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MOBILE CHASSIS FOR MECHANIZATION OF HARVESTING WORK IN INTENSIVE GARDENING

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Abstract
The article presents the development and evaluation of a mobile chassis designed to enhance the mechanization of harvesting operations in intensive gardening. Intensive gardening systems, characterized by high-density planting and optimized resource utilization, demand specialized equipment to streamline labor-intensive processes, particularly harvesting. This study focuses on designing a versatile and efficient mobile chassis capable of navigating the unique spatial constraints of intensive orchards. Key features of the proposed chassis include adjustable height and width for compatibility with various tree configurations, efficient maneuverability to reduce orchard soil compaction, and integration with harvesting tools to minimize fruit damage. The design prioritizes ergonomics and energy efficiency to improve productivity while addressing environmental sustainability. Field tests demonstrate the chassis's ability to significantly reduce manual labor, increase harvesting speed, and enhance the overall operational efficiency of intensive gardening systems. This innovation provides a practical solution to modern horticultural challenges, paving the way for improved profitability and sustainability in agricultural practices.

Keywords: Orchard, orchard machinery, harvesting and transport mechanization, mobile harvesting and transport chassis.

Introduction

Harvesting is the most labor-intensive process of fruit production technology. It is carried out either manually using ladders of various systems or by technical means for gardening. One of the positive aspects of manual fruit picking is the high preservation of the crop quality. In this regard, it is worth paying attention to the progress of the development of a special tractor mobile chassis for gardening applicable to all types of work in gardens, including harvesting and transporting fruits from the garden, developed by the National Research University “Tashkent Institute of Irrigation and Agricultural Mechanization Engineers”. Collection and removal of fruits is carried out in a single process with the help of 2-4 collectors; the main 200-kilogram container is in the tractor during collection. The collected fruits are transported to the storage facility. The characteristics of the mobile chassis for gardening equipped with platforms for unloading fruits from the fruit-picking container are given in the table below. The containers are placed on the roller tracks of the tractor. The use of containers on the tracks allows increasing labor productivity by no more than 2 times.

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The aim of this study to provides a practical solution to modern horticultural challenges. The mobile chassis for mechanizing harvesting operations in intensive gardening lies in its innovative design and adaptability to the specific challenges posed by high-density orchards and modern horticultural practices. While many harvesting machines are optimized for traditional orchards, this mobile chassis offers several new and unique features that address the unique needs of intensive gardening systems.

Method and Materials

A comprehensive assessment of the operational requirements in intensive gardening was conducted. This included analyzing orchard layouts, tree spacing, terrain types, and the specific demands of harvesting operations. Interviews with agricultural practitioners and field observations were utilized to gather insights into the challenges and opportunities for mechanization in intensive orchards. Key performance criteria, such as adjustable dimensions, lightweight construction, and minimal soil compaction, were identified.

Table 1. Technical characteristics of the mobile chassis for intensive gardening

No.		Wetting of indicators	The meaning of the indicators
1		Productivity, d/h	15
2		Service personnel, persons: tractor driver	1
3		auxiliary assembly worker	2
4		Maximum height of the lifts, working container, m.	2 , 5
5		Weight of main container kg	20.0

The main container with a capacity of 200 ... 250 kg is used for transportation of harvested apples and their storage . Based on the completed research and development work, a mobile chassis for intensive gardening was developed (Fig. 1) . A mobile chassis based on containers for the working staff engaged in fruit harvesting. When using it, the entire technological process can be completely mechanized: from harvesting to delivery of fruits for sale or processing.

Results

Our task was to develop a design for a gardening tractor chassis adapted for complex mechanization and mechanized work in gardening.

The task was solved by the fact that in a special chassis for intensive gardening, containing an engine , high-speed transmission control , a cabin installed on a frame, a hydraulic motor, a hydraulic pump, two vertical posts for fastening the collector's workplace made in the form of a basket and a conveyor belt with fixed containers, a power cylinder connected to the collector's workplace, in which a control panel is installed (Fig. 1-2) are additionally installed on the frame.

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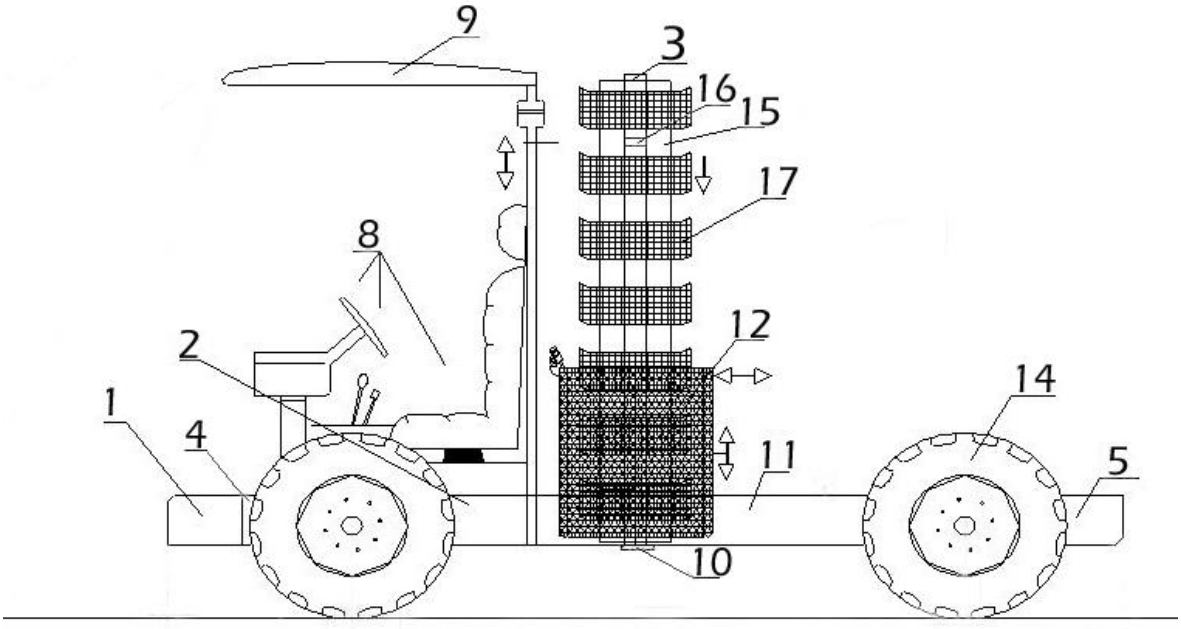

Figure 1. Special tractor mobile chassis for gardening

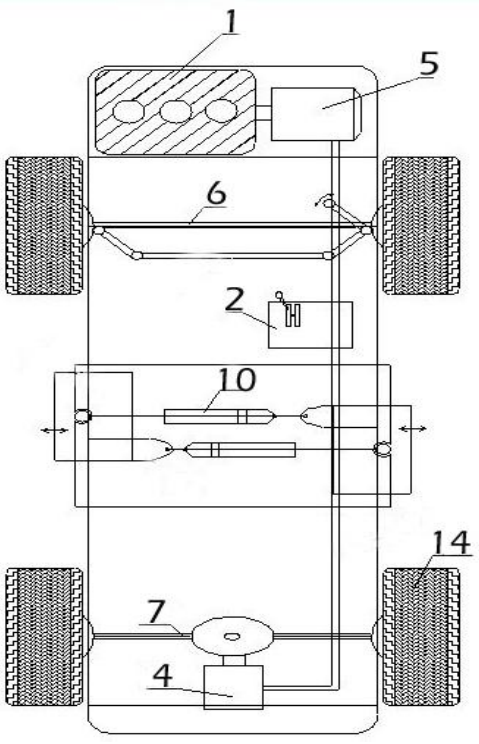

Figure 2. Chassis of a tractor for intensive gardening

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The implementation of the development in gardening of semi-dwarf and dwarf trees allows for complex mechanization of gardening. Therefore, the proposed design of the mobile chassis allows for the execution of a complex of mechanized works.

The picker's workplace is designed to be mobile and is controlled by the picker using a hydraulic system based on the condition of ensuring maximum ease of work to create an optimal horizontal and vertical distance relative to the trees for the fruit picker.

The use of hydrostatic transmission will allow creating a tractor layout adapted for work in the mechanization of work in gardening. Hydrostatic transmission provides an optimal speed mode of the tractor, ensuring high-quality performance of the technological process and increasing labor productivity. As is known, these indicators affect productivity and, ultimately, the cost of gardening products.

The use of racks with hydraulically controlled mobile platforms ensures the optimal distance between the picker and the collected products horizontally and vertically. The harvested crop is collected in conveniently located trays which, under the action of the gravitational weight of the harvested crop, move to the platform and are packed without damage into containers that are sent to special warehouses for long-term storage (Fig. 3).

The proposed design can be equipped with a liquid tank for chemical treatment of trees to combat pests in the spring and summer. Chemical treatment sprayers are on hydraulically controlled stands and the operator has the ability to create an optimal distance between the sprayer and low-growing trees.

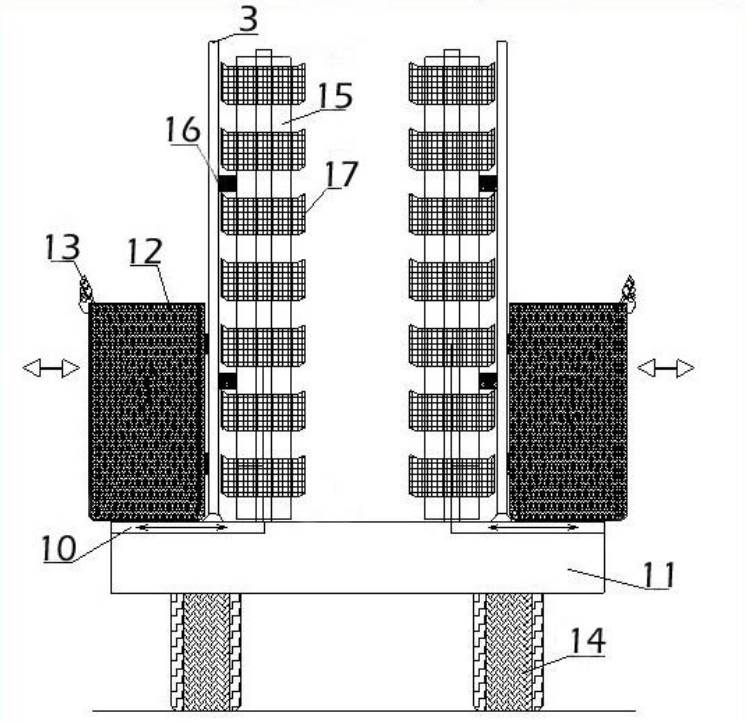

Figure 3. Rear view of the mobile chassis for intensive gardening

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Discussion

The proposed chassis contains (Fig. 1, 2 and 3) engine 1, high-speed transmission control 2, two vertical posts 3, a hydraulic motor 4, a hydraulic pump 5, a front axle 6 and a rear axle 7, a bucket 8, an umbrella 9, a power cylinder 10 installed on a frame 11. A picker's workplace 12 made in the form of a basket is installed on the conveyor post 3. The picker's workplace 12 is connected to the power cylinder 10, it is hydraulically controlled by the picker for the convenience of harvesting fruits and other work. A control panel 13 is installed in the picker's workplace 12, which is controlled by the picker of fruits from trees (Fig. 1). Four wheels 14 are fixed to the front axle 6 and the rear axle 7, two conveyor belts 15 are fixed to an axle 16, which are installed on the vertical posts 3, containers 17 are fixed to the conveyor belts 15, installed below the collector's workstation 12 serve to move the collector's workstation, i.e. the basket, to the optimal distance from the trees on both sides.

The mobile chassis operates as follows. The chassis design is intended for intensive gardening, the tractor's power transmission consists of a two-cylinder engine 1 with a rated power of 30 hp. The chassis transmission is hydrostatic. When engine 1 is started, power is transmitted to hydraulic pump 5 of two variable outputs, then to hydraulic motor 4 through a hose, from which it is transmitted to the rear drive wheels 14. Depending on the requirements of the technological process, the hydrostatic transmission can change the chassis speed from 0 to 10 km / h. This is especially important for semi-mechanized harvesting in intensive gardening and other mechanized work. Engine power can also be used to drive active soil-cultivating working bodies from a hydraulic motor. The chassis moves in a strip between trees, two fruit pickers located in the workplace 12 on both sides collect fruits. The collected fruits are placed in movable containers 17, which, under the action of their own weight of the collected fruits, move to the platform, where they are manually carefully transferred without damage into the container for transportation. Using the remote control, you can turn it on 180^0 degrees to ensure work on narrow rows in gardening. Sprayers can also be installed on racks 3 to combat pests and to feed trees with active growth and development agents in order to increase yields and improve the quality of fruits.

At present, tractors with low-power engines and classic layout are used for the mechanization of gardening, particularly intensive gardening. Complex mechanization of all processes in gardening with existing gardening tractors is not possible. Because the classic design of tractors is not adapted to the complex mechanization of intensive gardening. This leads to a decrease in the degree of mechanization. As a result, the costs of cultivation and harvesting increase, and the quality of the harvested product deteriorates.

Conclusion

The development of the mobile chassis for mechanizing harvesting in intensive gardening represents a significant advancement in modern horticulture. By addressing the unique challenges posed by high-density orchards and emphasizing adaptability, efficiency, and sustainability, this design offers an innovative solution that can substantially improve harvesting operations. The chassis's adjustable dimensions allow it to navigate diverse orchard layouts, while its low-impact maneuverability ensures minimal disruption to soil health. The integration of harvesting tools and the focus on energy efficiency and ergonomics make the system highly adaptable to various crops and ensure improved operational productivity and operator comfort. Field testing has demonstrated

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its potential to significantly reduce labor costs, increase harvesting speed, and enhance sustainability within intensive gardening systems. In conclusion, this mobile chassis design provides a practical, sustainable, and efficient approach to modern agricultural practices, offering a versatile solution that can be integrated into existing farming operations. It paves the way for the continued evolution of mechanized horticulture, contributing to improved productivity, profitability, and environmental stewardship in intensive orchards.

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