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THEORETICAL SUBSTANTIATION OF THE PARAMETERS OF THE PLOW OF THE GARLIC HARVESTER

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Nowadays, especially in European countries, separate harvesting machines have been developed for each type of root and fruit crop, which are high-volume machines, as the soil-climatic conditions and crop areas of these countries require. But at the same time, the cost of these cars is going to be higher. In addition, these machines cannot fully meet agrotechnical requirements in conditions of low soil moisture.

Based on this, it is an urgent task to develop a farmer-friendly, compact, high-efficiency garlic-picking machine for harvesting garlic products grown in our country, using improved and energy-saving work organs.

In view of the above, and taking into account the need to develop in Uzbekistan an energy- and resource-efficient garlic harvester machine that fully meets agrotechnical requirements and in the current market economy, based on the soil-climatic conditions of Uzbekistan, it is advisable to develop theoretical bases for the improvement of their improved main section plow, side disks and biter.

In the development of several scientifically based technical solutions for the construction of a universal and energy-efficient garlic harvester suitable for the soil-climatic conditions of the country , it is necessary to take into account the following:

- ensuring the energy-resource efficiency of the garlic harvester;
- ensuring the universality of the garlic harvester;
- increase the efficiency of garlic harvester.

Based on the above, it can be concluded that the energy efficiency and productivity of the garlic harvester can be achieved by not transferring excess soil mass to the sieves through the plows. Since the geometric parameters of the garlic nest are taken into account, it is advisable to dig out the soil block containing the garlic through the plows and transfer it to the sieves. Due to the transfer of a small soil mass to the sieves, crop losses (due to a decrease in the number of garlics reburied with the soil) and damage are reduced, and the resistance to traction of the plows is reduced, the working speed and productivity of the unit increase. The geometric dimensions of the plow, which are similar to each other, play an important role in ensuring the universality of the digging plow, as well as in digging garlic located on the surface of the ridge.

In recent years, the digging plows of foreign-made machinery have been made in sections. This is

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because during the digging process, weeds get stuck in the plow blades, and to eliminate this, the blades are made in sections. However, in our soil and climatic conditions, the use of only a sectional plow cannot eliminate such processes as the clogging of weeds during the process of digging up garlic, the formation of a pile of soil in front of the plow, etc.

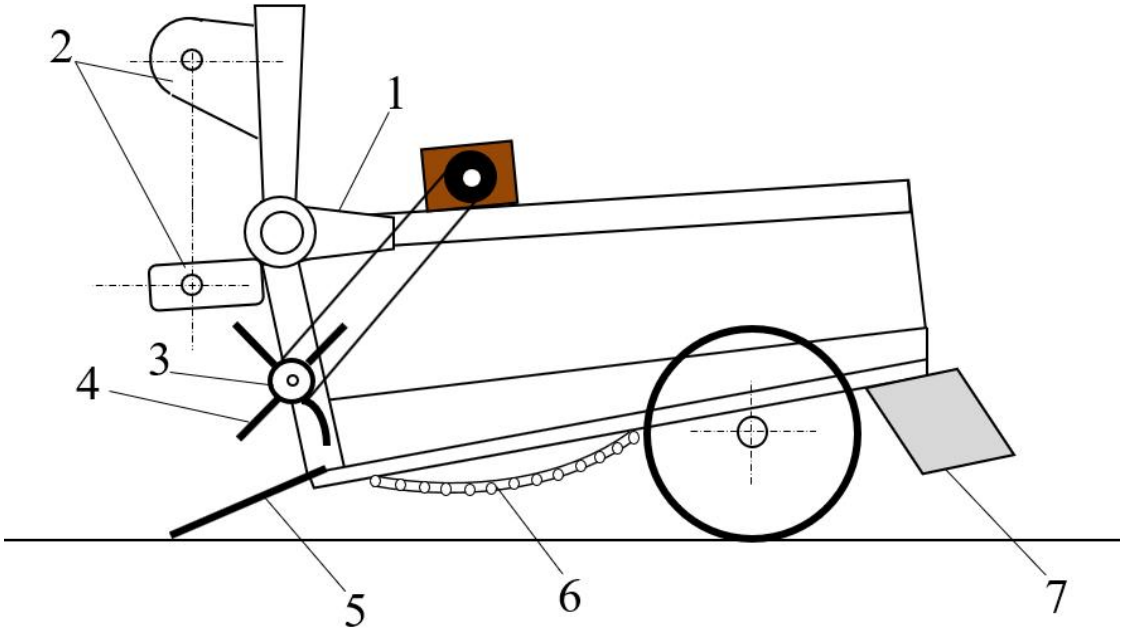
To eliminate the clogging of weeds in the lemex, it is necessary to choose the opening angles of their muzzle part to be 90^0. Taking into account the fact that the formation of a soil heap in front of the plows is different, as well as the friction coefficients of the garlic, it will be advisable to apply a rubber-parsed bitter between the sectional plows and the sieve, which will push the soil heap into the sieves. The sieving of the excavated soil mass is carried out by the rubber paddles of the biter, made of elastic material, in turn. The use of biters ensures that the soil clod being dug is crushed and allows the sectional plows to be adjusted to different angles relative to the horizon. In addition, the installation angles of the sectional plows can be varied by changing them in a checkerboard pattern relative to the horizon. For example, by installing each section of the plow at different angles to the horizon, it is possible to observe the deformation of the soil plow under the influence of bending. Increasing the installation angles of the levees relative to the horizon and their different placement results in partial soil erosion. As a result, the machine is energy-efficient and versatile, and it is possible to theoretically justify their parameters and study their kinematic modes (Figure 1).

Also, as a result of the application of the bitter on sectional plows, the clogging of the soil heap in the front of the machine is eliminated, and the degree of sieving of the transmitted mass in the sieves is improved, and the loss of garlic is reduced, as a result of which the possibility of giving up excess sieves is created. The shape and physical and mechanical properties of garlic cloves have been studied, and the distance between the rods of the sieving device and the number of sieves should be selected, and rubber tubes should be inserted into the sieve rods to reduce the degree of damage to them.

To reduce labor costs and the degree of damage and loss of garlic during harvesting, a device that simultaneously sifts the soil mass is also necessary. For this, the root-fruit stacker device at the end of the technological process should be designed in the form of a grid, and its grid bars should be covered with rubber.

The technical solution to the problem is to justify the parameters and develop the design of the garlic harvester. In this, the proposed garlic harvester consists of frame 1, the hanging device 2, the biter and its elastic propeller 3, 4, sectional plows 5, the elevator 6, guide 7 (Figure 1).

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1– frame; 2 – hanging device; 3, 4 – biter and its elastic propeller;
5 – sectional plows; 6 – elevator; 7 – guide

Figure 1. Structural drawing of a garlic harvester

When digging with a garlic digger with 5 sectional plows, their fragmentation is observed. Because sectional plows have a sharp-angled, trough-shaped working surface, the furrows being dug are deformed, increasing their breakage. The elevator 6 and the guide 7 are covered with rubber, which reduces damage to the garlic.

Taking it as a three-sided plow, since the 2-pointed part of the sectional plows of the garlic digger is flat, that is, a two-sided plow, and the two sides of the base are slightly at an angle to the horizon, with the help of which the decomposition of the soil is observed when the garlic

Sarimsoq kovlagich mashinasi seksiyali lemexining asosiy parametrlari uning gorizontga nisbatan o‘rnatilish burchagi α, lemex tumshuq qismining ochilish burchagi γ, lemex asossining ikki yon qirralari orasidagi burchak ε hamda lemexning umumiy uzunligi L_{um} uning tumshuq qismining L_t, asosining uzunligi L_{as} va eni B_l lar uning asosiy parametrlari hisoblanadi (2-rasm).

The main parameters of the garlic harvester machine sectional plow are its angle of establishment relative to the horizon α, the angle of opening of the plow muzzle γ, the angle ε between the two side edges of the plow base, and the total length of the plow L_{um} of its muzzle L_t, the length of the base L_{as}, and the width B_l are its main parameters (Figure 2).

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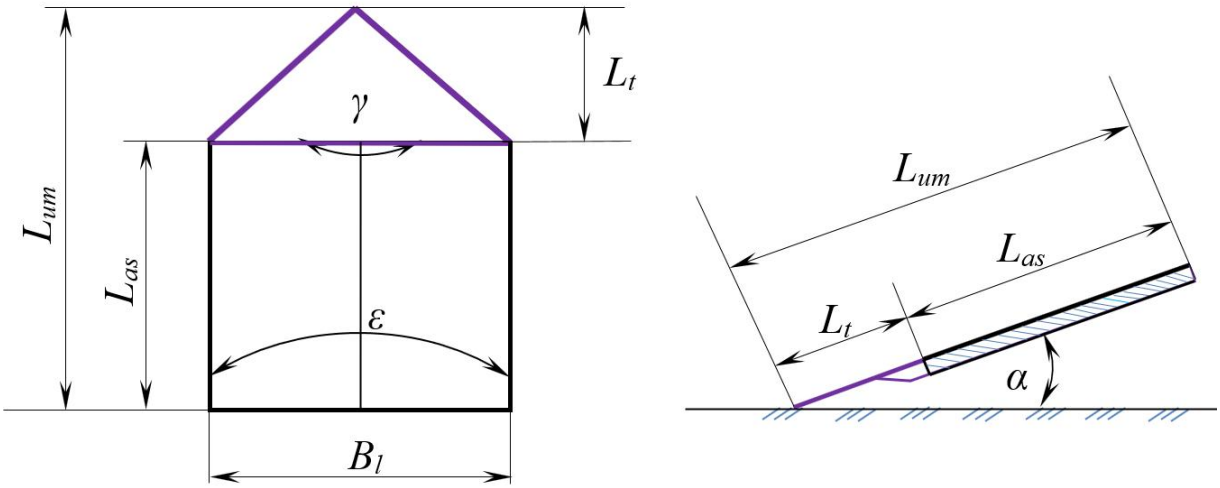


Figure 2. Scheme of the energy-efficient sectional plow of the garlic harvester

In order to ensure that the soil in the process of coiling the coils glides freely along the surface of the plow, the angle of installation of the plow relative to the horizon should not exceed 24-26^0, and its value is determined by this expression [1].

Based on the above and taking into account the physical and mechanical properties of garlic, we can justify the width and length of the proposed plow.

The total width of the garlic harvester share is selected from the condition that it can completely dig up the garlic located in the furrow, and the number of them and the structural dimensions of each sectional plow are determined.

First, we need to determine the number of sectional plows to completely dig up the garlic planted in a plot. To do this, we will use the most common planting scheme for garlic in our republic. According to the literature studied, garlic is planted in three rows, with a planting distance of 15 cm. Therefore, the total number of sectional plows should be 3 for digging one row and 6 for digging two rows.

Based on the above, the total width of the garlic harrow leme should satisfy the following condition [2]

$$B_{sum} = b_{o'rt} + 3\sigma + b_{yon}, \quad (1)$$

in this $b_{o'rt}$ – the average value of the width of the garlic nest.;

σ – the mean square deviation of the garlic clove in the nest.;

b_{yon} – horizontal lateral deviation of the unit during operation..

(1) Substituting the previously determined values of $b_{o'rt}$=45 sm, σ=1 sm, b_{yon}=5 sm nto the expression condition, we obtain $B_{sum}\geq$ 53 sm.

The width of each section of the plow is determined by the following expression. [2],

$$B_l \quad \frac{B_{sum} - 2d_s}{3}, \quad (2)$$

or

$$B_l \quad \frac{b_{o'rt} + 3\sigma + b_{yon} - 2d_s}{3}, \quad (3)$$

in this d_s – the smallest diameter of the garlic.

Substituting the value d_s=3,0 sm btained in previously determined studies into the expression (2)

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above, we obtain $B_l \geq 15{,}6$ sm.

According to the analysis of the literature, the value of the opening angle of the plow beak is found by the following condition [1,2]

$$\gamma \ 2(90-\varphi), \tag{4}$$

In this φ – The value of the friction angle φ of plant roots relative to the plowshare is 40-50^0 [1, 2].

According to formula (4), we can take the average value of the opening angle of the plowshare tip as 90^0.

Given the value of the opening angle of the lemex muzzle based on the above (4) expression condition is 90^0 (Figure 2), knowing that the lemex muzzle is an equilateral right-angled triangle, the length of the lemex is determined by the following expression

$$L_{um} = \frac{h_{o'rt}}{\sin\alpha}, \tag{5}$$

or

$$L_{um} = \frac{2d_{o'rt} - d_{\min} + l_{tu}}{\sin\alpha}, \tag{6}$$

In this $h_{o'rt}$ – the average height of garlic seedlings, m;

$d_{o'rt}$ – the average diameter of a garlic, m;

l_{tu} – the length of the root part of the garlic, m.

It follows that the angle of establishment of plow relative to the horizon is L_{um}=28,4 cm by expressing the values of α=25^0 [1, 2] and the garlic with an average height of $h_{o'rt}$ =12 cm (6).

Since the muzzle of the plow is an isosceles triangle, its length is determined by the following expression, assuming that it is half the width of the plow:

$$L_t = \frac{B_l}{2}. \tag{7}$$

or

$$L_t \quad \frac{b_{o'rt} + 3\sigma + b_{yon} - 2d_s}{6}. \tag{8}$$

Putting the value B_l=16 cm in the expression (7), we determine that the length of the plow muzzle part is L_t=8 cm.

Knowing the value of the expression (8), we can determine the length of the plow basis part as follows

$$L_{as} = L_{um} - L_t. \tag{9}$$

or

$$L_{as} = \frac{h_{o'rt}}{\sin\alpha} - \frac{B_l}{2}. \tag{10}$$

Substituting the values of (6) and (7) into expression (10), we obtain:

$$L_{as} = \frac{12d_{o'rt} - 6d_{\min} + 6l_{tu} + \sin\alpha\left(b_{o'rt} + 3\sigma + b_{yon} - 2d_s\right)}{6\sin\alpha}. \tag{11}$$

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According to expression (11), the length of the base part of the plowshare is L_{as}=20,4 cm.

According to the theoretical studies carried out, it was found that the optimal sectional drilling plow parameter of a garlic digger is that it can be reached when its total length is L_{um} =28,4 cm, the sectional plow width is B_l=16 cm, its angle of installation relative to the horizon is equal to α=25^0.

Knowing the width of each sectional plow, the angle ε between the two side edges of the plow base must be chosen in such a way that the garlic being plowed using plow must fall in the middle of the plow base and stand without rolling out of it to the side. That is, the garlic should be at least 2/3 of its length in the plow groove. Based on this, the angle ε between the two side edges of the plow base is determined by the following expression:

$$\varepsilon = \arctan \frac{b_{o'rt} + 3\sigma + b_{yon} - 2d_s}{4\left(2d_{o'rt} - d_{\min}\right)}. \quad (12)$$

Substituting the known values of the above into expression (12), we find that the angle between the two side edges of the plowshare base is ε=63^o.

Conclusion

For coiling the garlic onion by agrotechnical requirements, it follows that the angle of establishment of the garlic cover plow relative to the horizon is α=25^0 the average height of the garlic $h_{o'rt}$ =12 cm, the width of the sectional plow is B_l=15,6 cm, L_{um} =28,4 cm.

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