Development of cultivator model for processing seed potatoes with planting option in two-row seedbed

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Abstract. One of the main problems of the Russian agriculture is the production of the agricultural products required quantities. In connection with the norms of impact on agricultural landscapes exceeding due to their long and intensive agricultural use, it led to the energy and mass exchange disruption between its components, the progressive development of degradation phenomena, the decrease in soil fertility and productivity of agrocoenoses due to the abiotic and biotic stressors influence. The question of the seed potatoes cultivation technique by the tubers two-row placement in the seedbed is considered. The intensification of potato cultivation technology based on the use of modern science-intensive technical means is one of the main factors in obtaining this strategic agricultural crop highly stable and high-quality crops. The cultivator was designed for processing seed potatoes in order to increase energy efficiency in the production of potatoes for seeds when planting potatoes in two rows.

1. Introduction

Producing the required quantities of agricultural products in arid climate conditions and making it sustainable is one of the main problems of agriculture in the Russian Federation. Irrigation in combination with agrotechnical reclamation is a stability guarantee in obtaining the required volume of crop production in these conditions. However, exceeding the norms of impact on agricultural landscapes due to their long-term and intensive agricultural use, the use of working organs with low relative wear resistance led to the energy and mass exchange disharmonization between its components, the degradation phenomena progressive development, the decrease in soil fertility and productivity of agrocoenoses due to the abiotic and biotic stressors influence and, as a consequence, environmental stress [1,3]. In conditions of production processes traditional regulation limited possibilities in agrocoenoses, it is necessary to find ways to increase their potential yield through the rational use of excess man-made resources while observing ecological technologies of waste-free production [2,4].

In Russia, all the considered potato cultivation technologies became widespread to varying degrees, which, subject to technological discipline, ensure stable yields at the level of 25 t/ha. However, these technologies and the complex of machines for their implementation are designed to obtain ware potatoes.

The problem considered in this work is devoted to the adaptation of ridge-belt technology and the improvement of a machines complex for its implementation in the seed potatoes cultivation.
2. Materials and methods
Volgograd Region is one of the most economically developed regions of Russia with a balanced economic structure. Diversified agricultural production is combined with the industrial sector.

The development of resource-efficient intensive machine technologies, biotechnological and membrane processes, are among the state policy priority guidelines and the Russian Federation Strategy of scientific and technological development. The question of the planting seed potatoes technique by tubers two-row placement in the seedbed is considered. The intensification of potato cultivation technology based on the modern science-intensive technical means use is one of the main factors in obtaining this strategic agricultural crop highly stable and high-quality crops. At the same time, the choice of technology should be consistent with the zonal soil and climatic conditions, varietal characteristics of plants, and the functional purpose of the products obtained.

In the world practice, various technologies of potato cultivation were worked out and are applied, in particular, «Zavorovskaya», Gollandskaya, Wide-row planting, «Grimmovskaya» and Ridge-strip planting.

The seed potatoes cultivation main and actual problem is to obtain high-quality healthy tubers of small and uniform size, but in a larger quantity relative to food plantings. To the solution of this issue, in our opinion, it is necessary to approach from the standpoint of ridge-strip technology adaptation, which ensures the uniformity of factors that have a positive influence on the required seed material production quality and quantity, and the improvement of the machines complex that implement it.

The given technology allows to increase the seed potatoes yield by 10-30% higher in comparison with «Zavorovskaya» one, and when harvesting potatoes with combines, the separator receives 30-40% less soil than in the case of ridge planting. The distance between the ridges bases in this technology is 0.3 m, while a sufficiently large spacing is formed for the passage of the tractor wheels.

However, nowadays there is a problem of growing potatoes in the ridges with single-row agricultural machines and, in general, there is no domestic machines complex for the implementation of this technology [5-10].

3. Results and discussion
The cultivator for seed potatoes processing was designed (Fig. 1).

![Figure 1 - General view of the cultivator design for seed potato plantings processing with the option of planting in a two-row seedbed, top view.](image)

The cultivator for processing seed potato plantings consists of the cross-out boom 1, support wheels 2, parallelogram sections 3, plow beams 4, plow beam 4 contains a gauge-wheel 5, guide
brackets 6 and holders 7, holders 7 are installed in guide brackets 6 at the equal distance from the beam 4 longitudinal symmetry axis with the possibility of adjusting this distance, the parallelogram section 3 for surface treatment between the rows is equipped with toothed disk working bodies 8, which are arranged in pairs at an equal distance from the beam 4 longitudinal symmetry axis and are attached at the angle of 34 ° relative to the vertical component of the beam 4 to the frame 9 with the holder 7 and guide brackets 6, which are rigidly fixed on the beam 4 and are equidistant from the cross-out boom 1, while each toothed disk working body 8 on the beam 4 is set at the angle of 5 ° to the course of movement to converge to each other, between the toothed disk working bodies 8 installed with the 35-cm-wide center hoe 10, the parallelogram section for surface treatment in the row is equipped with the 30-cm-wide center hoe11.

The cultivator for processing seed potatoes planting works as follows. The cultivator is used to obtain potatoes for seeds on plantings, which are realized by planting potatoes in two rows in a seedbed. The width of the row base is 105 cm, the width of the row top is 70 cm, the distance between the bases is 35 cm. The cultivator is attached to the tractor by means of a hitch, the support wheels 2 during the cultivation are located in the row spacing, parallelogram sections 3 copy the unevenness of the soil surface. The beam 4 rests upon the gauge wheel 5, and guide brackets 6, holders 7 are also rigidly attached to the beam, which allow fixing the frame 9 in a stationary state. The cultivator is equipped with two different alternating parallelogram sections 3 for treating the surface between the rows and in the row.

![Figure 2 - Scheme of seeds potatoes cultivation.](image)

Parallelogram section 3 for surface treatment between the rows is equipped with toothed disk working bodies 8, which rotate on the frame 9 and are driven by the soil. The toothed disk working bodies 8 are installed at the angle of 34 ° with respect to the vertical component of the beam 4 to the frame 9 for cutting weeds on the row arch, and to strengthen and compact the arches, each toothed disk working body 8 on the beam 4 is set at the angle of 5 ° to the movement direction to converge to each other, between the toothed disc working bodies 8, a center hoe 10 with the width of 35 cm is installed, which trims weeds between the rows, and removes weeds in the inter-row space of the seedbed, a center hoe 11 with the width of 30 cm is installed on the parallelogram sections 3.

The cultivator for processing seed potatoes with the option of planting in two-row seedbed can be used both for row and smooth-surface plantings with row spacing of 50 - 75 cm (Figure 2).

4. Conclusion
The construction that provides inter-row cultivation of potatoes planted on seeds in two rows in the seedbed with the simultaneous restoration of the row geometry was designed. This method of growing potatoes for seeds can be used in arid and waterlogged areas. The claimed cultivator for processing plantings of seed potatoes provides weed cutting when planting potatoes on seeds in two rows in a seedbed, destruction of soil clods, strengthening of row arches. The large seedbed provides a high degree of moisture retention and reduces the risk of irrigation erosion.
Such conditions ensure the uniformity of factors limiting the intensive growth and development of potato plantings, obtaining high yields. These facts should be taken into account when cultivating potatoes for seeds.

References

[1] Larkin R P 2007 Griffin Control of soilborne potato diseases with Brassica green manures Crop Protection 26 1067-1077
[2] Kanatieva A V, Morozov D A and Kondrashov A V 2017 Analysis of potato cultivation technologies in difficult soil and climate conditions of the Russian Federation Young scientist 11.3 10-12
[3] Albegov K K, Sorokin I A and Sisek N A 1982 Tape-comb technology of potatoes cultivation and harvesting Moscow: Rosselkhoznadzor 26 p.
[4] Larkin R P and Honeycutt C W 2006 Effects of different 3-year cropping systems on soil microbial communities and Rhizoctonia disease of potato Phytopathology 96 68-79
[5] Elizarov V P, Ponomarev A G and Kabakov N S 1999 Methodical recommendations on the development of machine technologies of potatoes cultivation and harvesting Informagrotech 54 p.
[6] Kostyleva L V, Gapich D S, Motorin V A and Novikov A E 2019 Microstructure and abrasive wear resistance of heavy duty parts from high-strength cast iron in chisel plows Chernye Metally 3 37-42
[7] Kuznetsov Yu I and Burchenko P N 1993 Machine technology of potato production on rows without the use of herbicides 37 p.
[8] Novikov A E, Motorin V A, Lamskova M I and Filimonov M I 2018 Abrasive Deterioration Composition and Tribological Properties of Cutting Blades of Tillage Machines under Abrasive Deterioration Journal of Friction and Wear 39(2) 158-163
[9] Motorin V A, Kostyleva L V and Gapich D S 2020 Increasing Wear Resistance of Chisel Tools Working Bodies Based on Improving the Metallographic Structure of Grey Cast Iron Solid State Phenomena 299 652-657
[10] Maximov P L 2002 New working bodies and machines for the production of root crops: monograph Izhevsk: Publishing house Irgskha 80 p.