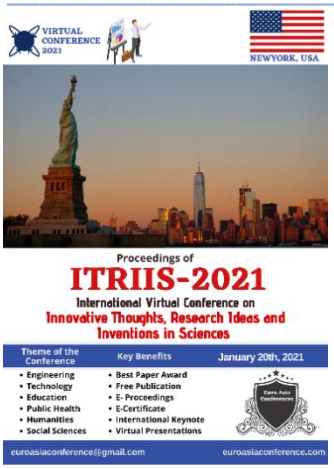

STUDY OF THE ANGLE OF OPENING OF THE LEVELING DEVICE FOR COMPLETE OPENING OF BURIED POME GRANATE BUSHES

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Annotation.

The article presents the results of theoretical studies to substantiate the opening angle of the device leveler for the complete opening of pomegranate bushes covered with a soil shaft. The research results showed that for the full opening of the pomegranate bushes and ensuring the agro technical requirements, the unevenness of the unevenness formed in the aisles, the opening angle of the leveler device should be within 60°-70°.

Keywords:

Pomegranates, pomegranate bushes, devices for opening pomegranate bushes, the opening angle of the leveler device, the degree of opening of the pomegranate bushes, the height of the unevenness formed in the aisles of the pomegranate bushes.

In recent years, the government of the Republic pays great attention to the development of pomegranate growing in order to better meet the needs of the population in food products, ultimately increase incomes and living standards of the rural population, develop fruit and vegetable growing and viticulture. To this end, resolutions and decrees of the Cabinet of Ministers No. 25 and 791 of January 20, 2017 and October 4, 2018 were adopted to increase the cultivation of pomegranate in the country and the development of this sector. They envisage the establishment of the Association of Pomegranate Growers in the country, the construction of an additional 24000 hectares of pomegranates by 2021, the gradual implementation of work to increase production, processing and export [1-2].

It is known that in order to prevent cold weather in the conditions of the republic, pomegranate bushes are buried in late autumn with hay or soil and opened in spring. However, due to the lack of special equipment, the burial and opening of pomegranate bushes is not mechanized and is still carried out by hand. This, in turn, leads to an increase in labor, working hours and other costs, and hinders the growth of pomegranate cultivation, the establishment of pomegranate plantations on large areas. It should also be noted that, given that pomegranate bushes are buried in late autumn, in the early winter years, pomegranate bushes are not completely buried in all areas by hand, and as a result, there are many cases of cold beating. This also makes it difficult to develop the industry and implement the above tasks. Based on the above, the plan of research work of the Research Institute of Agricultural Mechanization In the framework of the innovative project I-KX-2019-11 “Scientific and

technical solutions for the development of machines for burying and opening pomegranate bushes" [3] developed a device for full opening of pomegranate bushes (Figure 1).

The operation of the device is as follows: the tractor enters the row between the machine in the transport position, the tractor lowers the machine and, if necessary, adjusts the height of the air nozzle 12 using a leveling compactor 4, 5 hydraulic cylinder 6 relative to the soil piled on pomegranate bushes. The QOV of the tractor is added and the unit is moved along the row spacing after the fan 11 blades have made sufficient rotations. The machine smooths out the unevenness between the rows using a leveler 4 and compacts it with a leveler 5 as needed. The spherical disk of the device 3 lowers the soil in the buried pomegranate bushes and the remaining soil is fully opened by the air flow coming out of the nozzle. If necessary, the tractor adjusts the position of the nozzle relative to the soil pile using a leveling compactor 4, a hydraulic cylinder 6.

This article presents the results of scientific research to determine the opening angle of a device leveler that fully opens embedded pomegranate bushes.

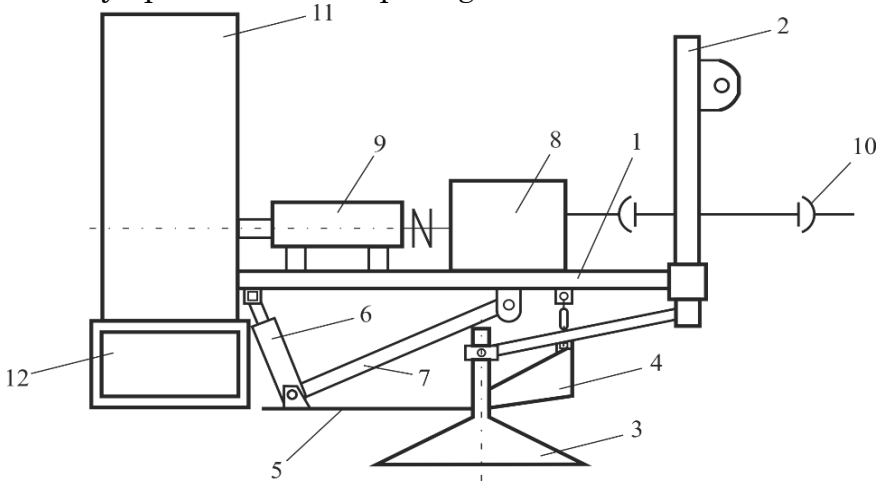
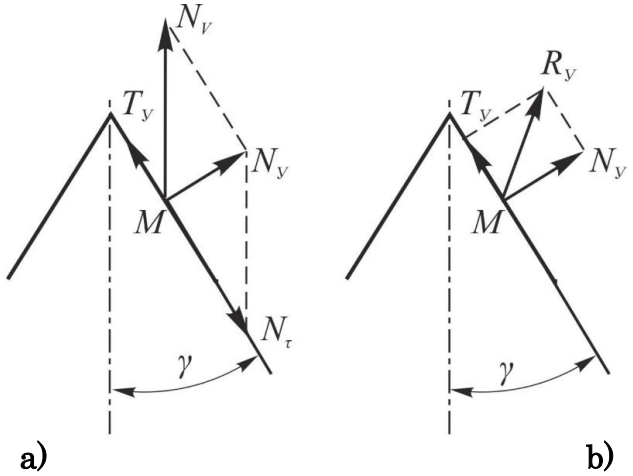


Figure 1. Design scheme of the device that fully opens the pomegranate bushes. 1-frame; 2 hanging device; 3-spherical disk; 4, 5 leveler-compactor; 6-hydraulic cylinder; 7-column; 8-multiplier; 9-val; 10-cardan shaft; 11-fan; 12 air nozzle

When the device fully opens the pomegranate bushes, the soil should not stick to its leveler and not fall asleep in front of it. This is achieved by substantiating the opening angle g of the straightener.

To substantiate the optimal value of the stated angle, we consider the motion of the soil particles in the horizontal plane under the influence of the leveler. (Figure 2a). In the horizontal plane, the soil particles are affected by normal Nu and friction $T_y=N_y tg\varphi$ forces by the working surface of the leveler.



a) b)

Figure 2. Scheme for determining the opening angle of the device leveler

We divide the normal N_y force into N_V directed along the direction of motion and N_τ directed along the working surface of the leveler. According to the scheme shown in Figure 2a

$$N_V = N_y / \sin\gamma \quad (1)$$

and

$$N_\tau = N_y ctg\gamma \quad (2)$$

where γ – is half the opening angle of the straightener. It is known from the literature [4] that the following condition must be met in order to prevent the soil from sticking and falling asleep in front of the leveler

$$N_\tau > T_y \quad (3)$$

Substituting the above values N_τ and T_y into this inequality, we obtain the following

$$N_y ctg\gamma > N_y tg\varphi_1 \quad (4)$$

$$\gamma < 90 - \varphi_1 \quad (5)$$

where φ_1 – is the angle of external friction of the soil. When this condition is met, the soil particles move in the direction of the Ry force, which is an equal effect of the N_y and T_y forces (Figure 2b), and at the velocity.

According to the scheme shown in Figure 3

$$V_a = V \frac{\sin\gamma}{\cos\varphi_1} \quad (6)$$

where V is the forward velocity of the unit. And we find the velocity V_a component perpendicular to the direction of motion

$$V_к = V \frac{\sin\gamma}{\cos\varphi_1} \cos(\gamma + \varphi_1) \quad (7)$$

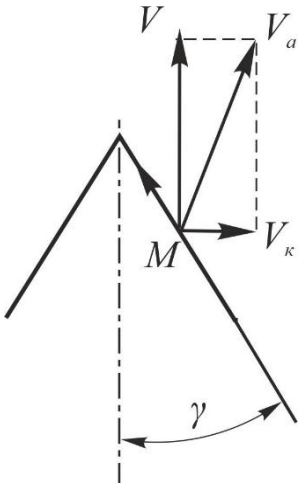
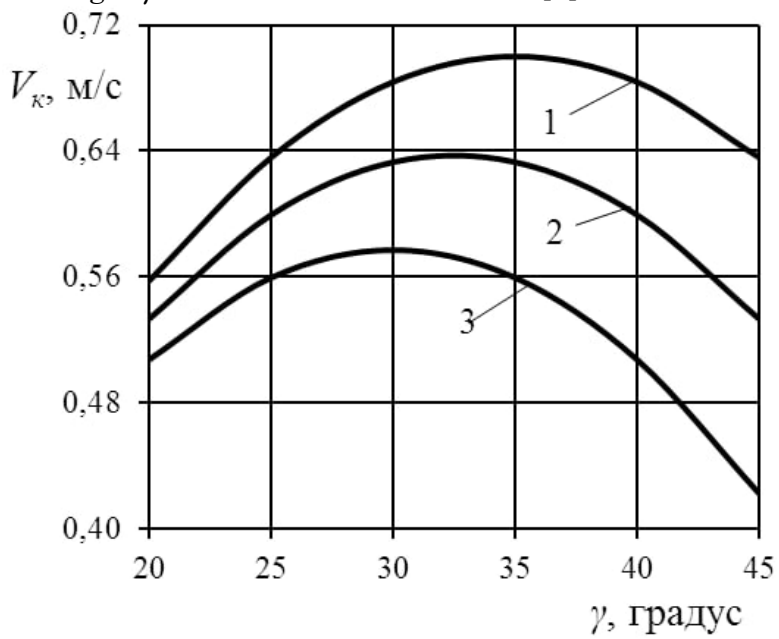


Figure 3. Scheme for determining the velocity of soil particles under the influence of the leveling surface

In Figure 4, assuming V=2,0 m/s, graphs of the change in velocity V_K at different values $\varphi_1$according to expression (7) depend on the angle γ. It can be seen from these graphical dependences that at all values φ_1 the change of velocity V_K depending on the angle γ has the appearance of a bubble parabola, and at certain values V_K has a maximum value. It can be said with complete confidence that at values γ of the angle that ensure the maximum V_K, the soil is less likely to stick to the leveling surface and fall asleep in front of it, and therefore it has less resistance to gravity.

Therefore, it is expedient to determine the opening angle of the straightener on the condition that V_K has the maximum value of velocity.

To find the value of the opening angle of the rectifier that maximizes V_K, we examine expression (7) to the extremum at an angle γ. To do this, we take the first-order product from the expression (7) at an angle γ and set the result to zero [5].



1 - φ_1=20°; 2 -φ_1=25° ва 3 -φ_1=30°

Figure 4. Graphs of the change in velocity V_K at different values φ_1 depending on the angle γ

$$\frac{dV_к}{d\gamma} = V\cos\varphi\left[\cos\gamma\cos\gamma+\varphi_1\right)-\sin\gamma\sin\left(\gamma+\varphi_1\right)]=0 \quad (8)$$

or

$$\cos\left(2\gamma+\varphi_1\right)=0 \quad (9)$$

From expression (9) we obtain the following

$$\gamma=\frac{\pi}{4}-\frac{\varphi_1}{2} \quad (10)$$

We put the known values φ_1 (20-30°) in this expression and find that the angle γ should be in the range of 30-35°. This means that the opening angle of the device leveler should be in the range of 60-70°.

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