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SUBSTANTIATION OF THE PARAMETERS OF THE GRADER OF THE COMBINED UNIT FOR TILLING THE SOIL IN THE ROW-SPACING PLANTS IN GARDENING

[1]T.S.Xudoyberdiev – d.t.s, [2]B.R.Baltabaev - c.t.s,[3]A.M.Abdumannopov

ABSTRACT--*WE know that, one of the factors of effective utilization of main field in row interspaces of gardening is qualitative softened soil grader in time. Therefore it is important to choose the right parameters of the given grader so that to level the land in high quality. The article is written on the basis of research results. Here we have given bending corner of the gathered soil clot before the grader as β and the curving corner from vertical plainness as γ and we have based its increase. The contradiction of the grader increases with the rise of its height. That is why the curviness of the grader and the outer curviness of soil clot play a great role. As the curviness of the grader rises, the contradiction decreases. The decrease of the contradiction of γ between 30° and 40° is due to the increase of soil clot from the grader. We have identified the reason of the increase of contradiction when B corner is equal to β=20°. Here, the contradiction increases as more soil is absorbed than when the corner B is equal to β=30° so that to make a soil clot.*

Key words-- *rows between gardens, working out the soil, preparing the land for planting, soil clot, grader, vehicles of stability, combined aggregate, technologic process, making the softened land plain, curving corner of the surface of soil clot, height and curving corner of the grader.*

I. INTRODUCTION

Following the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan №258 on April 3, 2018 "On measures to improve the efficiency of land use by farms in vegetable growing, horticulture and viticulture", special attention was paid to the use of inter-gardening seed drills. This is because the products from this area provide additional income for farmers. In order to obtain high yields between the rows of seedlings (in the first stage), it is necessary to carry out spring cultivation of the soil in good quality. The grading process is especially important after the soil is softened and treated. Because the planting area should be straight and flat, the top layer should be small, moisture-free, clean and free from weeds [2].

Graders must perform the following tasks:

- the grading of the softened area;

[1] ***Professor, doctoral student, Andijan branch of the Tashkent State Agrarian University.***

[2] ***associate professor, doctoral student,Andijan branch of the Tashkent State Agrarian University.***

[3] ***doctoral student, Andijan branch of the Tashkent State Agrarian University.***

- grinding of large pieces to the required level during smoothing (the structure of soil fraction in 0… 10 cm layer is not less than 80%).
- increasing the density of softened soil layer to the required level (1,1… 1,2 g / cm3).

The grading of smoothened area has a long history and wooden beams have been used for smoothing, and their width and weight have been selected depending on the gravity. The bars were later covered with iron. These liners are still used today. The tasks of the modern liners are straightforward and are still being improved. The factors that contributed to this process were the study of plant agrotechnics, the appearance of plows and various softeners, and most importantly, the creation of tractors of different capacities.

Instead of wooden beams, the flat metal pillars were created with a flattened PM [3] and a single metal frame with a flattened PR-5 [4]. As a result of the tests, the leveling quality of the straighteners was in demand. Once the importance of the smoothing became apparent, attention was drawn to their improvement, and their combinations began to be created. [5,6,7]

More tasks are now being imposed on the next leveler, such as smoothing [8], smashing soil fractures [9], smoothing - grinding - softening - cutting weeds and pushing them to a depth [10].

Based on the work of the flatteners considered above, the quality of soil leveling, compaction and crushing was assessed and their design was relatively simple. In areas that need to be leveled, their movement is mainly diagonal to the tilling. When moving in the direction of the tillage, they were ineffective and there were steps in the flattened area.

Numerous researches have been devoted to increasing productivity, lowering the amount of irrigation water and increasing the effect of aggregate on crop yields by smoothing the cultivated areas and increasing soil density [11,12,13,14,6,15,16].

Experiments have shown that the level of irrigation water in the flattened area was reduced by 66%, cotton yield increased by 1.25 t / ha [12]. % [17,18], as the seeds were sown to the same depth, the grain yield increased by 10… 25% and the aggregate speed increased by 30% [17,18].

Due to the high efficiency of the smelter, efforts were made to improve the construction, even if it was compicated. Such work is important not only in the conditions of Uzbekistan, but also in other developed countries, where levelling machine–compressors are made [18, 19, 20, 21, 22, 23].

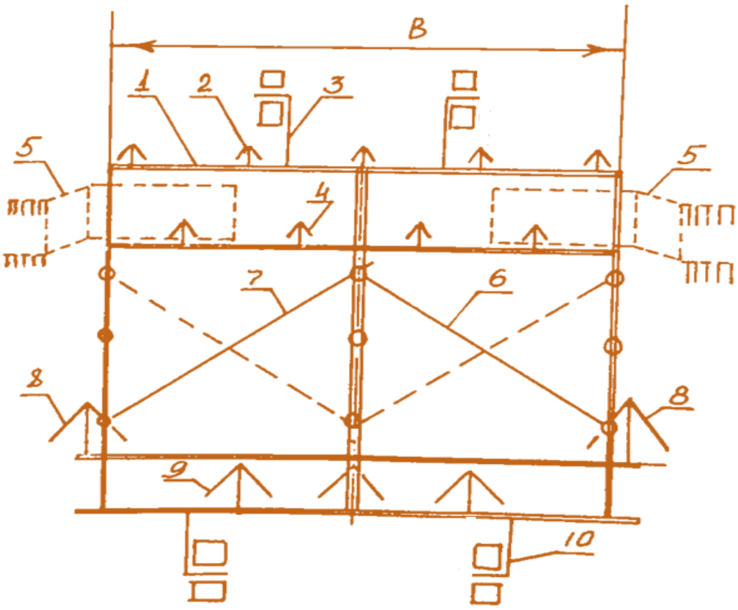
The following conclusions can be drawn from the studies we have learned:

- the working body of levelling of all levelling machine–compressors are positioned at a straight, acute and obtuse angle to the horizontal level. There are no specific recommendations for their installation;
- as the width of all leveling machines is 1.5 and 2.5 times higher than the gauge of the tractor they cannot be moved between rows of plants in gardening,
- the leveling machines move diagonally across the area to be leveled.

If one moves in the direction of the aggregate, the flat surface may leap to a certain extent as the area is wide. The use of levellers with such indicators in the field of seedling in gardening is not effective.

That is why in gardening levelling the lands remain a problem planting melons, vegetables and medicinal plants between the rows of seedlings in gardening after plowing. The solution to this problem is to select the type of leveller with the appropriate parameters in the rows and to install the aggregate in a universal combined unit for loosening, levelling and furrowing in the unit. The purpose of this work deals with this problem.

The main part. A leveller is mounted on a universal-aggregate unit with two parts (left and right) [24], Figure 1.

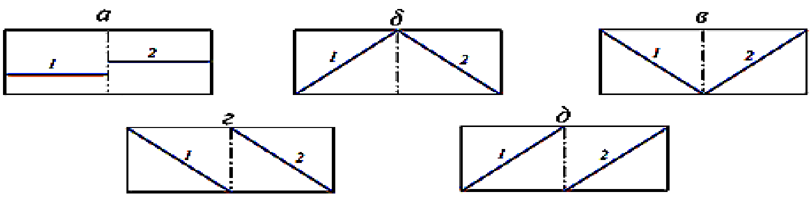


. B- the width of levelled area. 1- frame, 2,4-the first and second row of loosener, 3,10- front and rear supporting wheels of the aggregate, 5- cultivating wings of sideways of seedlings, 6,7 – right and left levelling devices, 8,9- irrigation channel and working bodies that get the furrow arches

Figure 1: The form of universal-aggregate unit cultivating between the rows of seedling s in gardening

When the width of the rows is 5m the width of melons and vegetables is 3.4 m., When the width of the rows is 4m the width of melons and vegetables is 2.6m, the leveling machine only moves in one direction. In this case, the knife-like shape of the leveler was adopted because of the low efficiency of the harrow-leveling machine. To improve the performance of the leveller, it is mounted in two parts to allow it to be positioned differently, fig.2

Here the cases of levelers are given: a) pushing the soil forward, b) pushing the soil in two parts, c) moving the soil to the middle part, d) moving the soil to the right, and d) moving the soil to the left. Depending on the relief of the softened area, the position of the levelling machine can be selected.



1-left part of leveling machine, 2- right part of leveling machine.

Figure 2: Cases of installation of levellers on the aggregate.

One of the important factors in the effective use of the main area between rows of horticulture is the timely cultivation of the soil. A special role is played by levelling of loosened soil. For high leveling, it is necessary to choose correctly the parameters of the leveling system.

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Figure 3 below shows the cross-sectional profile of a particular area after being plowed and smoothed.

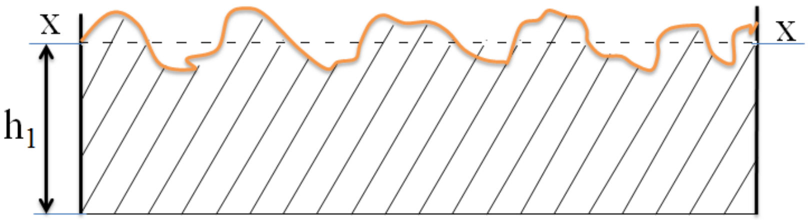
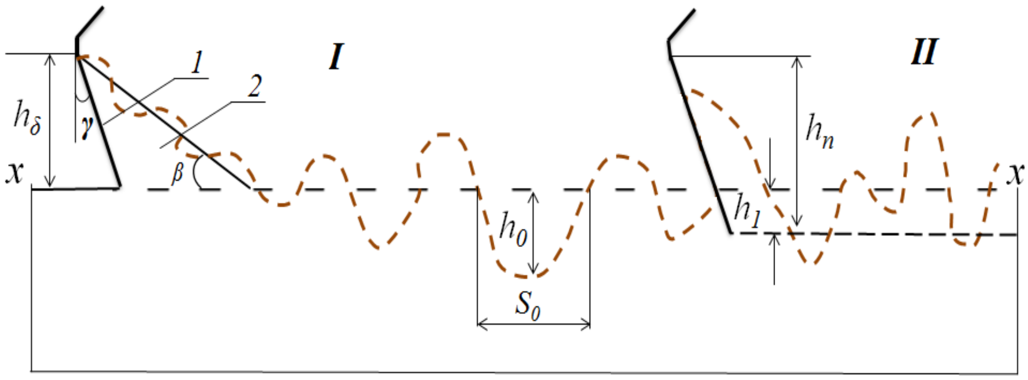


Figure 3: A cross-sectional area of the plowed and loosened area

After plowing and loosening, the soil surface becomes uneven. If we draw an x-line through the unevenness of the soil layer, we will see the relief of the soil and the slits in the bottom. If the width, length and depth of the plowed and softened area are clear, the size of the relief formed should be equal to V¬b, i.e.

$$V_{б} = V_{ў} \tag{1}$$

From this, the lowest point of working part of levelling machine is marked above, that is it should move along the line (x-x). Figure 4.



1-leveller; 2- heap of soil.

Figure 4: The working process of the working body in levelling the loosened surface

If the working parts move according to the form shown, the reliefs above the x-x line (1) shall be filled into the hole below the line. The size of the hole is determined by the following formula [25], (view I).

$$V_{ў} = \frac{2B \cdot S_0 \cdot h_0}{\pi \cdot \kappa}$$

Here, h_0 – the depth of hole;

S_0 – the width of base of hole;

κ- coefficient considering reduction of depth (height) of unevenness with the help of softeners, κ = 1,4…1,5;

B –the width of leveller.

The amount of soil heap generated by the displacement of the reliefs in front of the working body to fill the resulting holes is determined as follows.

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$$V_{\delta} = \frac{1}{2}\mathrm{B}\cdot h_{\delta}^{2}\left(ctg\beta - tg\gamma\right) \tag{3}$$

Here: h_{δ} - the height of leveller.

From the equality of two dimensions, we can determine the height of the working body, that is

$$h_{\delta} = \sqrt{\frac{4\cdot S_0\cdot h_0}{\pi\cdot k\cdot\left(ctg\beta - tg\gamma\right)}} \tag{4}$$

In order to make enough levelling, it is desirable that the soil heap formed in front of the leveller to be fully deposited in the slits, the size of the soil heap is slightly larger than the size of the holes. The following conditions must be met for this purpose:

$$V_{\delta} > V_{\breve{y}} \tag{5}$$

To achieve this condition, it is necessary to increase the leveling depth by h1 (Figure 4, Figure II). Then the height of the working body is as follows:

$$h_{п} = h_{\delta} + h_1 \tag{6}$$

If we put this formula into the formula (4), hp is equal

$$h_{П} = \sqrt{\frac{4\cdot S_0\cdot h_0}{\pi\cdot k\cdot\left(ctg\beta - tg\gamma\right)}} + h_1 \tag{7}$$

The amount of soil heap is defined as follows

$$V_{y} = \frac{1}{2}\cdot\mathrm{B}\cdot\left(h_{\delta} + h_1\right)^2\cdot\left(ctg\beta - tg\gamma\right) \tag{8}$$

If $S_0 = 45$sm, $h_0 = 12$sm (holes were counted in the footsteps of the arc softener) is assumed to be 1.5, h1 3cm, b = 20 °, 30 °, 40 ° and g = 0 °, 10 °, 20 °, 30 ° the variation of hp determined for the values of, 40 °, is shown in Fig. 5.

Агар $S_0 = 45$см, $h_0 = 12$см (ўқ ёйсимон юмшаткичнинг изида ҳосил бўладиган ўйиқлар хисобга олинди), $\kappa = 1.5$, $h_1 = 3$ см деб қабул қилиниб, β=20°, 30°, 40° ва γ=0°, 10°, 20°, 30°, 40° қийматлари учун аниқланган $h_п$ нинг ўзгариши 5- расмда келтирилган.

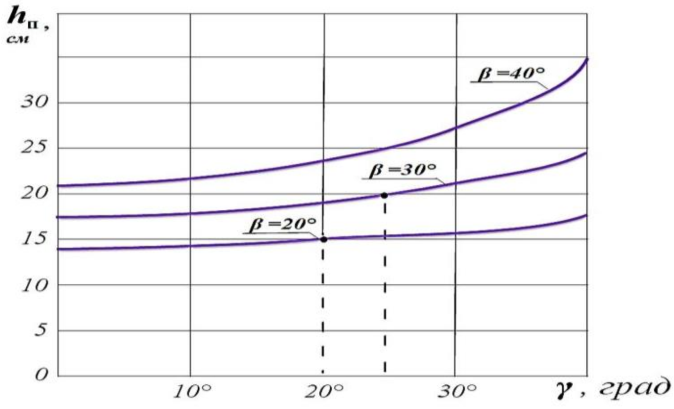

Figure 5: The change of working body height h_p by parameters β and γ.

The analysis shows that the slope of the soil heap collected in front of the leveler increases with the height of the leveller as the angle of deviation β and the deviation angle of the straightener from the vertical plane γ.Determining the boundary value of the slope angle γ and the height of the leveller h_p for the slope angle β of the soil heap surface**.** Obviously, when β=20°, $h_п$ = 15cm and its slope should be up to γ=20°, and when is β=30°, $h_п$ = 20sm, and slope angle γ=25° . An increase in the angle γ from these values will cause the heap to exceed the top of the leveller.

Thus, at β=20°, it is preferable that the height of the leveller is $h_п$ = 15cm and at β=30° , $h_п$ = 20cm.

To test the leveller it needs to know its width. It is defined as:

$$b = \frac{h_П}{\cos\gamma} ; \tag{9}$$

If *γ=20°* , *β=20°* , $h_п$ = *15см*, then *b=15.95≈16 см;* *γ*=30° да *b=17.44≈17.5*.5 cm. For calculations, *b=20 см* cm was assumed.

When smoothing the area, there are two different functions of the leveller: the first is to increase and push the heap of soil collected in front of the leveller, and secondly, to pour the heap in front of the leveller in the hole.

The first task. During movement, the pressure of the soil heap is resisted to the leveller. In order to cope with the pressure, an equal force is created on the leveller. This power was denoted by P_y. This force is also known as the force that simultaneously pushes the soil by the leveller. This force is equal to the following

$$P_y = f \cdot m_y \cdot g \tag{10}$$

Here; f – friction coefficient of moving soil with soil;

m_y - the mass of moving soil heap; g - acceleration of free fall.

The mass of soil heap is found by the following formula:

$$m_y = V_y \cdot \rho \tag{11}$$

Then consider the expression in (8),

$$P_y = V_y \cdot \rho \cdot g \cdot f \tag{12}$$

or

$$P_y = \frac{1}{2}\left(h_\delta + h_1\right)\cdot\left(ctg\delta - tg\gamma\right)\cdot \rho \cdot g \cdot f \cdot B \tag{13}$$

Figure 6 shows the forces acting on the slope of the soil during levelling

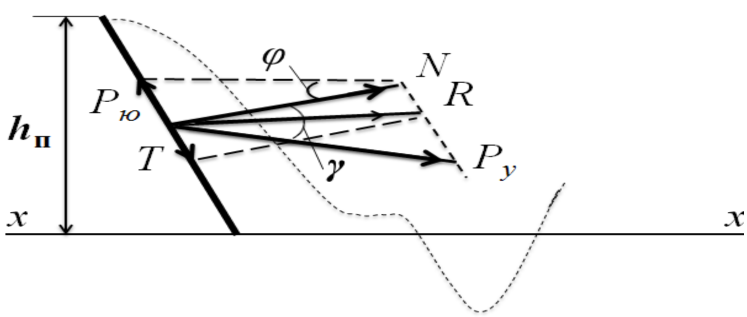

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Figure 6: Forces on moving the heap of soil by the leveller.

This force is divided into two constituents. One is called the normal force N because it is oriented vertically, and the other is designated $P_{ю}$ because it moves upward along the surface of the leveller. This force moves the heap of soil upwards. The friction force T is formed because of the friction between the soil and the leveller. As the soil heap moves upward, the friction T goes upward in the opposite direction of the $P_{ю}$ force. The following conditions must be met for the formation and reproduction of soil heaps

$$P_{ю} > T \tag{14}$$

Here

$$P_{ю} = P_y \cdot \sin\gamma \qquad T = Ntg\varphi = P_y \cos\gamma \cdot tg\varphi \tag{15}$$

then $$P_y \cdot sin\gamma > P_y cos\gamma \cdot tg\varphi$$

In order for this to be fulfilled, there must be the following inequality

$$\gamma > \varphi \tag{16}$$

The second task. In this case, the heap of soil in front of the leveller is on the slope of the uneven surface, Fig. 7.

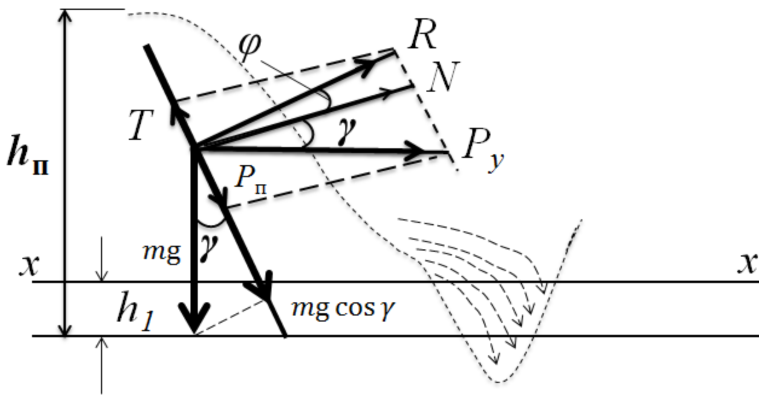

Figure 7: Schematic of the forces placed on the groove of the heap in front of the soil.

In this case, the heap resistance P_y is divided into two forces, namely T and $P_п$. In this case, the T force is upward as the slope of the soil slides down, that is, by the force of $P_п$ to fill the hole. In addition, because of the hole below the heap of soil, there is also a downward force of mg. The $mgcosg$ force on the surface of the leveller along with the downward P_y force moves the soil pile up to the hole. In this case, the conditions between P_y and T forces that arise through the force of P_y must be the same as in the first case, i.e.

$$P_п > T \quad \text{or} \quad \gamma > \varphi \tag{16}$$

In addition, the weight of the soil heap mg also accelerates soil penetration. Then the condition is as follows

$$P_п - mgcos\gamma > T \tag{17}$$

The resistance of the leveller to the pull. The leveler does not affect the weight of the leveller because the frame mounted on the four base wheels is tightly attached. If the depth of the leveller is changed, the frame will be changed from where it was fixed and then fixed again. In this case, the straightening resistance of the leveller is the resistance to the sliding of the soil heap in front of it. The resistance of the soil heap to displacement is determined by the formula (13)

$$P_y = \frac{1}{2} h_{\Pi} \cdot (ctg\beta - tg\gamma) \cdot \rho \cdot g \cdot f \cdot B$$

Quantities ρ = *1,12 = 1120 кг/м²*; *g=9,81 м/с²*; *f*=0,7; *B=1м*; equal to $P_п$ =5; 10; 15; 20 ;25 см; The values of P_y for γ=10°, 20°, 30°, 40° ва β=20°, 30° were calculated. The results are shown in Figure 6.

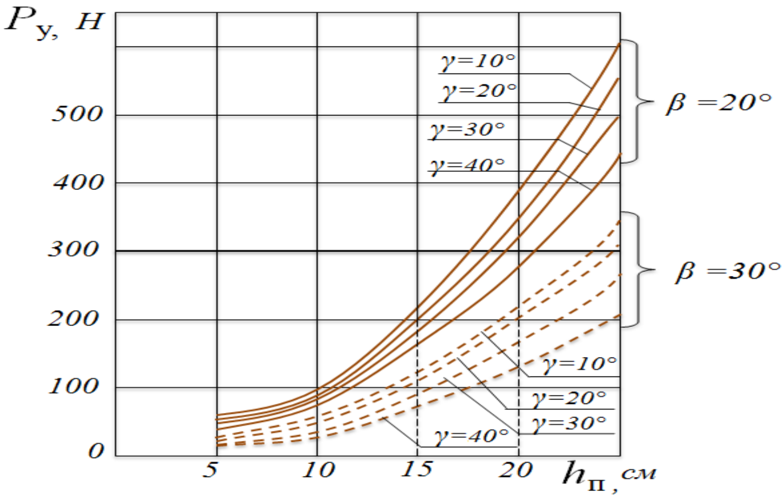

Figure 8: Changing the resistance of the leveller with the parameters *β, γ* ва $h_п$.

The analysis shows that the leveller's resistance increases with increasing height. The slope of the leveller and the slope of the outer surface of the soil play an important role here. As the slider grows, the resistance decreases. The slope of the resistance at 30 ° and 40 ° of the angle ***γ*** is due to the overlap of the accumulated soil heap. This is also illustrated by the analysis of the variation in the magnitude in Figure 5. This also occurs when the temperature *β* is between 20 ° and 30 °. The angle *β* = 20 ° is the increase in resistance because it takes into account that the leveller is more likely to move the soil at a greater distance than *β* = 30 ° to form a heap.

As mentioned before, when *β* = 20 °, it is found that the height of the leveller is $h_п$ = 15 cm and slope γ = 20 °. Given that the straightness of the leveller is P_y = 200 H / m, the height of the leveller at *β* = 30 ° is $h_п$ = 20 cm and the slope is γ = 25 °,

II. CONCLUSIONS

1. The process of leveling the field is important after the spring sowing and softening of the soil in order to obtain high yield between the rows of seedlings. Because the planting area should be straight and flat, the upper floors should be small, moist, and clean and free from weeds.

2. Due to the high efficiency of the leveller, the following conclusions were made on the studies carried out to improve their construction:

- all leveling machines are positioned at a vertical, acute and obtuse angle to the horizontal level of the working body. There are no specific recommendations for installing them;
- at planting in gardening cannot be moved between rows, because the width of the leveller is 1.5 and 2.5 times higher than the gauge of the tractor;

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➢ the levellers move diagonally across the area to be leveled. If it is moved in the direction of the aggregate, the flat surface may leap to a certain extent as the area is wide.

3. The slope value of $h_п$ for the slope surface β and the cross-section value of deviation angle γ is as follows; that is, when β = 20 °, the height of the leveller is $h_п$ = 15cm, the deviation angle is γ = 20 °; At β = 30 °, it is desirable that $h_п$ = 20 cm and the angle of deviation γ = 25 °.

4. When leveling the smoothing area, the leveller has two functions: first, to increase and push the heap of soil accumulated in front of the leveller, and secondly to pour the heap in front of the leveller in the hole.

5. It was found that the slope of the leveller with increasing height increases the slope of the leveller and the slope of the outer surface of the soil heap.

6. As the slider grows, its resistance decreases. The slope of the resistance at 30 ° and 40 ° is due to the overlap of the accumulated soil over the leveller, and the increase in resistance when β=20° is due to the fact that the soil is more distant than β=30° to form a heap.

7. *=200 H/m* with the slope height $h_п$ = 15см and slope γ=20° , when the slope of the soil pile surface is β=20° , β=30°, it is found that the height of the leveller is $h_п$ = 20см and the slope γ=25° is equal to $P_у$ = 215… 220 Н / m.

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