

Article

Analysis of Devices for Inter-Row Cultivation in Intensive Orchards

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Abstract: Worldwide, considerable attention is being paid to conducting extensive scientific research on the development of energy- and resource-efficient machines and devices with high productivity and operational efficiency for inter-row cultivation in orchards, as well as to their production and practical application in the agricultural sector. Therefore, under the soil and climatic conditions of the Republic of Uzbekistan, the development of energy- and resource-saving, highly productive machines and devices for inter-row cultivation in intensive orchards, along with the substantiation of their technological processes and optimal parameters, is considered an urgent scientific and practical task. In particular, significant importance is attached to the development of devices with optimal parameters that ensure high-quality performance of all technological operations in orchard inter-row cultivation with minimum labor and resource consumption.

Keywords: intensive orchard, resource-saving technology, universal device, disc harrow, bolt-nut connection, hydraulic cylinder, hydraulic system, mechanical system, tractor.

Introduction.

In recent years, considerable attention has been paid to the development of intensive horticulture in the Republic of Uzbekistan. In particular, this is evidenced by Resolution No. PQ-5009 of the President of the Republic of Uzbekistan dated February 26, 2021, “On Measures for the Implementation in 2021 of the Tasks Defined in the Strategy for the Development of Agriculture of the Republic of Uzbekistan for 2020–2030,” Resolution No. PQ-4406 dated July 29, 2019, “On Additional Measures for the Deep Processing of Agricultural Products and Further Development of the Food Industry,” as well as other relevant regulatory documents [1].

Currently, intensive orchards occupy more than 33.4 million hectares worldwide, and this figure continues to increase annually.

It is well known that the inter-row spacing of intensive orchards is generally 3–4 m. Therefore, the use of conventional large-sized agricultural machinery may cause damage to tree canopies and root

systems. For this reason, the analysis and improvement of compact mechanized devices capable of providing high-quality inter-row cultivation in intensive orchards constitute an important scientific and practical task.

Research Objective

The objective of the research is to develop an energy- and resource-efficient mechanized universal soil-cultivation device with high operational quality and productivity, capable of adapting to different inter-row spacing schemes of intensive orchards in the Republic of Uzbekistan.

Methods

In horticultural production, VK-5, KSL-5A, and MPV-1 orchard cultivators manufactured in Uzbekistan are widely used. In addition, KSG-5, KCM-5, KSN-4, and KVO-3 cultivators manufactured in Russia; PRVN-2.5, KCM-2, and KCM-5 cultivators with passive working bodies manufactured in Ukraine; as well as Dondi and Rinieri cultivators manufactured in Italy and other types of cultivation machinery are effectively used in orchards. Disc harrows are also widely applied for inter-row soil cultivation.

Within the framework of the research, a **transformable disc harrow design** capable of adapting to the variable dimensions of intensive orchard inter-row spacing was developed.

At the initial stage, a method for the discrete adjustment of the working width of the device by means of **bolt-nut connections** was investigated. In order to reduce manual labor and automate the adjustment process, a special **hydraulic cylinder** designed to be installed within the harrow frame was developed, together with its engineering drawings.

The parameters of the hydraulic cylinder, including its working volume, piston rod extension length, and operating pressure compatible with the hydraulic systems of orchard tractors, were determined using analytical and experimental methods.

The working width of the developed device is **2500 mm**. At the front section of the device, on both the left and right sides of the central frame, adjustable links (plates) with several circular holes are installed. By repositioning the bolts and nuts through these holes, the working width of the disc harrow and the cutting angle of the discs relative

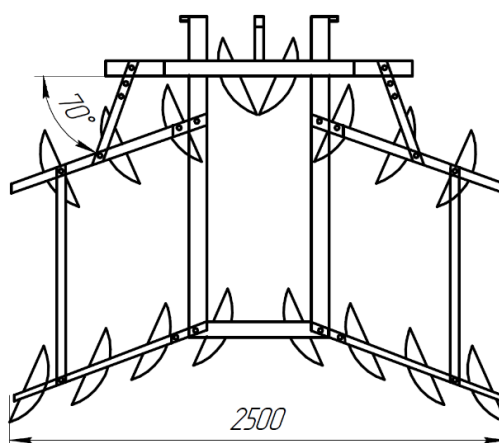


Figure 1. Kinematic diagram of the device for inter-row cultivation in intensive orchards.

Field tests of the device designed for inter-row cultivation in intensive orchards with different planting schemes were conducted in an intensive apple orchard belonging to “Navigul” LLC, located in Khojaobod District, Andijan Region.

For the field tests, the device for inter-row cultivation in orchards with different planting schemes was operated with working widths of **300 cm and 250 cm** and was mounted on a **Belarus-80.1 tractor**.



Figure 2. Working process of the device for inter-row cultivation in intensive orchards.

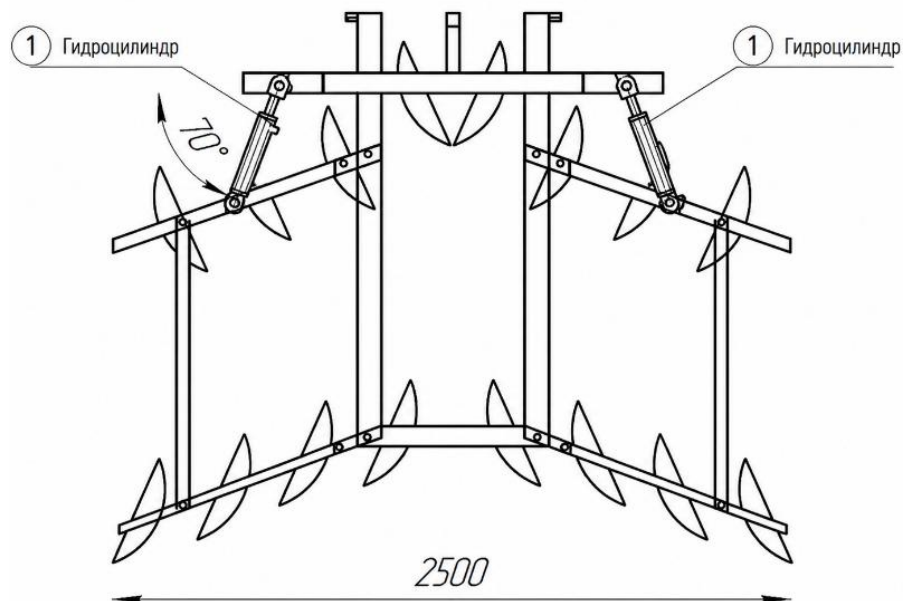


Figure 3. Structural diagram of the hydraulically extendable and retractable device

Results and Discussion

The main novelty and technical solution of this design is its **hydraulic control system**. The device is equipped with **two hydraulic cylinders**. These hydraulic cylinders enable the side wings of the implement to be moved and adjusted at angles of up to **70°**.

The analysis conducted on the basis of the designed hydraulic system and the developed engineering drawings showed that replacing the conventional bolt-nut adjustment mechanism with special hydraulic cylinders makes it possible to change the working width of the disc harrow directly from the tractor cab within **5–7 seconds while the machine is in operation (dynamic mode)**. This enables smooth adjustment of the harrow working width in orchard areas with varying inter-row spacing.

Adaptability to field relief. Owing to the hydraulic system, the wings can smoothly and independently adapt to uneven field surfaces and terrain variations, which significantly improves the quality of soil cultivation. As a result, the maneuverability of the machine within the orchard is increased, while the risk of damage to tree trunks and branches is minimized. At the same time, field productivity can be increased by **20–25%**.

Thus, it can be concluded that the proposed device differs from conventional mechanically adjustable implements in terms of rapid adjustment, reduced manual labor requirements, and a high level of automation.

Conclusion

The substantiation of the parameters of the hydraulic cylinders designed for the intensive orchard disc harrow demonstrated that replacing the mechanical bolt-nut adjustment system with a hydraulic system improves operational reliability while maintaining the structural strength of the device.

Proper selection of the operating parameters of the hydraulic actuators prevents excessive loading of the orchard tractor's hydraulic system and contributes to the optimization of energy consumption. Furthermore, the hydraulic adjustment mechanism enables rapid and smooth adaptation of the implement working width to different inter-row spacing conditions, thereby improving the quality and efficiency of soil cultivation in intensive orchards.

REFERENCES

1. **Resolution No. PQ-5009 of the President of the Republic of Uzbekistan dated February 26, 2021**, "On Measures for the Implementation in 2021 of the Tasks Defined in the Strategy for the Development of Agriculture of the Republic of Uzbekistan for 2020–2030."
2. **Amanov, Azamat Kushnazarovich**. *Substantiation of the Parameters of a Device for Cultivating Inter-Row Spaces of Different Widths in Intensive Orchards*. PhD Dissertation.
3. **Amanov, A., Xalilov, M.** Substantiation of the parameters of disc working bodies of a device for cultivating inter-row spaces of different widths in intensive orchards. In: *Innovative Solutions for the Development of Highly Efficient Agricultural Machinery and Improvement of the Utilization Level of Technical Equipment: Proceedings of the International Scientific and Technical Conference*. Gulbahor, 2024, pp. 228–230.
4. **Amanov, A.** Substantiation of the parameters between transverse and longitudinal discs of a disc device for cultivating inter-row spaces of different widths in intensive orchards. *Bulletin of Agrarian Science of Uzbekistan*, Special Issue No. 5 (17), Tashkent, 2024, pp. 120–123.
5. **Amanov, A.** Selection of the design of a device for cultivating inter-row spaces of different widths in intensive orchards. In: *Problems and Solutions for Increasing the Application of Innovative Machinery and Technologies in Agriculture: Proceedings of the Republican Scientific and Practical Conference*. Tashkent, 2024, pp. 31–35.
6. **Amanov, A.** Efficiency of disc working bodies in inter-row cultivation of intensive orchards. In: *Problems and Solutions for Increasing the Application of Innovative Machinery and Technologies in Agriculture: Proceedings of the Republican Scientific and Practical Conference*. Tashkent, 2024, pp. 35–38.