Original Article

Soil Tillage Unit For Repeated Crops

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Abstract

Based on the test results, a section of working bodies was selected for strip tillage, theheight, the length of the soil disks were determined experimentally. As well as the test result acceptable for strip tillage is a combination of working bodies, consisting of a one cutting paws with a soilproviding high rates of soil crumbling quality well as cleansing them of stubble and roots.

Keywords: cultivator section, the length of the soil bodies, lancet paw, flat-cutting paw, cultivated strip, strip tillage, sangle.

1. Introduction

Studies carried out in UzMEI, UzPITI, as well as other scientific institutions have shown [1,5] that strip tillage with simultaneous sowing is the most promising for growing forage crops after grain crops. In this case, in one pass of the unit, the soil is loosened in the zone of passage of the seeding working bodies of the seeder and the sowing of the seeds of the cultivated crop. This provides a sharp decrease (in comparison with continuous plowing, chisel - cultivator or disc harrow) labor costs, funds and fuel consumption, and most importantly, sowing of repeated crops can be carried out in the shortest possible time.

Based on the review and research, for the implementation of strip tillage with simultaneous sowing, we chose an aggregate consisting of a row-crop tractor, front sections of a cotton cultivator and a seeder mounted on the tractor's hinged system.

When the unit moves across the field, the working bodies installed on the ridges of the front sections of the cultivator clean the cultivated strips (mainly the tops of the cotton and other crop row-spacing ridges preserved from the previous year) from the after-harvest residues and loosen their top layer, and the seeder carries out sowing and seeding into these treated strips.

2. Materials and methods

The test results showed that the most acceptable for strip tillage is a combination of working bodies, consisting of a one-sided flat-cutting with a soil-shifting plate (Picture 1), a duckfoot and a pair of disc working bodies, which provide high indicators of the quality of soil crumbling and the evenness of the surface of the cultivated strips, as well as cleaning them from stubble and roots [2,3,4,6].

The technological process of the work of the working bodies proceeds as follows: when the unit moves, the one-sided flat-cutting share cuts the stubble roots of the cultivated strip. The cut stubble with soil is moved away from the cultivation strip with a soil-shifting blade, then the cleared strip is loosened with a duckfoot. Irregularities formed by the duckfoot paw are leveled by discs [7,8].

The main parameters of the working bodies that affect their quality and energy performance are: height (H) and length (l), soil-shifting plate, angle (a) of attack of the discs. In order to determine their rational values, special experiments were carried out.

The experiments were carried out on the fields of the experimental farm of the UzMEI during the preparation of the fields, freed from winter grain crops for repeated sowing. In terms of texture, the soil of the fields where the experiments were carried out belongs to medium-heavy loamy gray soils of old irrigation with deep (5 ...10) groundwater bedding.

Experiments studied the agrotechnical quality of soil crumbling, the degree of clearing the cultivated strip from stubble, the degree of leveling of its surface and the energy (traction resistance) performance of the working bodies for strip tillage, depending on the height and length of the soil-shifting blade, the angle of installation of the disc cultivators to the direction of travel, the transverse distance between them and the speed of movement of the unit [9,10,11].

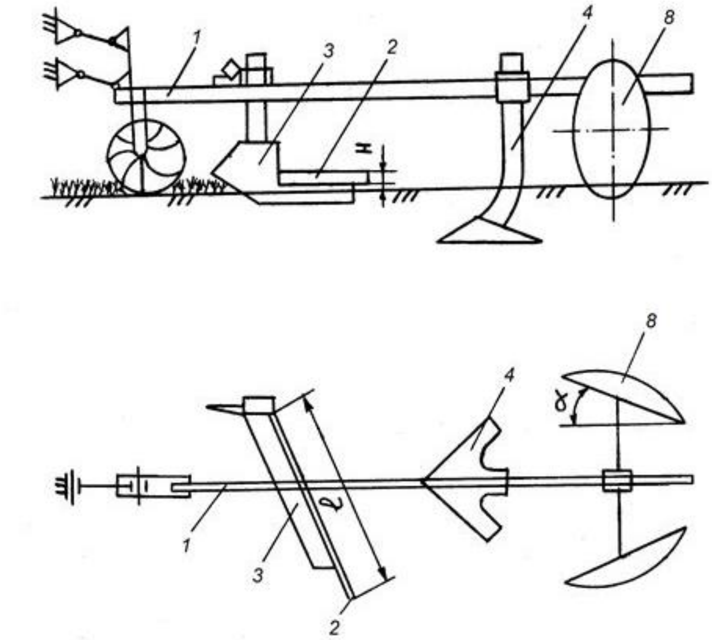

Figure 1. Section of working bodies for strip tillage:

1-linkage mechanism; 2-came; 3-flat-cutting paw; 4-soil-shifting plate; 5-lancet paw; 6-disc ripper

Before carrying out the experiments, the moisture and hardness of the soil, the amount of stubble and the infestation of the field with weeds were determined.

The number of stubble and weedines of the fields during the experiment was determined by the method of imposing a frame 1 m long and a width equal to the width of the processing zone. Weeds and stubble were taken into account in each cultivated strip. The experiment was repeated 5 times.

The quality of soil crumbling was determined by sifting the loosened soil through sieves with aperture diameters of 50 and 25 mm, and the traction resistance of the working bodies was determined by strain gauging.

The degree of clearing of the cultivated strip from stuble and roots was determined by their quantitative calculation before and after the passage of the working bodies in 5-fold repetition.

The flatness of the surface of the processed strip was determined using a coordinate rod. The horizontal position of the rail was checked by level. The distance from the surface of the field to the bottom side of the staff was measured with an accuracy of 0.5 cm over the entire width of the processed strip with an interval of 1 cm. The measurements were repeated 5 times.

The experimental data were processed by the method of mathematical statistics on a computer with the determination of the mean value, standard deviation and coefficient of variation.

The influence of the length and height of the soil-shifting plate on the performance of the cection of the working bodies. In the experiments, the influence of these parameters on the quality of soil crumbling, the degree of clearing the cultivated strip from stubble and the traction resistance of the flat-cutting share was studied.

3. Results and discussion

The results of the experiments are presented in table. 1-2.

Table 1. Changes in the quality of soil crumbling and the degree of clearing of the cultivated strip from stubble, depending on the length and height of the soil-shifting plate.

Plate length/height, mm	Content of soil fractions (%) dimensions, mm			Degree of clearing the treated strip from stubble, %
	>50	50…25	<25	
250/30	12,42/13,62	13,93/12,43	73,65/73,95	83,10/77,45
280/40	10,04/9,36	10,33/11,40	79,63/79,24	88,24/88,24
310/50	10,03/3,44	8,28/10,25	81,70/86,31	88,64/88,00
340/60	7,32/4,82	9,27/5,13	83,11/90,05	87,98/88,31

From the data in tables 1 it follows that with an increase in the length (from 250 to 340 mm) and height (from 30 to 60 mm) of the soil-shifting plate, the quality of soil crumbling improves. This can be explained by an increase in the path of pulling soil particles forward with a plate, and as a result, their additional crumbling from soil lumps between themselves and with the soil surface occurs.

The degree of clearing of the treated strip from stubble with an increase in the length of the blade to 280 mm and its height to 40 mm increases, and then remains constant, i.e. an increase in the length of the blade more than 280 mm and its height more than 40 mm does not have a significant effect on the degree of soil clearing from stubble.

Table 2. Change in the traction resistance of the flat-cutting share depending on the length and height of the soil-shifting plate

Plate length, mm	Traction resistance, N		Plate height, mm	Traction resistance, N	
	M_{cp}	±<Ь		M_{cp}	± a
250	178,2	4,37	30	159,6	4,10
280	190,4	2,15	40	175,2	4,01
310	198,5	3,12	50	186,4	2,11
340	211,6	4,13	60	195,2	1,49

From the data table. 2 it follows that with an increase in both the length and the height of the plate, the traction resistance of the flat-cutting paw increases, which is explained by an increase in the volume of soil and plant residues moved in front of the working body. An increase in the length of the soil-shifting plate by 30 and its height by 10 mm led to an increase in the traction resistance of the flat-cutting share by 4.25…6.84 and 4.72…9.77 %, respectively.

Thus, on the basis of the studies carried out, it can be argued that the length of the soil-shifting plate should be at least 280 mm, and the height at least 40 mm.

The influence of the angle of installation of disc cultivators to the direction of movement on the performance of the sections of the working bodies. In experimental studies, the influence of the angle of installation of disc cultivators to the direction of movement on their traction resistance, the quality of soil crumbling, as well as the degree of leveling of the surface of the cultivated strip was studied. The results of the experiments are presented in table 3.

With an increase in the disc installation angle from 10° to 20°, the traction resistance of the disc increased from 138.4 to 180.8 N, the content of agronomic valuable fractions (fractions less than 25 mm in size) from 68.84 to 78.66 %. This is due to the fact that with an increase in the disc installation angle, the intensity of its impact on the soil increases.

The main indicator of the work of disc cultivators is the degree of leveling of the soil surface of the cultivated strip. From the data table. 3 it follows that with an increase in the angle of installation of the discs from 10 to 20°, the degree of leveling of the soil surface increases from 44.6 to 83.2%.

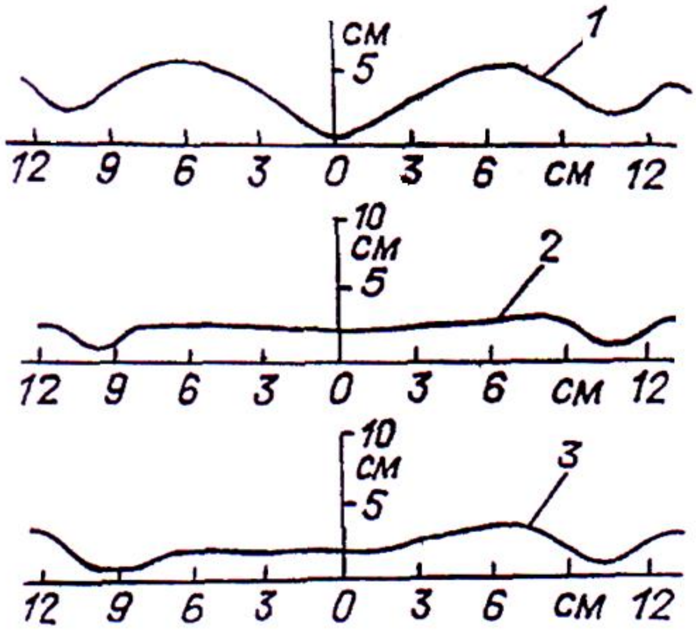

Figure 2. Profiles of the soil surface of the treated strip at the angles of the discs:
10^0 (1), 15^0 (2), 20^0 (3)

In picture 2 shows the profiles of the soil surface after the passage of disc cultivators with setting angles of 10°, 15° and 20°. It follows from the data that the complete closure of the furrow formed by the duckfoot paw is ensured at angles of installation of the discs of 15° and 20°, at an angle of installation of the discs of 10° it is partially closed.

Table 3. Changes in the performance indicators of the section of the working bodies depending on the angle of installation of the disc rippers to the direction of movement.

Installation angle deg.	Fraction content (%) with dimensions, mm			Leveling degree, %	Traction resistance, N	
	>50	50…25	<25		M_{cp}	± a
10^0	16,2	14,96	68,84	44,6	138,4	3,07
15^0	12,0	13,97	73,98	66,7	168,9	3,38
20^0	9,96	11,39	78,66	83,2	180,8	2,43

4. Conclusions

Thus, on the basis of the above, the installation angle of disc rippers can be recommended within 15^0 …20^0.
Thus, on the basis of the studies carried out, it can be argued that the length of the soil-shifting plate should be at least 280 mm, and the height at least 40 mm.

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