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About Some Results of Research of the Cotton Seeder Devices

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ABSTRACT: The information about the condition and some physico-mechanical properties of the soil, prepared for sowing cotton seeds, about cotton seeder equipped with a soil loosening device which providing loosening of the soil, 12-15 cm wide and 8-10 cm deep, in the cotton seed bed and with simultaneous sowing, as well as materials on verifying the operability of the seederbrooming device of the seeder and the results of studies determining the influence of parameters and its operating conditions on the aggregate composition of the soil. is given in this article.

KEYWORDS: Cotton seeder, tidying device, block, sprocket, sowing section, crawler coulter, technology, sowing, moisture, hardness, soil, soil composition.

I. INTRODUCTION

In the soil and climatic conditions of Uzbekistan, the preparation of the soil for cotton sowing is carried out mainly in the autumn. It begins with the harvesting of cotton stalks, the planning of fields, the application of organic and mineral fertilizers and ends with autumn plowing. In the spring, depending on the state of the field, that is, in the absence of weeds, a partial layout is carried out, harrowing with prayer; with a small clogging of weeds, cultivation is carried out to a depth of 6-8 cm or chiseling by plane-cutting working bodies to a depth of 10-12 cm, as well as harrowing with prayer; with a large contamination of the fields on the field, subsurface processing is carried out to a depth of 16-18 cm, followed by harrowing and praying [1]. At the same time, the required quality of the structurally-aggregate composition of the soil, prepared for sowing, is not always ensured, that is, the soil becomes coarse lumpy and upon milling the surface layer (2-8 cm deep) is strongly compacted, and individual lumps come remain in the arable layer. This situation during the sowing prevents to the deepening of the knives of the opener of the cotton seeder to a guaranteed depth, which results in disruption of the technological process of opening the grooves for seeds, to the formation and compaction of its bottom, as well as the sowing of seeds to the predetermined depth. As a result of this, the uniformity of the depth of seed placement is disrupted and about 40-60% of the seeds are not sealed at a given depth [2]. This, in turn, prevents the obtaining of full-fledged seedlings and optimal plant stand density and ultimately affects yield.

To eliminate these shortcomings, we have developed a soil-tidying device [3,4,5] (Fig-1) for a cotton seeder that provides loosening of the soil prepared for sowing, 12-15 cm wide and 8-10 cm deep in the cotton seed bed, with simultaneous sowing. A cotton seeder equipped with soil-cultivating devices (Fig.-1) consists of two support wheels 1, frame 2, the sowing sections 4, the markers (not shown in the diagram) of soil-sowing working bodies 6, the gearbox and drive devices 3. The sowing unit includes a sowing device , nesting device, skid-type opener spring-loaded extrusion rollers, dump earthing and sealing conical roller. The soil-tidying device (Fig.-1) includes a ploughshare 6, a block of sprockets 7 and a stand. The block of loosening sprockets of the soil loosening device is driven from the tractor PTO by means of a chain drive, the gearbox and driveshaft, and the sowing and nesting discs of the seed section are driven by the drive unit from the support wheel.

When the sowing unit moves along the field which prepared for sowing, the ploughshare goes deeper to a depth of 8 - 10 cm, cutting off a soil layer 12 - 15 cm wide; In this case, the soil layer is deformed, subjected to intensive processing in the gap between the ploughshare and a block of sprockets, the soil is loosened, the soil lumps are destroyed, acquiring the optimal aggregate structure and fall into place. The sowing sections of the cotton seeder installed behind this device sow cotton seeds in loose soil with an optimal structure.

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The purpose and objectives of the study.

Checking the wok capacity, determination of the quality indicators of the soil-sweeping working bodies of the cotton seeder, as well as the selection of parameters and modes of their operation.

Material and research methods.

When determining the quality indicators of the work of the swirling working bodies of the cotton seeder, standard assessment methods were used. In this case, the degree of loosening of the soil was determined using the sieves 0,5 × 0,5 in size for three soil samples during the passage of the unit in the forward direction and three in the opposite at the depth of processing. The size of the sieves is 0.25,1,3,5,10,15,25 mm. Depth of processing was determined by using furrow gauge. The hardness of the soil was determined using a VISKHOM device, and moisture by a pH meter. Processing of research results was carried out using methods of analysis and synthesis, as well as statistical analysis using new versions of computer programs Excel.

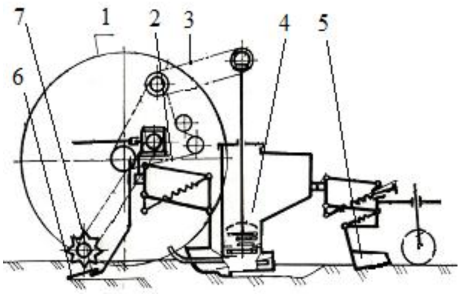

Fig. 1. Diagram of a cotton seeder equipped with a soil sweeping device. 1-frame; 2-wheel; 3-drive device; 4- sowing section; 5-sealing section; 6 ploughshare; 7-block loosening stars.

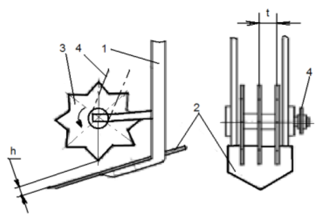

Fig. 2. Scheme of soil sweeping device

1-stand 2 ploughshare;

3- block of stars;

4-drive device.

Fig. 3. General view of the device.

Research results.

For checking the work capacity and determine the quality indicators of work, an experimental sample of soil-bumping equipment (Fig.-2 and Fig.-3) of a cotton seeder was made and the qualitative indicators of its work in laboratory and field conditions were determined. The research work was carried out in the fields of the training experimental station of Tashkent State Agrarian University.

The soil of the educational-experimental farm refers to the “Sugar loam” type, the relief of the field is smooth, the preceding cultivation is autumn plowing, chiselling, harrowing and praying. Before the experiments, the soil moisture and hardness were determined at a depth of 5, 10 and 15 cm in accordance with GOST 20915-11 with 6-fold turning, as well as its aggregate composition. The results are presented in table 1 and 2.

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Table 1

№	Soil depth, cm	Soil moisture%		Soil hardness, MPa	
		Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation
1	5	10,92	3,1	0,246	0,089
2	10	15,58	3,69	0,86	1,13
3	15	22,28	3,27	1,1	0,305

From table 1 it can be seen that at different depths of the soil moisture content is sharply different. At a depth of 5 cm, the soil moisture varies between -8.7 ... 14.7% and averages 10.92%, at a depth of 10 cm it is 10.8 ... 19.0%, on average 15, 58%, and at a depth of 15 cm, respectively, 18.2 ... 26.2% and an average of 22.28%. The hardness of the soil has a similar pattern of change. The hardness of the soil at a depth of 5 cm was 0.246 MPa, at a depth of 10 cm. 0.86 MPa, and at a depth of 15 cm. 1.1 MPa.

The degree of loosening of the soil by the soil-cultivating devices was determined (at six multiple repetitions) using a special framework for the depth of processing. When studying the operation of the soil-cultivating device, the working speed of the sowing unit was 5.2 km / h, the distance between the sprockets of the block was adopted - 4 cm, the depth of processing of the soil-sweeping the working body and the indicator of the kinematic mode of operation of the block of stars are set respectively 10 cm and i = 1.32.

The degree of loosening of the soil was studied when establishing the distances between the working surface of the share and the sprockets of the blocks b = 4, 6 and 8 cm. The data obtained are statistically processed and are shown in table 2.

As can be seen from this table, prepared according to the existing technology, that is, without the use of soil-cultivating devices, the degree of loosening of the soil is comparatively low, which does not satisfy the requirements of agricultural technology, while soil aggregates with a fractional composition of up to 15 mm are 65.1%, less than 25 mm, 15.76% and the soil aggregate with dimensions of more than 25 mm, 19.2%.

During cultivating the soil of the cotton seed bed with using soil-tidying devices, soil aggregates with sizes up to 15 mm increase sharply. When the distance between the working surface of the share and the sprockets was set at 4 and 6 cm, it amounted to 85.1 and 83.5%, respectively.

Table 2

The influence of the distance between the working surface of the share and the sprockets of the block on the degree of loosening of the soil

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<table>
<tr><td colspan="4">№</td><td>1</td><td></td><td rowspan="14">Fractional composition of the soil before treatment with a soil tiller</td><td></td><td rowspan="14">Fractional composition of the soil after treatment with a soil-tidying device</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td colspan="6">The gap size between the work surface of ploughshare and block sprockets</td><td></td><td>4</td><td>6</td><td>8</td></tr>
<tr><td rowspan="12">The degree of loosening of the soil,%</td><td rowspan="12">The degree of loosening of the soil,%</td><td rowspan="4">>25</td><td rowspan="12">Fractional composition of the soil before treatment with a soil tiller</td><td>Arithmetic mean</td><td>M_{cp}</td><td>65,1</td><td>85,1</td><td>83,5</td><td>77,8</td></tr>
<tr><td>Standard deviation</td><td>σ</td><td>3,81</td><td>4,77</td><td>6,76</td><td>8,9</td></tr>
<tr><td>The coefficient of variation, %</td><td>$V,\%$</td><td>5,85</td><td>5,6</td><td>8,1</td><td>11,4</td></tr>
<tr><td>Confidence interval</td><td></td><td>60,48 - 69,82</td><td>79,16-91,04</td><td>78,3-93,07</td><td>74,3-91,0</td></tr>
<tr><td rowspan="4">15-25</td><td>Arithmetic mean</td><td>M_{cp}</td><td>15,76</td><td>11,4</td><td>10,2</td><td>12,4</td></tr>
<tr><td>Standard deviation</td><td>σ</td><td>2,2</td><td>1,48</td><td>1,51</td><td>2,1</td></tr>
<tr><td>The coefficient of variation, %</td><td>$V,\%$</td><td>12,5</td><td>13</td><td>14,8</td><td>16,9</td></tr>
<tr><td>Confidence interval</td><td></td><td>15,35 – 19,11</td><td>9,17-11,7</td><td>8,33-12,7</td><td>11,8-15,0</td></tr>
<tr><td rowspan="4"><15</td><td>Arithmetic mean</td><td>M_{cp}</td><td>19,2</td><td>3,5</td><td>6,3</td><td>9,8</td></tr>
<tr><td>Standard deviation</td><td>σ</td><td>2,3</td><td>0,91</td><td>1,68</td><td>0,95</td></tr>
<tr><td>The coefficient of variation, %</td><td>$V,\%$</td><td>11,97</td><td>26</td><td>26,9</td><td>9,6</td></tr>
<tr><td>Confidence interval</td><td></td><td>16,35 – 22,05</td><td>2,37-4,62</td><td>4,21-8,38</td><td>8,62-9,98</td></tr>
</table>

The soil aggregates with sizes more than 25 cm are reduced and make up 3.5 and 6.3%, respectively. With the increasing of the distance between the working surface of the share and the block sprocket up to 8 cm, soil aggregates with fraction sizes up to 15 mm decrease slightly and will decrease to 77.8%, and soil aggregates with fraction sizes over 25 cm increase and reach up to 9.6%.

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From the above data it can be judged that when the size of the gap between the working surface of the ploughshare and the sprockets is installed 4 and 6 cm, the size of the aggregate composition is within the requirements of agricultural technology. Moreover, the soil lumps interfering with the work of the semi-shaped openers of the seeder are completely absent.

When studying the effect of the distance between the sprockets of the block of the soil-cultivating device on the degree of loosening of the soil, all parameters of the object of study were set without changes, except for the distance between the sprockets and the distance between the working surface and the block of sprockets. At the same time, they studied the operation of the sprocket block with a distance between the sprockets of 3, 5 and 7 cm, while the distance between the working surface and the sprocket blocks was set to 6 cm. The obtained and statically processed data are shown in Table 3.

The results of the experiments show that when treating the soil with a soil-cultivating device, its aggregate composition improves compared to the aggregate composition of the soil treated with traditional technology. In setting the distances between the stars 3 and 5 cm (grinding), the grinding of the soil and lumps is improved, while the volume of the aggregate composition of the soil with a size of less than 15 mm. increases and reaches respectively 89.2 and 84.1%. The volume of soil with dimensions of 15–25 mm was 8.9 and 10.3%, respectively, and the volume of soil with dimensions of more than 25 mm. accounted for 4.2 and 5.6%. respectively.

When the distance between the sprockets was set to 7 cm, the indicators of the soil-sweeping device deteriorated somewhat. The volume with the aggregate composition of the soil with the size of the fraction is 15 mm. decreased to 78.1%, the volume with an aggregate composition of 15-25 mm per revolution. and more than 25 mm. slightly increased and amounted to 13.7 and 7.6%, respectively.

Increasing of the volume of the soil aggregate with a fraction size of less than 15 and 25 mm. achieved due to the deformation of the soil and soil lumps. (parchalanish) grinding.

A comparative analysis of the quality of the aggregate composition of the soil treated with a cotton seeder tilting device and soil cultivation technology shows that, when tilling the soil with a tilting device, in which the distance between the sprockets was 3, 5 and 7 cm, the volume of soil aggregates with fraction sizes up to 15 mm. Compared with traditional tillage, the volume of soil aggregates with a fraction size of 15–25 mm increased by 33, 29 and 20%, respectively. the volume of soil aggregates with fraction sizes over 25 mm increased respectively by 77, 55 and 15%, increased respectively 4.5, 3.4 and 2.5 times. These indicators, that is, the improvement of the required aggregate composition of the soil, are ensured by the complete grinding of soil crumbs.

From the giver materials it can be seen that the soil-tidying devices of the cotton seeder allow high-quality tillage of the cotton seed zone. When the distance between the sprockets was set 3 and 5 cm. The qualitative indicators of the soil-tanning device work are required requirements for agricultural technology. When installing, the distance between the sprockets is 7 cm, the indictors of the sweeping working body is 1.9% lower than the requirement of agricultural machinery.

Comparison of the indictors of the soil-tidying devices equipped with a block of sprockets with a distance between sprockets of 3 and 5 cm showed that the aggregate composition of the soil with a fraction size of 15-25. mm and more than 25 mm. actually do not differ from each other. They lie within the confidence interval of the average value. Therefore, in further experiments in order to reduce energy and metal consumption, the distance between the sprockets of the block can be taken 5 cm.

Table3

The influence of the distance between the sprockets of the block on the degree of loosening of the soil

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№			1		Fractional composition of the soil before treatment with a soil tiller		Fractional composition of the soil after treatment with a soil-tidying device	2	3	4
The gap size between the work surface of ploughshare and block sprockets								4	6	8
The degree of loosening of the soil,% / The degree of loosening of the soil,%	>25	Fractional composition of the soil before treatment with a soil tiller	Arithmetic mean	M_{cp}		65,1		4,2	5,6	7,6
			Standard deviation	σ		3,81		2,30	0,79	1,59
			The coefficient of variation, %	$V,\%$		5,85		57,23	14,24	20,99
			Confidence interval			60,48 - 69,82		1,75	5,32	6,50
	15-25		Arithmetic mean	M_{cp}		15,76		8,9	10,3	13,7
			Standard deviation	σ		2,2		0,78	0,65	0,87
			The coefficient of variation, %	$V,\%$		12,5		8,81	6,36	6,37
			Confidence interval			15,35 – 19,11		8,63	10,11	13,37
	<15		Arithmetic mean	M_{cp}		19,2		89,2	84,1	78,7
			Standard deviation	σ		2,3		2,02	0,99	1,81
			The coefficient of variation, %	$V,\%$ $M_{cp} \pm ts$		11,97		2,33	1,18	2,30
			Confidence interval			16,35 – 22,05		88,66	83,67	7,29

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In studying the influence of the rotational speed of the block of sprockets of the soil-raising device on the degree of loosening of the soil, the distance between the working surface and the blocks of sprockets was set to 6 cm. The qualitative indicators of the soil-drying device at a frequency of its rotation are 180, 210 and 240 rpm The obtained and statically processed data are shown in table 4.

The presented data (Table 4) shows that the rotation speed of the sprocket block significantly affects the change in the aggregate composition of the soil, while the volume of the aggregate composition of the soil with sizes up to 15 mm is increased.

When treating the soil with a swivelling device with a sprocket block rotation frequency of 180 rpm. the aggregate composition of the soil with dimensions up to 15 mm. it makes up 76.3%, with dimensions - 15-25 mm 14.1%, and with sizes over 25 mm. -9.6% of the total cultivated soil.

In treating soil with a swivelling device with a sprocket speed of 210 and 240 rpm. the volume of aggregate composition of the soil with dimensions up to 15 mm. increases and reaches respectively to 83.6 and 89.2%. The volume of the aggregate composition with dimensions of 15 - 25 mm. amounts to 10.2 and 7.0%, respectively, and the aggregate composition with dimensions greater than 25 cm., respectively, is 6.2 and 3.8% [7]. Increasing of soil aggregate volume with fraction sizes up to 25 mm. as part of the treated soil, it is achieved by compressing the soil formation when it passes in the shell between the working surface of the share and block sprockets, as well as the intense action of the stars on the soil formation in this zone.

A comparative analysis of the quality of the aggregate composition of the soil processed by the seeder-baking device of the seeder and the traditional technology of tillage shows that when treating the soil with the soil-baking device, with a rotation speed of its block of asterisks of 180, 210 and 240 rpm. volume of soil aggregates with fraction sizes up to 15 mm. in comparison with traditional tillage increased by 17, 28 and 37%, respectively, the volume of soil aggregates with sizes of 15-25 mm decreased by 11, 54 and 124%, respectively, the volume of soil aggregates with sizes greater than 25 mm. decreased accordingly 2, 3 and 5 times. The achievement of the required aggregate composition of the soil after tillage with a soil-cultivating device compared to traditional tillage is achieved due to the intensive action of the sprockets of the block when the soil layer passes through the cracks between the working surface of the share and the block of sprockets of the device.

Table -4.
The influence of rotation speed of the sprocket block on the degree of loosening of the soil

№				1		Fractional composition of the soil before treatment with a soil tiller		Fractional composition of the soil after treatment with a soil-tidying	2	3	4
The gap size between the work surface of ploughshare and block sprockets									180	210	240
The degree of loosening of the soil,%	The degree of loosening of the soil,%	>25	the soil before treatment with a soil tiller	Arithmetic mean	M_{cp}		65,1		9,6	6,2	3,8
				Standard deviation	σ		3,81		0,95	0,68	0,53
				The coefficient of variation, %	$V,\%$		5,85		9,92	11,03	14,12

				Confidence interval			60,48 - 69,82		10,59-8,60	6,91-5,48	4,36-3,23
		15-25		Arithmetic mean	M_{cp}		15,76		14,1	10,2	7,0
				Standard deviation	σ		2,2		1,08	0,89	0,95
				The coefficient of variation, %	$V,\%$		12,5		7,69	8,74	13,61
				Confidence interval			15,35 – 19,11		15,23-12,96	11,13-9,26	11,13-9,26
		<15		Arithmetic mean	M_{cp}		19,2		1,18	2,19	1,83
				Standard deviation	σ		2,3		6,17	8,02	6,85
				The coefficient of variation, %	$V,\%$		11,97		76,3	83,6	89,2
				Confidence interval			16,35 – 22,05		81,32 – 85,88	87,25 – 91,15	74,71 – 77,89

In the summary .it can be stated that the soil-cultivating devices of the cotton seeder provide high-quality soil cultivation in the area where cotton seeds are deposited. When operating a soil-cultivating device with a rotation frequency of its blocks, an asterisk 210 and 240 rpm. the quality of the aggregate composition of the soil meets the requirements of agricultural technology. At a rotational speed of the sprocket block 180 rpm, the quality of the soil sweeping device deteriorates somewhat, and at the same time the aggregate composition with dimensions up to 15 mm. is 76.3% aggregate composition with fraction sizes up to 25 mm. - 14.1%, and the aggregate composition with a fraction size of more than 25 mm. - 19.2%. If we compare the performance of soil-bending devices with the rotational speed of their sprocket blocks of 210 and 240 rpm, they sharply differ from each other, while the volume of soil aggregates with fraction sizes up to 15 mm. rises, and with sizes over 25 mm. decreases.

In the study experience in the study of a cotton seeder equipped with a soil-cultivating device [4, 5] and organoleptic observations showed that the depth of seed placement was within the requirements of agricultural technology, the number of passes and unfinished seeds on the field surface were not observed. The number of seedlings compared to existing technology increased by 18%, which has a positive effect on cotton productivity

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II. CONCLUSION

Equipping a cotton seeder with a soil-cultivating device, consisting of a block of loosening stars and a ploughshare, makes it possible to additionally crush the lumps in the sowing layer and thereby ensure high-quality seed placement to a predetermined depth.

The new sowing technology with a cotton seeder equipped with a soil-cultivating device consisting of a block of loosening stars and a ploughshare creates better conditions for seed germination and friendly shoots. The further studies of improving the e seed placement, it is advisable to conduct research in the direction of clarifying the parameters and operating modes of the loosening blocks and placing it relative to the sowing section of the cotton seeder.

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