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## Test results of the new Root Crop Harvester

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**Abstract.** In the conditions of Uzbekistan, when harvesting early root crops in the summer, the soil moisture is reduced. Therefore, in the process of digging, the soil of the tuberous layer crumbles badly with the formation of large lumps, which makes it difficult to separate them from the tubers on the screen and elevator. This leads to increased loss and damage to root tubers. Serial digging working bodies of existing root crop harvester in the process of digging take away a significant amount of excess soil, and as a result, the tuberous mass is unloaded in front of the ploughshare. Therefore, this scientific research was aimed at developing a more efficient method of harvesting tubers that provides the required quality of work with less energy consumption and greater productivity. When aggregated with the MTZ-82 tractor, the energy indicators for the root crop harvester were obtained. Accordingly, speed of movement, traction resistance and traction power in the root crop harvester were ranged as 1.0-1.4 m/h, 4.10-4.35 kN, and 4.10-6.09 kVt, correspondingly. The traction resistance of the root crop harvester was 19-21% less than that of the serial digger.

### 1. Introduction

In Uzbekistan, special attention is paid to the introduction of science, technology and best agriculture practices. To increase the productivity and sustainability of agriculture, technologies and technical means of tillage, sowing and harvesting of agricultural crops and their primary processing have been developed and improved [1-5]. An important reserve for increasing crop yields is creating optimal soil conditions for the development of the root system of plants [6-9]. With the development of science and technology, scientists have developed many technological methods of cultivating agricultural crops [10-12].

In many countries of the world, research work is underway aimed at developing new scientific and technical foundations for resource-saving technologies that ensure the movement and separation of a layer with dug roots at lower energy costs, as well as separation from the soil and laying them in a swath without damage. In this regard, an important task is considered to be the implementation of scientific research in such areas as the provision of energy saving methods with the development of sectional undercut plowshares and the use of side discs, the development of paddle beaters to intensify the soil separation process.

Growing and harvesting root crops is an important component of the republic's agricultural production. At the same time, much attention is paid to the development of highly efficient and resource-saving technical means that ensure the digging of root crops with minimal energy



consumption. In the soil and climatic conditions of our Republic (high summer temperatures, low relative humidity, soil compaction after irrigation), in the process of harvesting root crops, the soil of the tuberous layer disintegrates into large soil lumps that are more hard than root crops, thereby making it difficult to separate it from root crops at the elevator. This circumstance is the main reason that prevents the introduction of root and tuber harvesters.

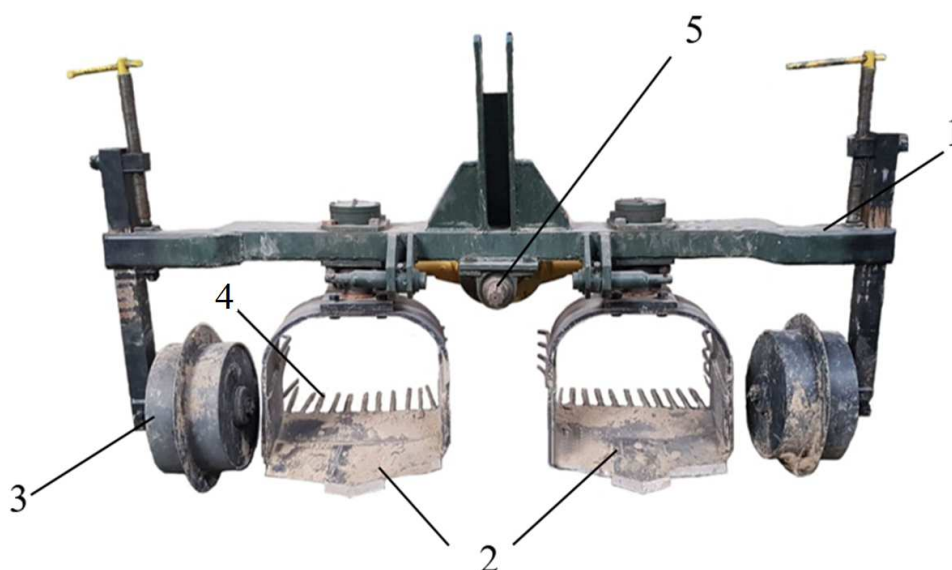
Currently, vegetable growing needs the introduction of advanced technologies, equipped with highly efficient technical means adapted to the economic and soil-climatic conditions of the republic. The analysis of the current state of cultivation and harvesting of root crops in the republic showed that in vegetable growing, harvesting of carrot tubers is one of the most labor-intensive operations with a low level of mechanization [13-15]. When using carrot diggers, the process of selecting tubers after digging them out is performed manually. This circumstance, in turn, leads to an increase in labor costs for the production of products. Numerous studies presented that in the technological process of root crop harvesters, the main thing was to separate the tubers from the clumps of soil without damage under any operating conditions.

The results of the analysis of the quality indicators of the existing root crop harvester showed that the agrotechnical requirements for digging root tubers were most fully met, mainly when working on light soils with optimal humidity and not containing strong soil lumps [16]. In difficult soil and climatic conditions, the machines do not fully meet the agrotechnical requirements for the process of digging tubers. As a result, losses and damage to tubers are quite large, which worsens the marketability of products and, as a result, reduces the cost of its implementation. Therefore, the reduction of losses and the degree of damage to tubers during the development of the root-tuberizer through the use of new technical solutions that meet agrotechnical requirements, with minimal energy costs, is an urgent task. Serial digging working bodies dig out the excess volume of the soil layer (row spacing zone) and as a result, the soil is unloaded in this zone, especially at high speeds of the unit, energy consumption increases, and there is a large loss of tubers. The digger for digging root tubers should provide high-quality, in accordance with agrotechnical requirements, digging with minimal energy consumption, be less metal-intensive and labor-intensive in maintenance.

On the basis of foreign experience in the design of root diggers and taking into account the soil and climatic features and the variety of physical, mechanical and technological properties of the soil in different periods of harvesting root crops, as well as agrotechnical requirements, the following requirements for the digger were formulated [17, 18]: 1) the digging working bodies of the root crop harvester should dig out the part of the bed where the nests with root tubers are located, without unloading the soil, which will reduce their traction resistance; 2) to ensure the maximum release of soil and plant impurities of the root crop harvester by using an intensifier, which will significantly reduce the energy and metal consumption of the separation process; 3) lay the potato harvesters in the roll with minimal damage, for which to ensure the damping of shock effects by reducing the height of the fall in the process of dropping them on the surface of the field, which reduces the complexity of assembling the tubers. Therefore, this scientific research was aimed at developing a more efficient method of harvesting tubers that provides the required quality of work with less energy consumption and greater productivity.

## **2. Materials and methods**

In this research, "Sayyotxon mushtari bogi" farm in Yangiyul district of Tashkent region was selected as study site, where the field experiments were conducted in June 2020. During the field experiment, the root crop harvester was used to collect harvest in the study site. The developed root crop harvester consists of a frame 1, trough-shaped active ploughshares 2, support wheels 3, intensifiers 4, and a gearbox 5. Trough-shaped active ploughshares 2 consist of two main and an intermediate ploughshare. Intensifiers 4 are made of rods with a diameter of 12 mm, attached to the ploughshare. The technical characteristics of the experimental root crop harvester were given in Table 1.



**Figure 1.** General view of the root crop harvester; 1-frame; 2-trough-shaped active ploughshares; 3-support wheel; 4-intensifier; 5-gearbox

**Table 1.** Technical characteristics of the experimental root crop harvester

1	Type of machine	mounted
2	Working width of the potato digger	1400 mm
3	Length	700 mm
4	Height	1300 mm
5	Working speed	0.8-1.2 m/h
6	Number: in pieces of digging working bodies	2 pieces
7	Digging depth	18-22 cm
8	Weight	300 kg

### 3. Results and discussion

Taking into account the above requirements, the design scheme of the root crop harvester and the scheme of the technological process of its operation with the indication of the main parameters were developed (Figure 1). According to the program, the following indicators were determined during the tests [19-21]: losses and damage to tubers; traction resistance of the potato digger; fuel consumption. The results obtained during the tests were given in Table 2 and 3.

**Table 2.** Agro-technical indicators of the work of the root crop harvester in terms of losses and damage to tubers

Indicators	Root crop harvester	
Speed of the unit, m/h	0.8	1.2
The completeness of the digging of tubers,%:		
a) extracted to the surface	94.0	92.0
d) total losses	6.0	8.0
Width of spreading tubers in the roll, cm	97.5	103.4
Damage to tubers,%, by weight	5.1	7.2

As a result of the conducted experiments, when aggregated with the MTZ-82 tractor, the energy

indicators for the root crop harvester were obtained. Accordingly, speed of movement, traction resistance and traction power in the root crop harvester were ranged as 1.0-1.4 m/h, 4.10-4.35 kN, and 4.10-6.09 kVt, correspondingly (Table 3).

**Table 3.** Energy performance of the compared potato diggers

Name	Root crop harvester	
Speed of movement, m/h	1.0	1.4
Traction resistance, kN	4.10	4.35
Traction power , kVt	4.10	6.09

#### 4. Conclusion

The traction resistance of the root crop harvester was 19-21% less than that of the serial digger. The advantage of the proposed root crop harvester is that the use of the above-mentioned working bodies reduces the intake of excess soil volume together with lumps and, thereby, reduces the degree of loading of the working bodies, as well as improves soil separation, reduces losses and damage to tubers, as well as traction resistance.

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