

# Plow for processing row spacing of gardens

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**Abstract.** Existing plows do not provide high-quality tillage between rows of orchards and vineyards. The purpose of the study is to develop and justify the parameters of the plow for cultivating the soil between rows of gardens to tractors of class 0.9 kN. A design scheme of a single-body plow for smooth, rowless plowing of garden aisles has been developed. The proposed plow consists of a movable and fixed frame, a disc knife, a screw body with a hostage. The research uses the laws of agricultural mechanics, mathematical statistics, and methods of strain measurement. The technology of cultivating the soil between rows of gardens with a single-body plow for smooth plowing is justified. To implement the proposed technology, the position of the plow body changes relative to the tractor during operation. It is established that when equipping a plow with a movable and fixed frame and performing a body width of 45-52. 5 cm, the required plowing quality is achieved with the lowest energy consumption.

## 1 Introduction

In the agricultural production of the Republic of Uzbekistan, large-scale measures are being taken to reduce labor and energy costs, save resources and develop high-performance agricultural machines; in particular, special attention is paid to the development of technical means that ensure the high-quality implementation of all technological processes of crop cultivation from tillage to harvesting and processing of products [1-23].

It is known that to improve the water-air regime, therefore, for the normal development of garden plantations and vineyards and increase their productivity, plowing between rows is carried out annually with serial plows. The disadvantage of serial plows used in horticulture is the formation of collapse furrows and pile ridges due to the turnover of the reservoir in the neighboring furrow. These irregularities worsen the working conditions of the units during subsequent processing. V.Sakun [6, 14-15], Ya.Lobachevsky [6-7, 9-10, 12-15], V.Sharov [6, 11], O.Sizov [6, 15], F.Mamatov [19-24], I.Ergashev [24], B.Mirzaev [19-20, 22-23], N.Aldoshin [22-24], H.Ravshanov [25-26] and others.

However, in these studies, the issues of developing a plow for smooth plowing for

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tractors of class 0.9 kN are not sufficiently studied.

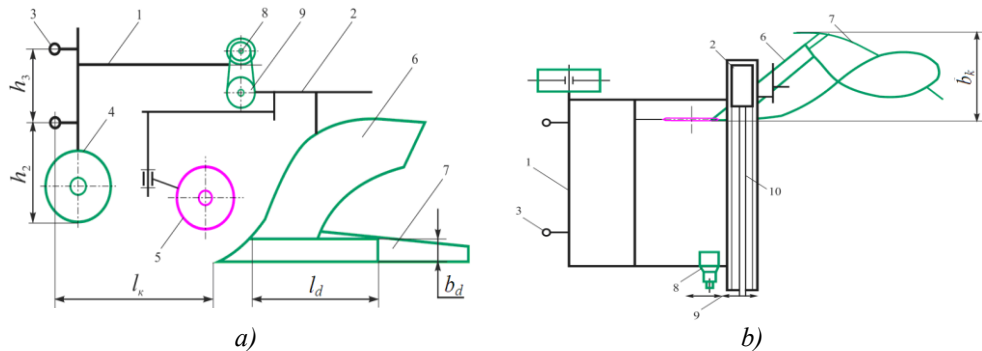
The purpose of the study is to develop and justify the parameters of the plow for cultivating the soil between rows of gardens to tractors of class 0.9 kN.

## 2 Methods

The research uses the laws of agricultural mechanics, mathematical statistics, and methods of strain measurement. The technology of cultivating the soil between rows of gardens with a single-body plow for smooth plowing is justified.

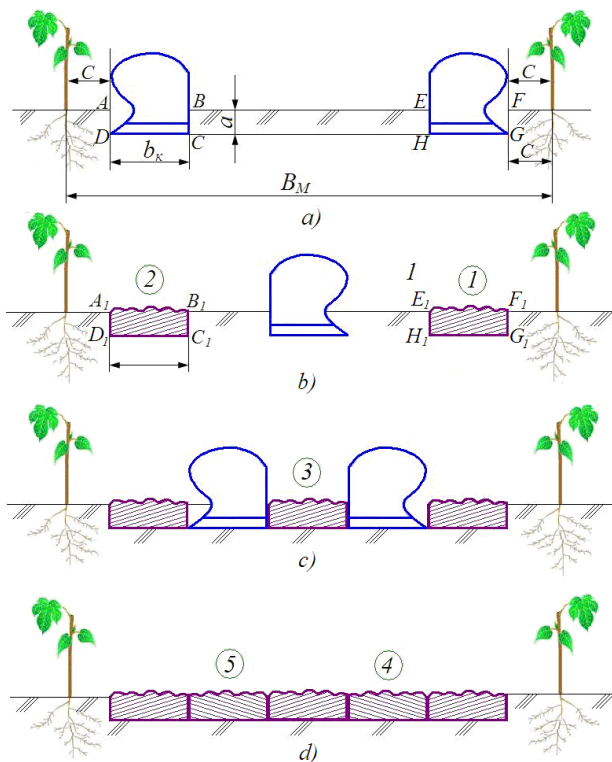
Based on the analysis of research, plowing technologies and equipment in developed countries, and agrotechnical requirements for the main tillage plow between the rows, a structural scheme of a single-plow flat tillage plow between rows and small contour fields was developed (Figure 1).

The single-body hollow flat plow consists of a main frame 1, a moving frame 2, a suspension device 3, a support wheel 4, a disc blade 5, a screw body 6, a piston 7, a hydraulic motor 8, a chain extension 9 and a screw 10 (2.1, *a*, *b* and *v*-pictures). The plug can be equipped with a roller if necessary. The working bodies of the plug are mounted on the movable frame 2. Depending on the machined path of the row spacing, the position of the moving frame 2 is changed using a screw mechanism 5 relative to the main frame 1. In this case, the moving frame 2 slides along the aisle in the main frame 1. The movement of the propeller mechanism to the screw 10 is transmitted from the hydraulic motor 8 through the chain drive 9. Using a helical mechanism, the housing can slide from the right edge to the left edge up to  $3b_k$  (Fig.1).



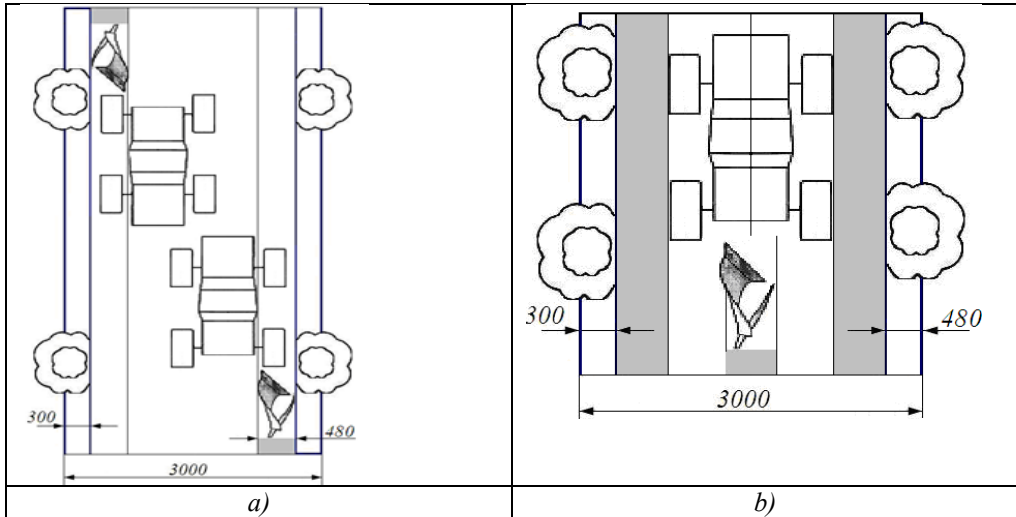
**Fig. 1.** Design diagram of a single-body plow for smooth plowing: *a* – side view; *b* is top view; 1 is main frame; 2 is movable frame; 3 is attachment; 4 is support wheel; 5 is disc knife; 6 is body; 7 is plow; 8 is hydraulic motor; 9 is chain drive; 10 is screw

The technological work process of the plow in the cultivation of garden spaces and small contour fields is as follows. In the first transition, the housing is in the most extreme position on the right side of the frame (Figures 1, *b*, and 2, *a*). The soil is cut in the vertical plane with the blades 3, and in the horizontal plane with the lemex of the main body 1, resulting in a slab with a "half cut" of 35-70 mm. The main body is first independent and then interacts with the zaplujnik 2, rotating the palach and laying 1800 on the boundary of its owner. When the drive unit returns from the field, the body is in the right position relative to the frame (Fig. 2, *a*) and performs the plowing process as described above. In subsequent passes of the unit, the plug handles between the rows. In this case, the body is moved a certain transverse distance relative to the tractor.



**Fig. 2.** Technology of soil cultivation between rows of gardens: *a* is type of row-spacing before the passage of the unit; *b* is view of the row spacing after the first and second passes of the unit; *c* is view of the row spacing after the third pass of the unit; *d* is type of row spacing after the fourth and fifth passes of the unit

The number of passes and the transverse displacement distance associated with it depend on the garden row spacing width. The largest transverse shear size of the plug body is  $3b_k$ , where  $b_k$  is the coverage width of the body. Thus, flat plowing of small garden spaces and small contoured plots is carried out. When working the soil between the gardens with a row spacing  $V = 3$  m, the technological work of the plow is as follows: at the first and second (return), the body is in the extreme position on the right side of the frame (Fig.2, *a*). In this case, the plug processes the strip near the protection zone, the width of which is  $b_k = (B-S) / 6$ , where  $S$  – is the width of the protection zone. In the first and second transitions, the body is in the extreme right position relative to the frame, i.e., to the right of the axis of symmetry of the tractor.



**Fig. 2.** Diagram of the tractor movement with a single-body plan for processing letters on the side of the protective zone (a) and the silver intercity lane (b)

In the third transition (Figure 2, b), the plug handles the middle of the garden row spacing. In this case, the body is placed along the axis of symmetry of the tractor and the fixed frame. In the fourth and fifth transitions (Fig.3), the plug handles the strips between the first and third transitions and the second and third transitions. In this case, the body is moved from the extreme right position of the frame to the left by a distance equal to the coverage width of the body. Thus, the garden is treated evenly between rows.

Depending on the width of the garden row spacing, the coverage width of the hull, the number of passes, and the movement scheme of the unit are selected.

We determine the number of flat plow bodies for tractors of class 0.9 by the following expression

$$n = \frac{\eta_t P}{K b_k a}, \quad (2.1)$$

where  $\eta_t$  is the coefficient of traction of the tractor;  $P$  is rated traction power of the tractor, N;  $K$  is the specific resistance of the soil to tillage, Pa;  $a$  is maximum processing depth, m;  $b_k$  is the coverage width of the case, m.

Assume that the traction force of a 0.9 class wheeled tractor is 9 kN,  $\eta_t = 0.95$ ,  $K = 6.5 \cdot 10^4$  Pa, and the maximum machining depth is  $a = 0.24$  m. When the depth of processing is 20-24 cm, the width of the enclosure of the hulls, which overturns the pallets within the boundaries of its owner, should be in the range  $b_k = 45-52.5$  cm. Considering the above, it follows from the expression (2.1) that the number of housings for 0.9 class wheeled tractors is 1.33-1.05. Therefore, for 0.9 class wheeled tractors, we assume that the number of plow bodies is 1 when the body coverage is in the range of 45-52.5 cm.

### 3 Results and Discussion

In experimental studies, the effect of the coverage width and machining depth of the plug body on its quality characteristics and tensile resistance was studied. In the study, the body coverage width of a single-body plug was changed from 450 to 525 mm at 25 mm intervals, and the processing depth was changed from 20 cm to 26 cm at 2 cm intervals. The speed of

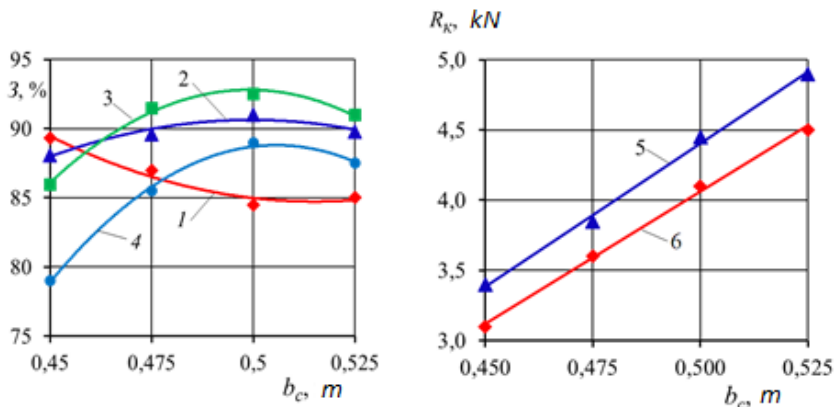
the unit was set at 6, and 8 km / h, the distance between the upper and lower attachment points of the suspension device was set at 500 mm, and the vertical distance from the base plane of the plug to the lower attachment point was set at 500 mm.

During the experiments, the width of the housing cover was changed by sliding the seal across the body.

The results of the experiments are shown in Fig.4.

According to experimental studies, the burial rate of plant residues at different processing depths does not differ much from each other depending on the coverage width of the hull, and this figure is at the level of agrotechnical requirements at all coverage widths at processing depths of 20-24 cm (Figure 4). Increasing the coverage width of the hull when the processing depth is 20 cm decreases the burial rate of plant debris. This can be explained by the fact that at a small processing depth, as the coverage width  $b$  increases, the paddle splits into several pieces, mixes, and turns randomly.

According to the results of the experiments, as the coverage width of the body increased at both speeds, its gravitational resistance increased proportionally along the straight line (Fig.4). This can be explained by the fact that as the coverage width increases, the cross-sectional area of the body-treated slab increases.



**Fig. 4.** Graphs of the dependence of the degree of embedding of plant residues  $Z$  and the traction resistance of the housing  $R_{kc}$  on the width of the body grip: 1 –  $a = 20$  cm; 1- $a = 22$  cm; 1- $a = 24$  cm; 1- $a = 26$  cm; 5- $V = 6.24$  km/soat; 6- $V = 7.64$  km/hour

According to the results of the experiments, as the coverage width of the hull increased at both speeds, the hull resistance of the hull increased proportionally according to the straight-line law (Figure 4). This can be explained by the fact that as the coverage width increases, the cross-sectional area of the corrugated plate increases

## 4 Conclusions

1. The technology of cultivating the soil between rows of gardens with a single-body plow for smooth plowing is justified. To implement the proposed technology, the position of the plow body changes relative to the tractor during operation.
2. It is established that when equipping a plow with a movable and fixed frame and performing a body width of 45-52. 5 cm, the required plowing quality is achieved with the lowest energy consumption.
3. Single-body plow for smooth plowing with a composite frame for tractors of class 0,6-0,9 allows you to produce high-quality tillage between rows of garden plantings.

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