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Analysis of technical means of extraction of root crops

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ABSTRACT: This article provides an analysis of technical means for harvesting root crops, as well as their technological processes. The study of the state and trends in the development of potato diggers designs has shown that the main reason for the low efficiency of potato diggers, used in potato growing in the Republic of Uzbekistan is the discrepancy between the design and technological parameters of diggers to working conditions. The authors proposed a potato digger with vibrating rods, which consists of ploughshares, rods and mechanism for transferring motion to the rods. Preliminary studies have shown that this digger is superior to the existing diggers in terms of quality indicators.

KEY WORDS: root crop, digger, power harvester, plowshare, bracket, root crop harvesting process, screen digger, vibrating bar.

I. INTRODUCTION

In Uzbekistan, the cultivation of various root crops is currently developing rapidly. The technological process of growing and harvesting root crops is a labor-intensive process. Labor costs during the harvest period account for about 55-65% of the total process labor costs [2, 4]. Failure to harvest the roots in a timely manner has a significant impact on their quality. Due to the rapid decline in their quality, special agronomic requirements are placed on root harvesting machines. One of the most important aspects influencing the improvement of excavator working bodies will be the acceleration of the excavation process, i.e. the reduction of the amount of soil falling on the machine and the acceleration of its deformation. Such requirements for harvesting lead to the development of working bodies that ensure minimal damage and waste of roots of various physical and mechanical characteristics during mining.

II. SIGNIFICANCE OF THE SYSTEM

The article presents the results of the analysis of existing potato harvesters. The study of literature survey is presented in section III, methodology is explained in section IV, section V covers the experimental results of the study, and section VI discusses the future study and conclusion.

III. LITERATURE SURVEY

With N.Dedenkov [1], V.Martynov [2], G.Petrov [3], P.Beketov [3], E.Trubilin [4], V.Ablikov [4] developed a universal potato digger with a working tool of cramp type. V.Ablikov [4] proposed a combined working body. It consists of a digging disc and a softening disc. The working principle of the combined digging working body is as follows: when the working body moves along the potato row, its softening disk breaks up the soil pulp, which passes through the shrinking interval between the potato needle softening and spherical digging disks. At present, various designs of working bodies for digging roots are being developed.
The purpose of the study is to justify the parameters of the auger of the potato harvester.

IV. METHODOLOGY

The basic principles and methods of classical mechanics, mathematical analysis and statistics were used in this study.

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V. EXPERIMENTAL RESULTS

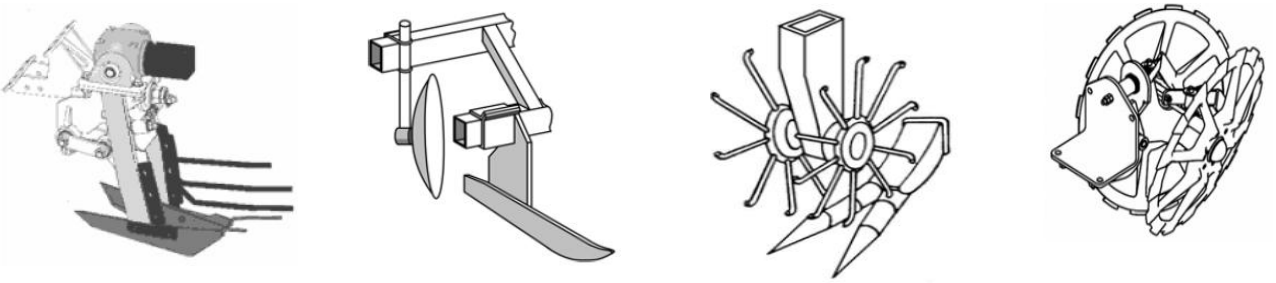
At present, Uzbekistan uses more manual labor to harvest roots. Depending on the degree of mechanization of the process of digging the roots are divided into non-mechanized, semi-mechanized and fully mechanized types. Non-mechanized means the use of manual force (without technical means) in harvesting roots. In this case, shovels are used to cut the rootstock and to remove the roots from the ground. In the semi-mechanized type, the rootstock is cut with a special technique that cuts the roots, and with the help of diggers the roots are removed to the surface. It is then hand-loaded into containers, loaded onto a vehicle, and brought to the sorting site. At the sorting site, the roots are taken down and sorted. Selected roots are re-placed in containers and sent for storage. Fully mechanized type means the use of machines for harvesting roots. That is, the machine cuts the stems of the roots, removes them from the ground, sorts them and loads them on the vehicle.

Currently, root farms are forced to choose the equipment and facilities offered from European countries and the United States when harvesting roots. The development and scientific substantiation of energy-efficient digging working bodies, designed for the collection of root crops grown in small areas (0.5-075 ha), taking into account climatic conditions, is a modern requirement.

In recent years, motoblocks have been widely used in the harvesting of root crops grown in gardens. A digging working body mounted on motoblocks is designed to remove the roots from the ground. The advantage of using motoblocks in the harvesting of roots, mainly on farmland, is low labor and energy efficiency. Its disadvantages are the inconvenience of movement of the motoblock controller from the rear and in some cases the fact that a large amount of soil sticks to the working body and the working body is buried in the ground.

Figure 1. Motoblocks equipped with excavating working bodies of various constructions

The function of the root-digging working bodies is to break the connection between the soil and the root-root and remove it from the soil and transfer it to the next working body, i.e. to the cleaning-conveyor for cleaning from soil and plant mixtures. The excavator working body is tasked with transferring a small amount of plant residue to the next working body, increasing the degree of soil compaction. Excavators for digging roots consist of lemex. Lemexes come in three types: active, passive, and combined. The types of digging working bodies of root harvesting machines are described in Figure 2 below [2].



a) ploughshare; ***b)*** ploughshare-disc; ***c)*** rotary fork; ***e)*** disk

Fig.2. Types of diggers

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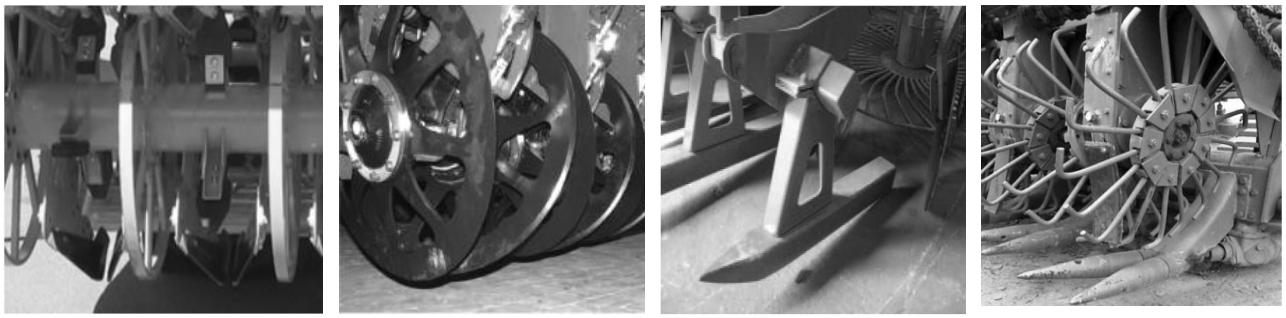
Companies such as ROPA, Grimme, and Dewulf (Fig. 3), which produce machines for harvesting roots in foreign countries, have working bodies for digging in their potato harvesters [2, 4]. The advantage of these machines is the complete mechanization of the method of harvesting roots. These machines cut the stems of the roots and dig them out. The use of these techniques and equipment in the process of harvesting root crops planted in small areas is not considered economically viable. Also, due to the high cost of the above machines, their purchase is a problem for farms.



a) ROPA firm lemex excavator working body

b) Grimme's disk active digging working body

c) Dewulf's lemex-disc excavator working body

d) Rotor-fork excavator working body of Dnepropetrovsk plant

Fig.3. Different kinds of diggers

SNU-3S beet lift for partial mechanization harvesting, OPKSh-1,4 working body, potato and onion diggers equipped with special equipment for stream harvesting used. With the SNU-3S beet lift, the beets move from the location of the root crops on the surface of the soil - carrots, radishes, turnips, etc., making it easier to harvest them by hand. The width of the beet lift, which is used on tractors MTZ-60 and T-40M, is 1.4 m. cm to set the roots planted in the range of two cm. The productivity of the SNU-3S is 0.6 ha / h, operating speed is 4-5 km / h. The beet lifter cuts the soil layer to a certain depth with a bracket or claws during the work, partially lifting it and crushing it at the same time. As a result, the connection between the soil and the roots is lost. Potatoes, which are considered to be root crops, are harvested using special potato diggers.

Scientists from the Primorsky Agricultural Research Institute have proposed the following method of preparing a potato crop for mechanical harvesting for efficient shredding of soil lumps. On the day of potato harvesting, the cultivator picks up the left part of the pile with a working body in the form of a straightening claw along with the bottom cut where the potato is located and moves it along the longitudinal axis of the pile. This causes deformation of the cut part of the pile and some displacement of the uncut part of the pile. After the left side of the pile is moved, the working organ affects its right side, where it also cuts, lifts up and moves to the left, resulting in the processed pile returning to its previous position. As a result of shifting each half of the stalk in the opposite direction, the soil lumps are rapidly disintegrated, the potatoes are removed from the sticky soil, and they are separated from the stem part. Disadvantages of this method include: increased passage of machines through the field, resulting in excessive compaction of the soil, increased labor and fuel consumption.

Potato diggers are divided into rotor, elevator, grokhot and combined types. KTN-A potato diggers with elevators are used when planting potatoes with row spacing of 60 and 90 cm. Potato digger with elevator "KST-1,4" is designed for digging two rows of potatoes with a row spacing of 60 and 70 cm [1, 3, 5]. The efficiency of elevator potato diggers is great.

Today, many types of energy-efficient potato diggers are produced. Potato diggers are inexpensive and convenient to use in areas planted in small areas. But the disadvantage of this type of excavators is that the quality of mining depends on the nature of the soil. In Russia, Ukraine, Belarus, India and other countries, several different types of potato diggers are used. There are such types of combined potato diggers as rotor-elevator, rotor-grokhot. In recent years, rotor-grocery potato diggers are widely used. These are also called "vibrators" in the vernacular.

Currently, the authors are conducting research on the working body of digging roots. Several variants of the excavators were developed and tested, and the most optimal variant was selected. Drawing from the above experiments, an improved excavation working body was developed. The excavator is based on receiving power from a power transmission shaft. The excavator consists of a frame, a cardan shaft, a reducer, bearings, a round rod, a pole, a

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specially shaped lemex with steel rods fastened, and vibrating rods driven by a power transmission shaft. The unit is designed to remove roots in two rows at a time. The power received from the unit power transmission shaft drives the vibrating rods through the reducer. During the operation of the excavator, the working body lifts the soil when it comes in contact with the soil at an angle and transmits it to the vibrating rods. Vibrating sticks crush the stalks and leave the roots on the ground. The advantage of these techniques and devices over previous mechanisms is their high energy efficiency.

VI. CONCLUSION AND FUTURE WORK

1. The study of the status and trends in the development of potato harvester designs has shown that the main reason for the low efficiency of potato harvesters used in potato growing in the Republic of Uzbekistan is the discrepancy between the design and technological parameters of diggers to working conditions.
2. Suggested potato digger with vibrating rods, which consists of ploughshares, rods and mechanism of transfer of movement to rods. Preliminary studies have shown that this digger surpasses existing diggers in qualitative indicators.

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