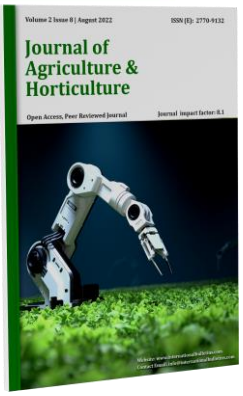

A STUDY OF THE WORKING PROCESS OF A TWO-TRACK HARROW

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https://doi.org/10.5281/zenodo.10065437

Abstract. The following article presents the results of theoretical and experimental studies aimed at improving the performance of two-track harrows, that is two series of sequential fixed harrows. In theoretical studies, the question of ensuring their stable movement and, therefore, improving performance is considered by reducing the torsion moment, which leads to a violation of the equilibrium state of the harrow in the process of working a two-track harrow. In experimental studies, however, based on the results of theoretical studies, Uz Dst 3412: 2019 "Testing agricultural techniques. Machines and equipment soil surface treatment. Testing program and methods" and Uz Dst 3193: 2017 "Testing of agricultural machinery. Based on the method of energy evaluation of machines", the processing depth of the two-track harrow, the quality of soil abrasion, the average quadratic deviation of the heights of irregularities on the surface of the field, the influence of the steep distance between their existing and reduced connecting points on the resistance of the harrow are studied. According to the results obtained, it is noted that the connecting points of the two–track harrow, located on the first and second rows, should be lowered by at least 50 mm compared to the existing cases.

Key words: Two-track harrow, theoretical and experimental studies, harrows located in the first and second row, points of connection of harrows to each other, existing and reduced states of connection points, vertical distance between existing and reduced connection points, performance indicators of two-track harrow.

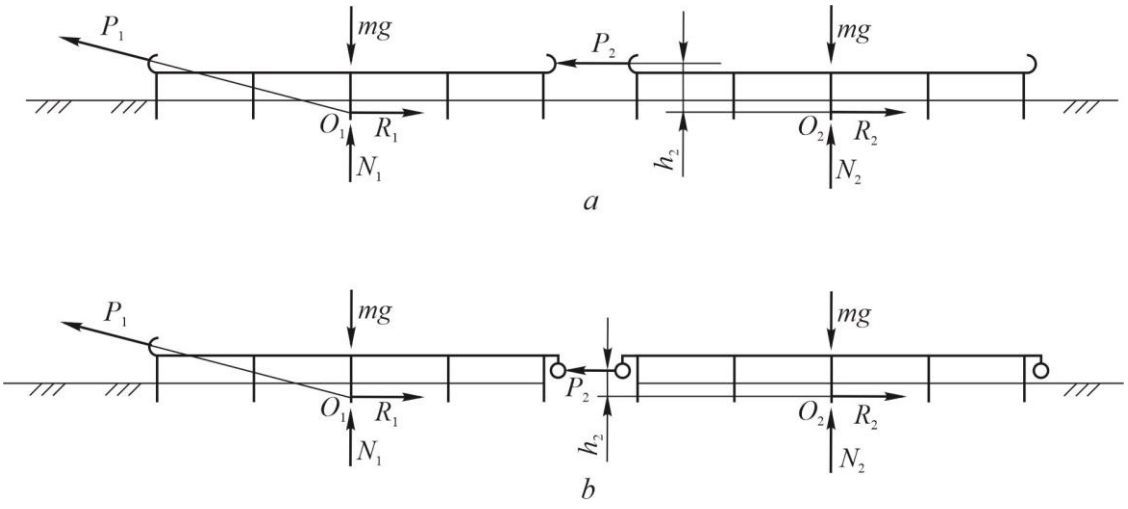
Enter. Fertilizing the fields is the main and first task in preparing the land for planting in the spring. Timely and high-quality implementation of this event ensures the formation of a soft layer on the surface of the field, the loss of germinating weeds, the long-term preservation of moisture accumulated in the soil, and the rising of salt in the soil. If spring fertilizing is not carried out or is delayed, the moisture in the soil will rise, the fields will be overrun by weeds, and the soil will harden. Therefore, in the spring, all fields are fertilized as soon as the top 8-10 cm layer of soil is formed. Then the soil will be fertile, with small fractions that will give grassy grass [1,2].

In order to ensure the required level and high quality of work in the conditions of our republic, harrowing in all areas is carried out with two-track harrows, i.e. two rows of toothed harrows (further harrows). In this case, the harrows in the first row are connected to the trailer, and the harrows in the second row are connected to the rear connection points of the harrows in the first row (scheme a in the picture). Due to this, the pulling force P_2 of the furrows located in the second row will have a horizontal direction, and their center of resistance will not pass through O_2, but above it. As a result, the harrows located in the second row are rotated counterclockwise, and the harrows located in the first row are rotated

clockwise $M_2 = R_2h_2$ (where R_2 is the resistance of the harrows located in the second row, N; h_2- the vertical distance from the center of resistance O_2 of the second-row furrows to their connection points O', m) moment is generated. As a result, the balance of the harrows located in the front and rear rows is disturbed, and their teeth do not sink to the same depth.

$M_2 = R_2 h_2$ under the influence of the torque, the front teeth of the harrows located in the second row in the direction of movement sink deeply, and the rear teeth sink shallowly. The opposite is true for the first-row harrows, that is, the front teeth are shallow, and the back teeth are deep. This leads to a decrease in the processing quality and deformation (bend) of the harrow teeth.

Research object and method. In order to eliminate the above-mentioned disadvantages of the two-track harrow, we recommend lowering the points of connection of the first and second rows of harrows to each other compared to their current state (scheme b in the picture). Because in this case, the torque decreases due to the reduction of the distance h_2, and it does not significantly affect the working process of the harrows. In order to verify these statements, a two-track harrow consisting of BZSS-1.0 toothed harrows was used and experimental studies were carried out, in which the differences between the existing and lowered states of the connection points of the harrows located in the first and second rows (in the following, the existing and lowered connection points of the harrows between) the effect of the vertical distance on the performance of the two-track harrow was studied. In the



experiments, the vertical distance emphasized was varied from 0 to 75 mm in 25 mm intervals.

a) existing; b) offered

Schemes of connection of harrows located in the first and second rows in a two-track harrow to each other and to the trailing

Experimental studies were conducted in the fields of the experimental farm of Scientific Research Institute of Mechanization of Agriculture (SRIMA) during the period of early spring fertilizing of the plowed lands in gray soils with medium-heavy mechanical composition at speeds of 6 and 9 km/h. In this case, the depth of tillage, the quality of soil compaction, the mean square deviation of the height of unevenness on the field surface, and the resistance of the two-track harrow to traction, corresponding to the coverage width of 1 m, were taken as evaluation criteria.

Before the experiments, there were formed the moisture content of the soil in the 0–10 and 10–20 cm layers was determined, and they were 15.4 and 17.2 percent, hardness 0.70 and 1.46 MPa, and density 1.21 and 1.24 g/cm^3, respectively. The above-mentioned performance indicators of the suspended two-track harrow during the experiments are in accordance with Uz Dst 3412: 2019 "Testing of agricultural machinery. Machines and equipment for soil surface treatment. Testing program and methods", Uz Dst 3193: 2017 "Testing of agricultural machinery. The method of energy evaluation of machines" was determined [3,4].
The experiments were conducted using a specially designed device [5].

Results and analyses. The results of the experiments are presented in the table. It can be seen from them that increasing the vertical distance between the existing and reduced connection points of the two-track harrow led to the improvement of all its agrotechnical indicators, that is, the depth of cultivation increased, its mean square deviation decreased, the mean square deviation of the heights of irregularities on the field surface decreased, and the level of soil compaction increased. At the same time, it is worth noting that these indicators changed rapidly when the vertical distance between the existing and reduced connection points of two-track harrow harrows changed from 0 to 50 mm, and when it increased from 50 to 75 mm, their change speed decreased. For example, when the vertical distance between the existing and reduced connection points of the two-track harrow harrows increased from 0 to 50 mm at a speed of 6 km/h, the tillage depth increased by 1.6 cm, its root mean square deviation decreased by ± 0.33 cm, soil compaction level, that is, the amount of fractions with a size smaller than 25 mm increased by 1.5 percent, the mean square deviation of the heights of irregularities on the field surface decreased by ± 0.16 cm, when this distance increased from 50 to 75 mm, the highlighted indicators were 0.4 cm, respectively, Changed by ± 0.13 cm, 0.3 percent and ± 0.06 cm. Similar data were obtained at a speed of 9 km/h.

With the increase of the vertical distance between the existing and reduced connection points of the two-track harrow, the increase in its agrotechnical indicators is mainly explained by the improvement of the stable movement of the harrows located in the first and second rows according to the depth of processing, that is, their tines are ensured to sink to the same depth. When the vertical distance between the existing and reduced connection points of the two-track harrow

The effect of the vertical distance between the existing and reduced connection points of a two-track harrow on its performance

The vertical distance between the existing and lowered connection points of the hurricanes, mm	Processing depth, cm		Amount of the following size (mm) fractions of soil, %			The mean square deviation of the heights of irregularities on the field surface, ± cm	Compare to drag resistance, kN /m
	$M_{o'r}$	$\pm\sigma$	>50	50-25	<25		
Movement speed 6 km/h							
0	4,6	1,81	8,5	9,7	81,8	1,77	1,77
25	6,1	1,50	8,1	9,3	82,6	1,69	1,86
50	6,4	1,38	7,8	8,9	83,3	1,61	1,95
75	6,6	1,35	7,6	8,8	83,6	1,55	1,98
Movement speed 9 km/h							
0	4,3	1,83	8,2	9,6	82,2	1,71	1,89
25	5,3	1,46	7,6	9,3	83,1	1,62	1,98
50	5,7	1,30	7,4	8,8	83,8	1,55	2,09
75	5,9	1,22	7,2	8,6	84,2	1,52	2,10

increases from 0 to 75 mm, its traction resistance increases from 1.77 kN to 1.98 kN at a speed of 6 km/h, and from 1.89 kN at a speed of 9 km/h increased to 2.10 kN. This happened mainly due to the increase in processing depth.

Therefore, in order for the two-track harrow to ensure high work quality, the points of connection of the harrows located in the first and second rows should be lowered at least 50 mm below the existing position.

Summary: According to the results of our theoretical and experimental studies, the vertical distance between the existing and reduced connection points of the harrows located in the first and second rows should be at least 50 mm in order for the two-track harrow to ensure high work quality and reliably perform the technological process.

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