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Обоснование угла установки рабочего органа для укрытия открытых корней деревьев в интенсивных садах

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Аннотация. Представлены результаты полевого эксперимента, проведенного в НИИ механизации сельского хозяйства, по обоснованию угла вертикальной установки сферического дискового рабочего органа машины для заглубления открытых корней деревьев в интенсивных садах и работы в междурядьях. Разработан экспериментальный образец машины, с рабочими органами для укрытия открытого корня дерева в интенсивном саду. Полевые испытания Uz DSt 3236:2017 «Почвообрабатывающие машины и орудия в садоводстве. Методы испытаний», Uz DSt 3193:2017 «Испытания сельскохозяйственной техники». Проводились на основе методики энергетической оценки машин и других нормативных документов. Испытания проводились между рядами интенсивного сада с капельным орошением, посаженного по схеме 4x1,2. В статье установлено, что сферический дисковый рабочий орган машины для укрытия открытых корней деревьев в интенсивном саду должен устанавливаться под вертикальным углом 10-15°, чтобы соответствовать заданным агротехническим требованиям.

Ключевые слова: интенсивный сад, дерево, почвенная грунта, испытание, энергетические показатели, рабочий орган, сферический диск, вертикальный угол установки, технологический процесс работы.

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Justification of the installation angle of the working element for covering open tree roots in intensive gardens

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Abstract. The results of a field experiment conducted at the Scientific Research Institute of Agricultural Mechanization on the justification of the vertical installation angle of the spherical disk working body of the machine that buries exposed tree roots in intensive gardens and works between the rows are presented. A model of a machine equipped with working bodies for burying exposed tree roots in an intensive garden was developed for testing. Field tests Uz DSt 3236:2017 «Soil tillage machines and tools in horticulture. Testing methods», Uz DSt 3193:2017 «Testing of agricultural machinery. It was conducted on the basis of the method of energy evaluation of machines» and other normative documents. Tests were conducted between the rows of an intensive drip-irrigated garden planted in a 4x1.2 scheme. In the article, it was determined that the spherical disc working body of the machine for burying exposed tree roots in an intensive garden should be installed at a vertical angle of 10-15° in order to meet the specified agrotechnical requirements.

Keywords: intensive garden, tree, soil pile, test, energy indicators, working body, spherical disk, vertical installation angle, technological work process.

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Introduction

Ensuring the implementation of the Decree of the President of the Republic of Uzbekistan dated October 23, 2019 «On approval of the strategy for the development of agriculture of the Republic of Uzbekistan for 2020-2030» No. PF-5853, fruit and vegetable and production of high-value-added products in the field of viticulture, increase in export volume, utilization of abandoned and dry land, increase of export-oriented agricultural crops in areas that are being reduced from cotton and grain, as well as the possibilities of gardens, vineyards and greenhouses several tasks have been defined in order to establish effective use [1]. It is known that intensive garden trees located in the upper layer of the roots of drip-irrigated orchards and semi-short orchards grown in the conditions of our republic [2] and their roots exposed as a result of drip irrigation reduce the productivity of intensive orchards this causes them to dry up on hot summer days and on cold days they get frostbite and eventually dry up. In the literature, taking into account that the frost resistance of intensive garden tree roots is up to minus 10-11° C, taking into account that the air temperature in our republic is on average minus 15-17 ° C in the winter months, it is necessary to bury the tree roots of intensive gardens. In intensive gardens with a drip irrigation system, puddles are formed under the influence of water under the tree [2]. As a result, the roots of the tree will be submerged in water, soil hard layer will form on the bottom of tree , and the heating of that water on hot summer days will cause negative consequences for the tree. In order to overcome these shortcomings, it is one of the important tasks to develop high-quality and productive and energy-resource-efficient tillage machines and tools through intensive garden row cultivation and burying tree roots.

Research methodology

First, intensive garden tree architecture and root morphology were studied [2]. Based on the obtained results, a pilot copy of the machine (hereinafter referred to as the machine) for burying exposed tree roots in the intensive garden and working between the rows was developed at the Agricultural Mechanization Research Institute.

Studies on the justification of the angle of installation of the spherical disc for burying the exposed roots of trees in relation to the vertical G.N. Sineokov, F.M. Kanarev, P.S. Nartov, N.V. Butenin, Ya.L. Luns, D.D. Merkin, A. Tukhtakuziev, A.N. Khudoyorov, A.U.Igamberdiev, Sh.U.Ishmuradov, M.M.Ergashev was conducted using the research conducted by and others [3; 216-230-p., 4; 100-124-p., 5; 101-130-p., 6; 22-23-p., 7; 34-38-p., 8; 50-58-p., 9; 150-153-p.].

Figure 1. An experimental copy of the machine

Experiments were carried out to verify the theoretical results of a machine for burying exposed tree roots and inter-row cultivation in an intensive orchard by produced. In theoretical studies [10], the installation angle of the spherical disc with respect to the vertical was found to be 15°[11].

It consists of a frame 1 equipped with a suspension device, spherical discs 2, soil pusher levelers 3, support wheels 4, cross bars 5, brackets 6 attached to columns.

During the experiments, the angle of installation of the spherical disk working body relative to the vertical was changed from 5° to 20° with 5° intervals. In this case, the installation angle of the spherical disc relative to the direction of movement is 40º, the diameter of the spherical disc is 610 mm, the longitudinal distance between the spherical disc and the soil pusher leveler is 50 cm, and the aggregate movement speed is 5.0 and 7.0 km/h. In the spring of 2024, experiments were conducted in a 5-year-old drip-irrigated intensive apple orchard on the 8th card of the experimental farm of Tashkent Fruit LLC.

In the tests, the laboratory device was used aggregated with the MTZ-80.1 wheeled tractor of 1.4 class. Before conducting the tests, the physical and mechanical properties of the garden soil located at «Tashkent Meva» LLC: GOST 20915-11 «Testing of agricultural machinery. Methods of determining test conditions» was determined according to the conditional test. The soil moisture, hardness and density of the tested field soil were taken from the garden row. (Table 1) [12].

According to the requirements, the following performance indicators of the working bodies for burying exposed tree roots were determined in the experimental tests: - the average height of the soil pile, - resistance of the working body to traction, - quality of the crushing soil.

These are the indicators were determined

Table 1 - Soil parameters

The layer from which the soil sample was taken, cm	Soil moisture, %	Soil hardness, MPa	Soil density, g/cm^3
0-5	18,6	0,4	1,11
5-10	19,19	0,63	1,18
10-15	19,97	0,85	1,24

Table 2 - Spherical disc performance indicators

The angle of installation of the spherical disk relative to the vertical, °	The percentage of soil fractions, %			The average height of the soil pile, cm	The resistance of working bodies, kN
	sizes of fractions, mm				
	>100	100-50	<50	M_{av}	
V=5,0 km/h					
5	-	10,12	89,88	11,87	1,92
10	-	12,75	87,25	9,56	1,87
15	-	13,88	86,12	8,49	1,76
20	-	17,27	82,73	5,78	1,69
V=7,0 km/h					
5	-	8,49	91,51	10,58	2,1
10	-	10,36	89,64	8,71	2,01
15	-	11,67	88,33	7,37	1,95
20	-	15,25	84,75	5,14	1,86

according to Uz DSt 3236:2017 «Soil tillage machine and working tools in gardening. Test methods» [13] and Uz DSt 3193:2017 «Testing of agricultural machinery. The method of energy evaluation of machines» [14].

Results and discussion

According to the data obtained in the experiments, mathematical statistical methods were used to find the average arithmetic values of the indicators [15]. The average height of the soil pile, when the installation angle of the spherical disk relative to the vertical is 5 and 20, caused a decrease in the time of contact of the soil pieces with the working surface of the disk and insufficient lateral movement of the soil slabs cut by it. As the angle of installation of the spherical disc relative to the vertical increases, the drag resistance of the device decreases. This can be mainly explained by the fact that the spherical disc sinks into the soil and its cutting angles, as well as the height of the soil rising along the working surfaces and the reduction of their impact on the soil.The results are presented in Table 2.

If aggregate movement speed increased from 5.0 km/h to 7.0 km/h, due to the above-mentioned reasons, the quality of soil compaction decreased due to the reduction of the effect of the above-mentioned spherical disk on the soil.

Conclusion

So, at the speed of the machine to of 5.0-7.0 km/h the average height of the soil pile and the low drag resistance of the working bodies, the installation angle of the spherical discs should be in the range of 10-15°.

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