were carried out by F. M. Mamatov [1-4], D. Sh. Chuyanov [5], V. G. Abezin [28], Kh. Fayzullaev [6-7] and others. However, in these studies, the issues of substantiating the parameters of the working bodies of a combined machine for sowing melons under a closed tunnel film, which ensure high quality of work with minimal energy consumption, are not sufficiently studied.

From the analysis of the research, we came to the following conclusions that the reduction of fuel consumption and other costs, as well as harmful effects on the soil of agricultural tools, can be achieved by using tillage tools that perform all technological processes (loosening the soil to a given depth, leveling its surface part, compaction and cutting furrows) of preparing the soil for sowing melons under the film in one pass of the unit across the field.

The purpose of the study is to develop a tillage tool for preparing the soil for sowing melons under a film.

2.Methods and results

The authors developed a tillage tool based on a non-shaft working bodies of the "paraplau" type, designed to prepare the soil for sowing melons under the film. Combined machine (Fig. 1) frame 1 and mounted suspension 2, support wheels 3, axle claw 4, right and left pair of pits 5 and 6, bearing 7, parallelogram mechanism 8, rotary worker The organ consists of 9. The combined

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machine is aggregated with Class 2 tractors.

The frame is fixed to the frame by means of an axial claw, recesses and a clamp (fixed), the rotating working body is hinged (movable) by means of parallelogram mechanisms. During the work, the claw softens the middle part of the cultivated strip to a depth of 10-12 cm and a width of 26 cm, the dredgers soften the planting zones, the ditch forms an irrigation ditch, and the rotary dredgers create a seed or seedling line. It softens the top of the ridges and forms a soft layer on it.

The machine prepares the entire tunnel for planting with a closed tunnel in one pass through the field.

To study the transverse and longitudinal distance between the deep dredgers, as well as the working speed on their traction resistance and the degree of soil crumbling, multivariate experiments were conducted using mathematical planning of experiments.

The multivariate experiments were conducted according to the Hartley – 4 plan. At the same time, the main factors were selected as the longitudinal (X_1), and transverse (X_2) distance between the deep reclaimers, the depth of processing (X_3) of the deep reclaimers, as well as the speed of the unit (X_4).

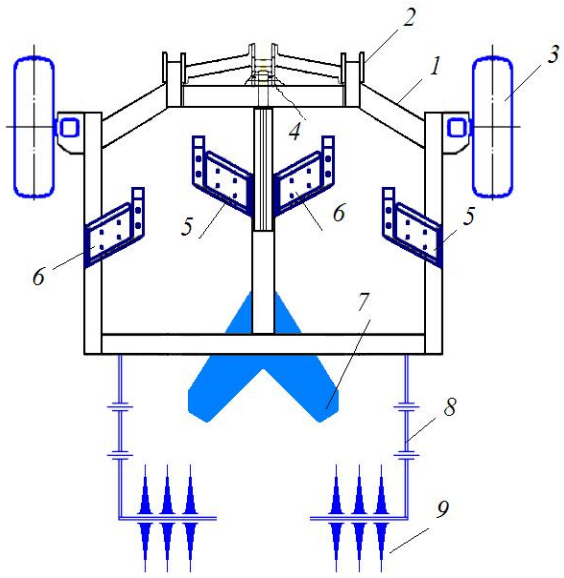

Fig.1. Constructive scheme of the tillage tool

(view from above): 1 – frame; 2 – hanging device; 3 – base wheels; 4 – story claw;

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5 and 6 – left and right pits; 7 – drain; 8 – parallel mechanism; 9 – rotary working body.

The degree of soil crumbling (Y_1), i.e. the amount of fraction less than 50 mm in size and the traction resistance (Y_2) of deep-diggers were used as evaluation criteria.

The data of the obtained multivariate experiments were processed according to the PLANEX program. At the same time, the Cohren criterion was used to estimate the variance of adequacy, the Student criterion was used to estimate the values of the coefficients, and the Fisher criterion was used to evaluate the adequacy of regression models.

The experimental results were processed according to the specified procedure and the following regression equations were obtained that adequately describe the evaluation criteria: by the degree of soil crumbling (%):

$$Y_1 = 82,5+5,5\ X_1- 2,96\ X_2 -0,92\ X_3+5,1\ X_4-2,718\ X_1^2+$$

$$+1,562X_1X_2 +1,121X_1X_4+1,715\ X_2^2-0,471\ X_2X_3--2,813\ X_2X_4-2,518\ X_3^2+0,965\ X_4^2; \quad (1)$$

- according to the specific traction resistance of the deep loader (κN) :

$$Y_2 = 6,467-1,122\ X_1-0,853X_2+1,48\ X_3+0,515\ X_4+0,681X_1^2-$$

$$- 0,124X_1X_2+0,198\ X_1X_3-0,049X_1X_4+1,173\ X_2^2-0,577X_2X_3-$$

$$-0,449\ X_2X_4-0,341X_3^2+0,103X_3X_4+0,324\ X_4^2. \quad (2)$$

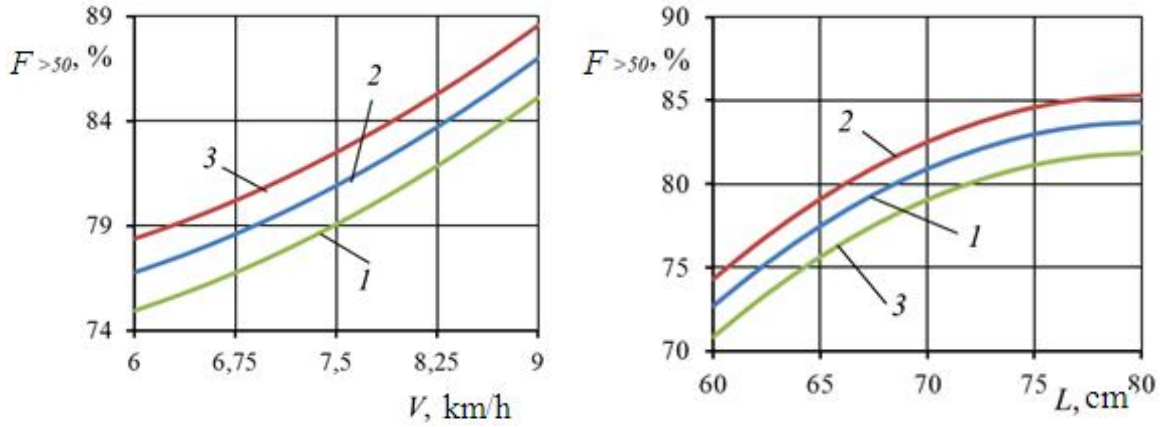

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Fig.2. Dependence plot of soil crumbling on pre-sowing speed: 1, 2 and 3, respectively, at a depth of 26, 30 and 34 cm

Fig.3. Plots of soil crumbling as a function of longitudinal spacing of no-till tools: 1, 2 and 3, respectively, at a depth of 26, 30 and 34 cm

The analysis of the obtained regression equations showed that all factors had a significant impact on the evaluation criteria.

When determining the values of the design parameters that ensure the required quality of pre-sowing processing with minimal energy consumption, the regression equations (1) and (2) were solved together in the MS Excel and Planex programs. In the joint solution of the regression equation, the following conditions were adopted, criterion Y_1, i.e., before pre-sowing treatment, the number of soil fractions with a size of less than 50 mm should be at least 82%, as well as criterion Y_2, i.e. the traction resistance of the non-loose working bodies should have a minimum value.

According to the results obtained, at speeds of 6-9 km / h, to ensure the required quality of work with minimal energy consumption at a processing depth of 26-34 cm, the longitudinal distance between the paired deep reclaimers should be within 72-75 cm, and the transverse distance should be within 50-60 cm. These results correspond to the results of theoretical studies.

Based on the results of theoretical and experimental studies, an experimental sample of a tillage tool was made (Fig. 4 and 5).

Fig.4. General view of the combined machine in the unit with the tractor T 100 A

(side view)

The main parameters of the working bodies of the combined machine are: the angle of entry of

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the bit of the deep dredger 200; the width of the bit is 5 cm, the maximum depth of processing of the deep-digger is 34 cm, the height of the deep-digger is 70 cm, the longitudinal and transverse distance between adjacent deep-diggers is 70 cm and 60 cm, respectively, the longitudinal distance between the deep-digger and the pointed foot is 40 cm, the transverse distance between the deep-digger and the support wheel is 12 cm, the longitudinal distance between the deep-digger and the furrow cutter is 52 cm, the longitudinal distance between the furrow cutter and the rotary working body is 120 cm. The working width of the developed machine is 1.4 m, the depth of tillage is 33-34 cm, the working speed is 6-9 km/h.

In one pass, the following parameters of a combined machine that prepares the soil for planting melons under a closed tunnel film were determined: depth of cultivation; soil compaction quality; relief of the planting area; width and depth of irrigation ditches; work productivity; fuel consumption.

Fig.5. Fragment of the combined machine operation

The study was conducted in 2019-2022 in the Kashkadarya region of Uzbekistan. Type soil dredger light serous. Moisture content of soils 0-10, 10-20, 20-30, 30-40 cm were 1.86; 1.18; 1.91; 2.35 MPa and 16.9; 17.9; 18.6; 17.9%.

Specifications of the combined machine Tst 63.04:2001 "Testing of agricultural machinery. Machines and tools for surface tillage. Program and test methods", Tst 63.02:2001 "Testing of agricultural machinery. Machines and tools for deep tillage. Program and test methods" and Tst 63.03:2001 "Testing of agricultural machinery. Energy assessment methods" detected.

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In the tests, the machine was aggregated with a TL 100A tractor (Fig.5). Table 1 shows the results of the combined machine tests. The trials were conducted in fields intended for planting melons in early spring (Fig. 5).

In the tests, the planting depth was set at 33 cm, but in practice the average value was 32.5 cm. Fractions smaller than 25 mm in size averaged 81.1%. The width of the upper part of the irrigation ditch was 50.8 cm and the depth of the irrigation ditch was 23.4 cm (Fig.5).

Table 1. Combined machine test results

№	Name of indicators	According to agrotechnical requirements	Based on the test results
1	Operating speed, km / h	6 - 9	7,3
2	Depth of planting area (pits), cm: $M_{ave.}$ ±σ *v;* %	 from 32 см to 34 см ±2 <10	 32,5 2,5 5,3
3	The amount of the following size fractions in the soil of the area treated by the pits, % > 50 mm 50-25 mm < 25 mm	 < 10 - > 80	 9,2 9,7 82,3
4	Depth of irrigation ditch, cm	25 ± 3	24,5
5	The width of the upper part of the irrigation ditch, cm	50± 3	51,2
6	Fuel consumption, kg / ha	no information	10,2

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These data show that the performance of the combined machine meets the agro-technical requirements.

The combined machine developed in the tests performed the specified technological process completely and reliably, and the test results fully meet the requirements.

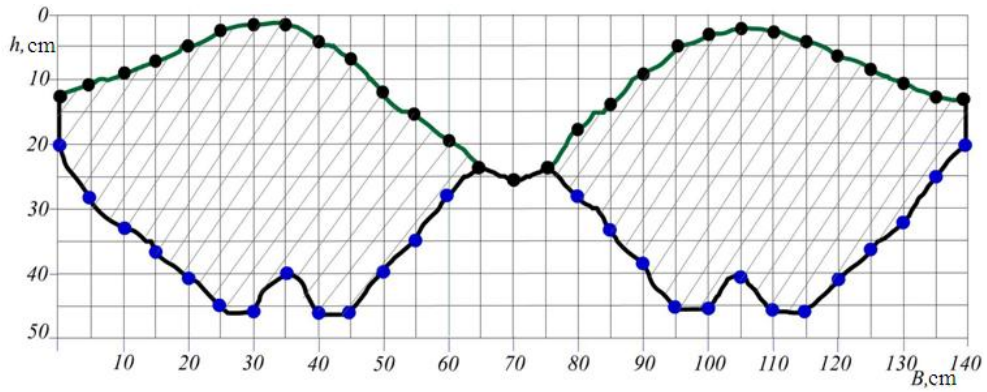

Fig.6. Cross-section profile of the field after processing by the machine

Calculations show that the use of a combined soil preparation machine for planting melons under a closed tunnel film reduces the direct (operating) costs per 1 hectare by 32.5%.

1 Conclusions

1. The test results have established that the developed machine reliably performs the specified technological process and its performance indicators fully meet the requirements.

2. The use of a combined machine for preparing the soil for sowing melons under a film developed on the basis of research for tillage during preparation reduces the direct cost of processing 1 hectare of area in comparison with the technical means used by 32.5 %.

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