ANALYSIS OF RESEARCH ON WORKING WITH SOIL ACTIVE WORKING ORGANS AND SOIL MILLS

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Annotation: The article presents an analysis of studies conducted on soil cultivation with active working bodies and rotary cutters.

Keywords: rotary machine, milling cutter-cultivator, active working element, cutting speed, disk and spring working element, working width.

In the Commonwealth of Independent States and foreign countries, many scientific research works on the study of constructions of soil tillage machines with an active working body have been carried out.

In particular , A.D.Dalin [1] made a great contribution to the theory of rotary machines . He created the basis of the technological process of soil milling, the kinematics and dynamics of rotary machine elements, and proposed the methods of calculating milling cutter blades. In doing so, many studies were conducted in different soil and climate conditions to justify the parameters and operating modes of machines equipped with milling bodies.

B.D.Dokin [2] conducted studies on the performance of tiller cultivators in Siberian soil conditions. For high-quality grinding of the soil with low energy consumption, the milling drum, consisting of three G-shaped blades, has a working depth of 13 cm, a movement speed of 2.26 m/s, 2.7-3.0 on light and medium soils, and and in heavy soils, it was found to work in kinematic modes equal to 3.5.

V.S.Surilov [3] determined that the drum equipped with G-shaped blades along the horizontal axis, perpendicular to the direction of movement, makes up 9-24% of the force used to push the milling cutter. In this case, he proposed to equip milling cultivators with passive working bodies for efficient use of this power.

S.A.Myan [4] investigated the performance of a milling cultivator in the cultivation of sugar beet in the harsh soil conditions of Kazakhstan. According to the results of the study, the FPU-4.2 milling cultivator uses less energy to ensure high-quality grinding of the soil. 25 ^{0} , the speed of rotation should be 5 m/s, the transmission of the blade should be 6-8 cm, and the kinematic mode of operation should be 3.0.

In the research works of E.P.Yatsuk [5], a combined milling cutter, which ensures good sinking of milling cutters with a cylindrical working surface and effectively softens the ground, is proposed. However, when the blades in the front part of the wing sink into the soil, plant remains get stuck. At the same time, it pushes the subsoil moisture layer to the surface of the field in large quantities, which causes moisture loss.

In foreign practice [6] milling cutters with G-shaped, needle-shaped, disc and spring working bodies are widely used.

Among the foreign researchers, it is possible to highlight the work of German scientists V.Zone, who researched tillage tillage [7].

W. Söhne studied G-blades with a coverage width of 35-95 mm, set at 20 mm intervals. In his works, it is mentioned that the G-shaped knife has a coverage width of 65 mm and a low energy consumption when the blade sharpening angle is 15 ^{0} and the cutting angle is 20-25 ^{0} . In the research conducted by him, the influence of the shape of the blade on agrotechnical indicators was studied, in which it was found that the blade with a smooth surface requires less energy than the blade with a loop. Blade-type working bodies require less energy at high rotational speeds compared to others.

When analyzing a number of working bodies, spring tines have shown a number of advantages in the cultivation of small stony, rooted, weedy soils.

[8] conducted by the Japanese scientific research universities, the optimal parameters of the G-shaped blade were obtained (Fig. 1).

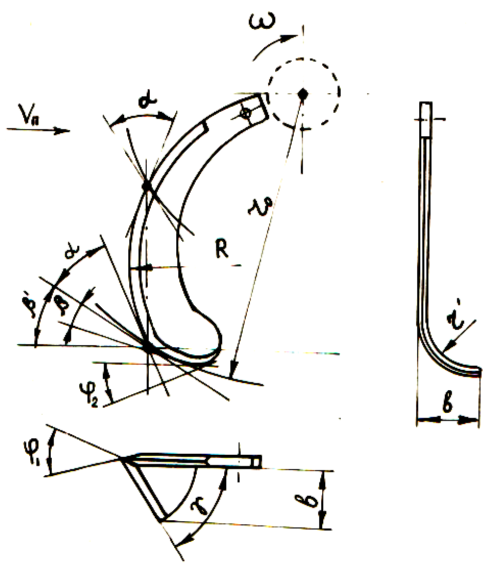


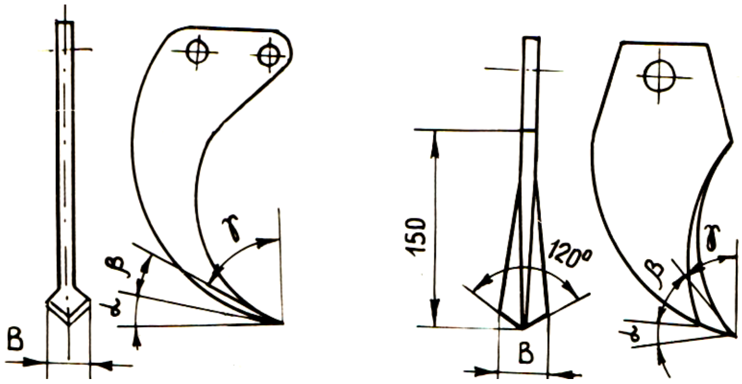
Figure 1. The main parameters of the working body of the "Nataba" type

The sharpening angle of the blade column φ_1=20 ^{o} -35 ^{o} ; sharpening angle of the blade φ_2= 17 ^{o} -30 ^{o} ; cutting angle α=30 ^{o} -70 ^{o} ; rear angle β=17 ^{o} -25 ^{o} ; blade wing mixing angle τ=60 ^{o} -65 ^{o} ; the length of the G-shaped part of b the blade = 0.50-0.54 m; blade bending i radius = 0.15- 0.30 m ; the largest rotation radius of the blade: 0.08 m at the beginning of the column, 0.02 mm at the end; the width of the blade is variable, usually 0.25 m at the head of the column, 0.45-0.60 m at the beginning of the bend of the G-shaped part. The column of the blade of the working organ is made in the form of a logarithmic spiral.

The main disadvantage of these working bodies is the small coverage. To increase the coverage width, it is necessary to increase the number of disks, as a result, the number of knives must also be increased, in this case, the power spent on milling will increase. If the coverage width of the knife is increased, the surface of the lower moist layer of the soil increases.

addition to G-shaped working bodies, sword-shaped working bodies developed by the company "Sato" are widely used in Japan . There are also working bodies in the form of spears, three of which are spear-shaped and arrow-shaped (Fig. 2) [8] .

The main disadvantage of these working bodies is that they are clogged with large metal capacity and plant debris. For this reason , they are not widely used.



a) b)

a-lanceolate; bull-shaped

2 . Working bodies in the form of a saw

Therefore, in milling cutters, knives in the form of a knife, conical, G-shaped, arrow-shaped, tiered, combined, hinged are used a lot [8] .

of F.M.Kanarev [6] , MFSenin [9] , V.V.Melikhov [10] , G.N.Sineokov [11] , I.M.Papov [12] presented the theory of tillage machines with active working bodies.

N.F.Kanarev [6] determined that the higher the cutting speed of the milling tool, the higher the relative energy consumption.

To more accurately determine the thickness of the slag, they proposed the following formula

$$\delta = S\cos\alpha + R(1-\cos\Delta\alpha)\,, \qquad (1.1)$$

in this

$$\Delta\alpha = \arcsin\frac{S\sin\alpha}{R}\,, \qquad (1.2)$$

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S - transmission to the blade, m; α - turning angle of working body, °; R - milling radius, m.

V.V.Melikhov [10] analyzed the effect of blade width on the installation angle and proposed the following relationship

$$\gamma = arctg\sqrt{\lambda^2 - 1} - \frac{B\lambda}{2R\sqrt{\lambda^2 - 1}}, \qquad (1.3)$$

where V is the width of the blade wing , m ; λ -kinematic mode of operation.

One of the most important argotechnical indicators of rotary tillage machines is the sickle shape of the bottom of the treated layer.

GNSineokov [11] stated that the permissible height of the scythe h_g can be expressed by the following condition

$$h_g \le 0,2a, \qquad (1.4)$$

where a *is* the processing depth , m.

According to IMPapov's proposal [12], the minimum permissible kinematic operating mode depending on the height of the scythe is determined as follows

$$\lambda = \frac{\pi}{z_f \cdot \arccos\left(1 - \frac{h_г}{R}\right)} \pm 1, \qquad (1.5)$$

where z_f is the number of blades on the disk, pcs.

[8] , R.I.Boymetov [13] , STSultanov [14] , SBDjumakulov [15] , RIKhudayberdiyev [16] , URIgamberdiyev [17] and B.Otakhanov [18] were engaged in the research of milling machines in cotton-growing areas .

A.A.Axmetov [8] , based on the results of his research, based the optimal values of a milling drum equipped with a composite blade, that is, the radius of the drum is 0.180 m, the location radius of the blade blade is 0.150 m, the number of blades on one disk is 2 pieces, the distance between the disks is 0.200-0.225 m, wing installation angle 1.06-1.09 rad, tilt angle 1.73-1.83 rad, blade coverage width 0.101-0.116 m, kinematic mode of operation 4.1-4.2, angular speed 56.25- 61.49 rad/s, stated that the speed of movement will be 1.8-2.2 m/s.

S.T.Sultanov [14] researched the agrotechnical and energetic indicators of horizontal milling operation in processing between rows of cotton. According to the results of the experiment, they found that the optimal coverage width of the blade is 0.100-0.110 m, the angle of inclination is 105-110 °, the cutter diameter is 0.380 m, the angular speed is 28.54 rad/s, the number of blades on the disc is 4 pieces, the transfer to the blade is 0.60 -0.80 m and determined that the speed of movement will be 1.25-1.31 m/s.

S.B.Dzhumakulov [15] suggested using a conical milling drum equipped with a G-shaped blade for processing wide rows of cotton between rows.

Based on the soil conditions of Turkmenistan, R. Khudoyberdi [16] determined the parameters of a horizontal milling machine installed parallel to the direction of aggregate movement. In this case, it is stated that the segment blade milling cutter with a diameter of 0.350 m has a transmission of 0.373 m, an angular speed of 51.31 rad/s, and the number of blades in the drum is 9 pieces.

It should be noted that the above scientific works were mainly carried out for processing between cotton rows.

According to the above analysis, it was found that G-shaped knives of cutting type are widely used in soil cultivation. Wide use of G-shaped knives is due to its universality and self-cleaning properties [12] . But in this case, their geometric dimensions, the mutual arrangement of their elements and the blade parameters differ from each other. In addition, as mentioned above, they have significant shortcomings, and to overcome them, theoretical and experimental studies on the justification of parameters and operating modes are required [19, 20, 21, 22, 23, 24].

At the same time, as a result of the analysis of the above, it can be concluded that the process of high-quality processing of the soil with the help of a milling cutter depends on the type, shape, parameter and mode of operation of the working body, as well as the physical and mechanical properties of the soil. It is seen that the parameters of the working body have different values in different soil conditions , which in turn means that the influence of soil-climate conditions is high [25, 26, 27, 28].

The results of the conducted analysis are used to justify the selection and parameters of the type of work body that crushes the soil in the aggregate developed for preparing the land for planting.

Based on the literature and research review and patent search analysis, the following conclusion can be drawn:

Current research is focused on the development of aggregates that perform several operations in the preparation of land for planting. Such aggregates Create current from issues one he is his own the solution requires finding .

Today, the existing technology and the aggregates that implement it are widely used, although they meet the agrotechnical requirements for tillage machines before planting, but they cannot prepare the soil for planting in one step, even if their construction is improved [29, 30, 31, 32, 33] .

Based on the conclusions made based on the obtained results, the main goal of the research work was determined, in which the aggregate preparing the soil for planting in one pass should grind the soil layer to the required level and provide the necessary fractions.

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