Experimental study of the dynamics of the hydro-tracking system of the rotary share of a garden cultivator

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Abstract. The article presents the results of the experimental studies of the dynamics of the hydro-tracking system of the rotary share of a garden cultivator. A prototype garden cultivator equipped with a rotary flat-cutting paw controlled by a hydro mechanical device was used for the experiments. Based on the tests carried out, it is recommended to keep in production an garden cultivator with a garden cultivator with a hydromechanical device for tillage in intensive gardens with a planting pattern of up to 4 meters in a row.

1 Introduction

The garden cultivator tills the soil in a row and in inter-stem strips in one pass in intensive orchards with a row spacing of 4 and 5 m. The age of the plantations was in the range of 4-12 years. The garden machine worked mainly in the 4-meter version in terms of the width of the capture. The test conditions were typical for intensive orchards in the Republic zone and did not adversely affect the test results.

When developing a program and methodology for experimental research of a garden cultivator with a retractable section, the program and methodology for bench and laboratory-field identification tests of hydraulic automatic control systems for the working bodies of machines for near-stem and inter-bush tillage in orchards and vineyards were taken as the basis [1, 2].

2 Materials and methods

As objects of study, a prototype garden cultivator was used, equipped with a rotary flat-cutting paw controlled by a hydro mechanical device, which passed laboratory tests. During field tests, a garden cultivator is used, which is aggregated with an MTZ-82.1 tractor. Trees in the garden are divided into scoring areas. Each scoring area consists of 3 trees. After the

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passage of the unit in the rows where the soil was processed, an agro technical assessment of the quality of work is carried out. Then a series of experiments is carried out at the maximum speed of the unit - 1.6 ± 0.1 m/s. At the same time, attention was paid to possible cases of damage to plants or the approach of the soil tillage boundary to the plant trunk at a distance of less than 10 mm [3, 4].

The assessment of the real performance characteristics of the hydraulic drive of a garden cultivator is carried out on the basis of measuring the pressure in the hydraulic drive of the rotary share, depending on the type of hydro mechanical device and the scheme of planting trees in the garden. Registration of parameters is carried out with the help of a device for studying pressure changes in the cavity of the power hydraulic cylinder for turning the paw with sensors of the DDMP-100A type. To amplify the output signals of strain gauges, an 8ANCH-4M amplifier was chosen, and a specially developed program was used for recording in the laboratory "Mechanics of Fluid, Gas and Drive Systems" of the Research Institute of Mechanics and Seismic Resistance of Structures. M.T. Urazbaeva of the Academy of Sciences of the Republic of Uzbekistan (Figure 1).

Information about the loads in the hydraulic drive of the garden machine is registered during the shift, after which it is read and processed using the "Excel" program. To obtain comparable information about the load modes in the hydraulic drive of the cultivator, the design of the classifier allows you to register only the working process for inter-stem tillage. Stops, transfers, etc, cut off from the experimenter's control panel [5].

Fig. 1. General view of the right section of the garden cultivator with installed sensors: a - connected to measuring devices, b - transitional mode - bypassing the bole.

Transitional mode - bypassing the trunk. The probes make periodic deviations without pauses; the hydro mechanical device, by means of hydraulic cylinders, carries out input and output to the extreme positions of the rotary paws.

3 Research and discussion

The operating mode is characterized by the duration of a full cycle. The probes make a periodic deviation with a pause equal to the time of passage of the aggregate between two adjacent plant boles. In the pause, the probes are in their original position.

The general principles for assessing the accuracy of the results of parameters during tests corresponded to the principles and requirements that are described above.

In order to study the impact of the change in the structural and kinematic parameters of the device for processing the soil of the prescription-mechanical laces in the gardens on agricultural and energy indicators for each issue of the program, the corresponding technique was developed, according to which studies were conducted [2]. When the probe is in contact with the tree stamp, the spool turns from one extreme position to another. The pressure in the hydraulic cylinder during the withdrawal of the laps from the sectral zone is 3.2 MPa.
The hydromechanical device (GMU-3) is structurally with a spool unloading, which calls for the working fluid during the passage of the paw in the sectorship zone to pass freely for the drain. The pressure on the schedule (Figure 2) is about 3.2 MPa. This indicates that most of the time of the working cycle occurs in unloading mode [6, 7].

![Figure 2](image-url)

Fig. 2. Change in the pressure in the hydraulic cylinder cavity.

To verify the effectiveness of the use of a hydromechanical device in intensive and wide gardens, preliminary and periodic tests of a garden cultivator with a new hydraulic drive of rotary knives were carried out.

4 Conclusion

The high sensitivity of the hydraulic drive control system of rotary knives allows for the treatment of soil in the sewage stripes of young gardens without damage to trees. This creates the prerequisites for the introduction in the gardens of resource-saving soil tillage technologies in orchard.

The productivity of the garden cultivator per hour of the main time is within the requirements of the technical conditions and is 2.25 ha/h. The machine availability factor was 0.98, which meets the requirements of the technical specifications.

Agrotechnical assessment confirmed the feasibility of using a hydromechanical device. At operating speeds in the range of 0.8-1.6 m/s, the area of the untreated zone around the tree trunk did not exceed 0.25 m², which corresponds to the technical specifications. No damage to trees by probes was found. The machine worked effectively even at a speed of 1.6 m/s, however, the size of the protective zone increased to 0.26 m, which does not meet the requirements of the technical conditions [3].

Based on the tests carried out, it is recommended to keep in production a garden cultivator with a garden cultivator with a hydromechanical device for tillage in intensive gardens with a planting pattern of up to 4 meters in a row.

References

2. The search for typical automatic control systems for the working bodies of machines for the care of orchards and vineyards based on the use of unified hydraulic equipment Research report. NPO VISHOM, subject 15.301-87, inv. No. 01870017523 (Moscow) 182 (1999)
3. 20174 O’z DSt 3236:217 Agricultural machinery testing. Machines and implements for tillage in gardens (2017)
4. Agrotechnical requirements for agricultural machines with hydraulic control systems for tillage in orchards and vineyards (M., Agropromizdat, 1994)