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SELECTION OF THE TYPE OF RACKS OF THE WORKING BODIES OF THE CHISEL-CULTIVATOR

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Abstract:

In this article was discussed a comparative study of the choice of the stand types of the working bodies of the chisel-cultivator. In bench tests, each stand was mounted on a special frame then was applied a static load to them, simulating the resultant resistance forces of soil. At each loading stage, the movement of the leading-edge cap of the hoe was measured. Moreover, the agro-energetical indicators of chisel cultivator's work with various stands were studied. According to the results of the study, a spiral elastic stand was chosen.

Keywords: Cotton, electroactivated water, copper, cob, leaf, boll, biological efficiency, rate of economic harm, plant protection, insecticide. A lot of work is being done in the agriculture of our country to develop and implement modern technologies for obtaining abundant and high-quality crops.

1. INTRODUCTION

One of the ways to increase the efficiency and productivity, as well as the reliability of chisel tools for pre-sowing tillage is to improve the design of their working bodies. It should be noted that in the recent period there have been significant changes in the energy base of agriculture, energy-saturated high-speed tractors have been created and are increasingly being used. At the same time, individual agricultural implements and their working bodies remained the same, this also applies to the chisel cultivator. In the cotton-growing zone, chisel cultivators are the main tools for loosening the soil after washing and spare watering.

Recently, both in our country and abroad, the working bodies of chisel cultivators and other tillage machines have been equipped with spring-safety or elastic racks. According to many researchers, the use of such racks leads to a decrease in the traction resistance of the gun, provides better quality indicators of its operation, eliminates breakdowns of working organs./1-6/quarrels

Despite this, the working bodies of cotton chisel cultivators CHKU-4 and CHKU-4A still have rigid racks.

In this regard, we conducted a scientific, technical and patent review of the leading countries producing chisel tools, and based on its results, the most promising options for elastic struts and suspensions were selected (Fig.1 and Table.1)

I.Spring-safety suspension of the cultivator KPE-3,8;
II.Spiral elastic cultivator rack KCHP-5,4;
III. Spiral elastic stand of the "VISKHOM" design;
IV. C-shaped cultivator stand KPS-4
V. S-shaped rack of the NZ-97 spring cultivator from Vaderstad (Sweden).

2. MATERIALS AND METHODS

These racks have passed comparative bench and laboratory-field tests in order to select the most rational of them for the working bodies of cotton chisels-cultivators.

In bench tests, each rack was fixed on a special frame, a static load was applied to them, simulating the resultant forces of soil resistance. At each stage of loading, the movements of the toe of the paw (working organ) were measured horizontally "e" and vertically "h" (Fig.2).

According to the data obtained, the stiffness of the racks was determined and their elastic characteristics were constructed in the form of graphs expressing the dependence of the toe of the paw horizontally on the load (Fig.3.a).For clarity, these graphs are combined with diagrams showing the kinematics of the toe of the working organ (Fig.3.b).It should be noted that in order to ensure the oscillatory process of the working body and the uniformity of the depth of tillage, the stiffness of the rack should be within 15-20 N / mm, and the movement of the toe of the working body in the vertical direction under the action of the workload, which is 0.8..1.2 kN /1/, should not exceed +2cm.

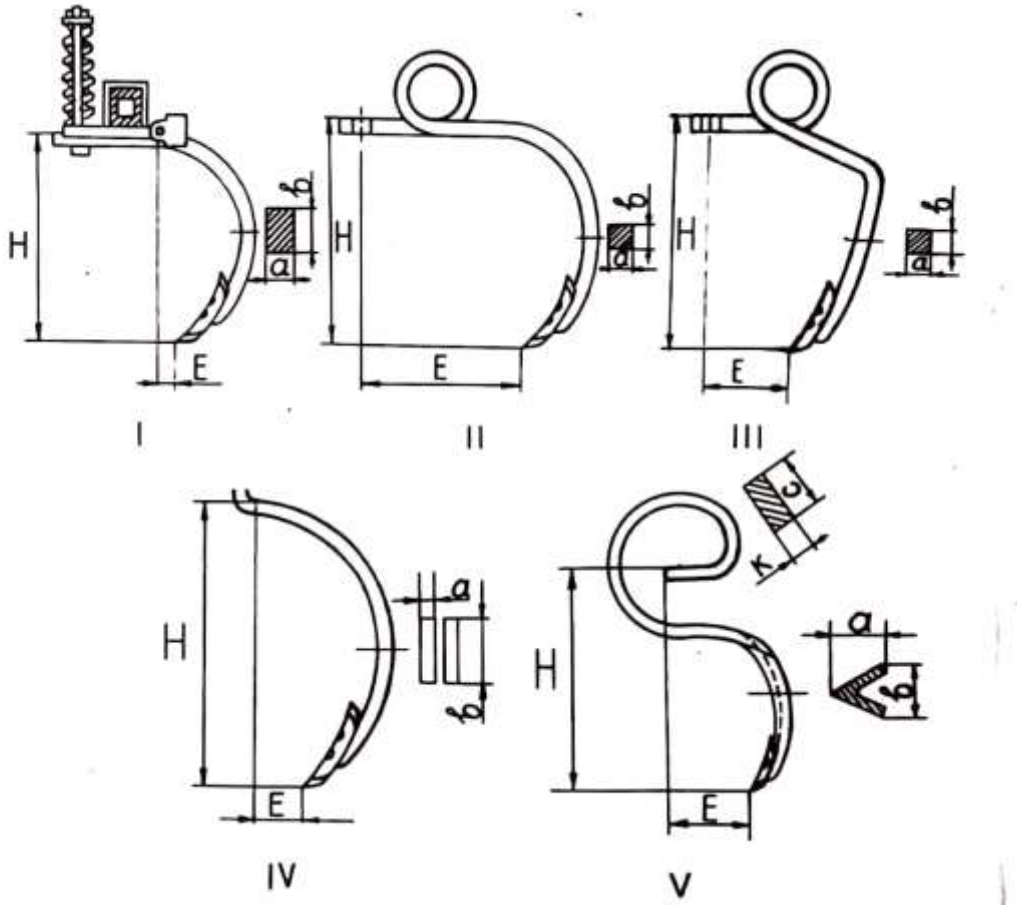

Fig.1. Types of studied racks of chisel-cultivator working bodies

3. RESULTS AND DISCUSSIONS

Table 1
Parameters of elastic struts and spring-safety suspension

№	Options	Name	Weight G, kg	Sizes, mm			
				H	E	a x b	c x k
1	I	Spring-safety suspension of the KPE cultivator-3,8	27,5	560	180	55 x 25-2	-
2	II	Spiral elastic stand of the KCHP cultivator-5,4	16,4	660	400	30 x 30-3	-
3	III	Spiral elastic stand "VISHOM"	15,4	630	270	30 x 30-4	-
4	IV	Spring C-shaped CPS Cultivator Rack-4	4,6	460	50	40 x 8-5	-
5	V	Spring-loaded S-shaped cultivator stand NZ- 9,7	4,1	300	260	23 x 9	45 x 9

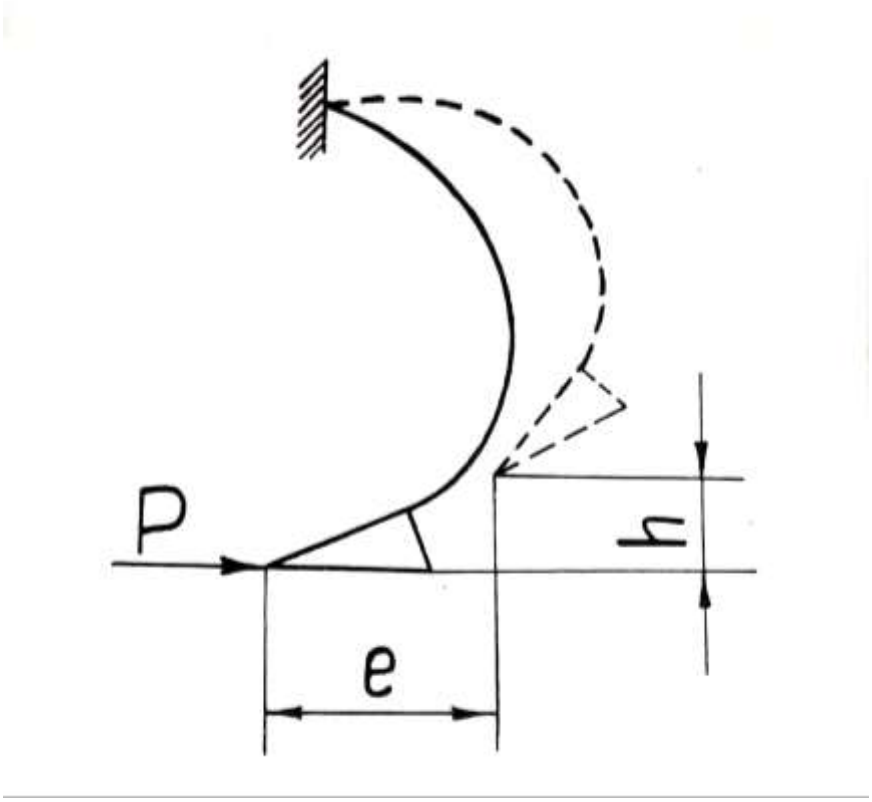

Fig.2. Scheme for determining the movement of the toe of the working organ

Analysis of the results of bench tests showed the following. The spring-safety suspension (in Fig. 3, curve I) has a two-stage characteristic. In the range of loads up to 1.2 kN, its stiffness decreases from 67 to 21 N/mm, and with a further increase in the load to 1.6 kN, it increases to 24 N/mm. In the operating load range, the stiffness of this rack is 20-25 N/mm. With an increase in the load, the paw is dug out, i.e. its toe moves up. At the maximum workload, the paw was 15 mm deep, which is permissible according to agrotechnical requirements.Spiral elastic racks of the cultivator KCHP-5,4 (in Fig.3 curve II) and "VISKHOM" (in Fig.3 curve III) have a rectilinear elastic characteristic. Their longitudinal stiffness is almost the same and amounts to 15.2...17.4 and 14.3...16.7 N/mm, respectively. With an increase in the load at both racks, the paw is dug out. However, at the rack of the cultivator KCHP-5,4, the paw extension is twice as large as at the "VISHOM" rack, and already with a workload of 0.8 kN, it exceeds the permissible limit. At the "VISHOM" rack in the operating load range (0.8....1.2 kN), the paw extension is 10....16 mm, which is within acceptable limits. The C-shaped rack also has a curvilinear characteristic (in Fig.3, curve IV). In the range of loads up to 1kN, its stiffness decreases from 22 to 17 N/ mm. With an increase in the load, the paw deepens, i.e., under the influence of the workload, its toe moved down, this entails an uneven processing depth and an increase in traction resistance.

Based on this, the rack in question can also be considered unacceptable for the loosening paw of the chisel cultivator. The S–shaped rack has a slightly pronounced curvilinear characteristic (curve V in Fig. 3) and low rigidity (10....13H/ mm).With an increase in the load, the paw is intensively dug out and in the entire range of the workload, its excavation significantly exceeds the permissible limit. Therefore, this rack for a chisel cultivator is not acceptable.

Thus, the research results show that the most acceptable for a cotton chisel cultivator are a spiral elastic hanging rack and a spring-safety suspension.

In the future, the agro-energy indicators of these racks were studied in comparison with a rigid rack.

The experiments were carried out in the fields of the experimental farm of SAIME. Soil moisture in the horizon is 0....20 cm was 16.11%, and the hardness was -2.08Mpa.The study was carried out on an installation that allows mounting various working bodies. The installation was aggregated with the MTZ-80 tractor at speeds of 1.5...3.3 m/s. The working bodies were installed on all variants to a depth of 18 cm with an interval of 150 mm.

RESULTS

The test results are presented in Table.2.For all working bodies, the quality of soil crumbling improves with an increase in the speed of movement, i.e. in the loosened soil layer, the number of agronomically valuable fractions with sizes less than 50 mm increased, and with sizes larger than 50 mm decreased.

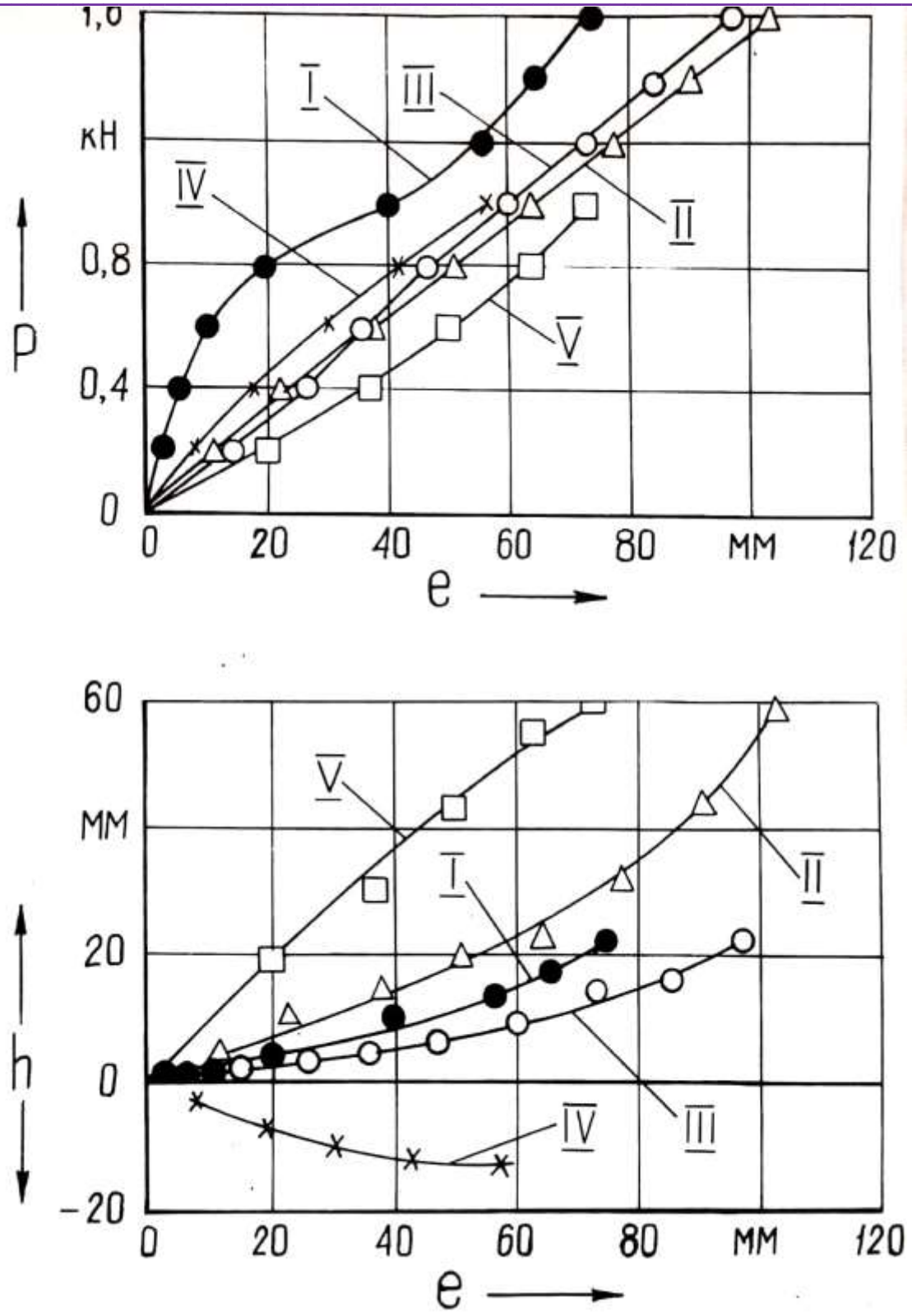

Fig.3.Elastic characteristics of the racks (a) and kinematics of the working body (b):
curves I; II ; III; IV; V correspond to the types of racks in Fig. I

This is due to the fact that the impact force of the working bodies on the clumps of soil increases and they are crushed into smaller particles. The best quality of soil loosening was provided by working bodies on spiral elastic racks. The yield of agronomic valuable fractions after the passage of working bodies on these racks is 10.4....13.3% more than that of serial rigid racks. The working bodies on the spring-safety suspension also provides a better quality of soil crumbling compared to the rigid one. However, it is somewhat inferior to the working bodies on an elastic-spiral rack.

According to the uniformity of the depth of tillage between the compared variants, approximately the same indicators were obtained. Some decreases in the depth of tillage with an increase in the speed of movement can be

explained by an increase in the traction resistance of the tool. From the table.2 it can be seen that with an increase in the speed of movement, the traction resistance increases in all working bodies. However, with the same speed of movement at the processing depth, the specific traction resistance of the working body on an elastic spiral rack is 17.9... 24.7% less than that of the working body on a rigid rack. This is explained by the fact that in the process of operation, the elastic rack, due to the variable resistance of the soil, makes forced fluctuations, which

Table-2

Agro-energy performance of the chisel cultivator with various racks

№	Speed of movement m / s	Uniformity of processing depth		Fraction content (%) dimensions, mm			Specific traction resistance, kN/m
		M sr, cm		> 50	50-10	< 10	
Spiral elastic							
1	1,51	18,41	1,58	12,73	34,26	53,01	5,9
2	2,02	18,12	1,77	9,73	34,58	55,69	6,2
3	2,94	17,84	1,89	7,2	35,09	57,71	6,8
4	3,35	17,48	2,06	6.02	35,63	58,35	7,4
Spring and safety							
1	1,51	18,13	1,64	19,09	33,12	51,79	6,5
2	2,02	17,83	1,78	13,63	34,44	51,93	7,4
3	2,94	17,3	1,83	10,42	53,79	53,79	8,5
4	3,35	16,87	1,90	6,08	37,37	57,55	9,2
Serial hard (control)							
1	1,51	19,29	0,99	23,8	33,79	42,41	7,8
2	2,02	18,76	1,25	23,04	35,52	43,44	8,7
3	2,94	18,6	1,37	18,48	36,03	45,49	9,2
4	3,35	18,19	1,51	15,11	36,5	48,39	9,9

It affects the nature of the process of soil destruction and leads to a decrease in traction resistance. In addition, during operation, due to the oscillation of the elastic rack in front of the working body, a compacted core is not formed and there is no sticking of the paw with soil and clogging with plant residues of the rack, which helps to reduce its traction resistance. The indicators of the spring-safety suspension are located between the serial rigid and elastic spiral strut.

3. CONCLUSIONS

Thus, based on the conducted research, it can be argued that the best quality of tillage with minimal energy consumption is provided when installing the working bodies of the chisel cultivator on spiral elastic racks. In the future, it is necessary to investigate the layout of the loosening paws on elastic racks on the gun frame.

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