INVESTIGATION OF STABLE MOVEMENT OF THE IMPROVED CHISEL CULTIVATOR AT THE SPECIFIED PROCESSING DEPTH

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Annotation: *In order to improve the quality of work and reduce energy consumption, an analytical expression is given, taking into account the factors that affect the performance of the improved chisel cultivator at a certain depth of cultivation and stable movement at this depth. The analysis of the obtained expression showed that the operation of the improved chisel cultivator at a set depth and stable movement at this depth is mainly provided by changing the vertical distance N_1 from its base plane to the lower hanging points.*

Keywords: *improved chisel-cultivator, processing depth, stable movement, softening claw, curved claw, lower hanging point, upper hanging point, traction resistance, working speed, open cutting conditions, closed cutting conditions.*

ChKU-4 and ChK-3.0 chisel cultivators are widely used in pre-sowing tillage in all regions of the country [1-3]. However, these chisel cultivators have been produced for a long time without any significant changes. For this reason, they do not meet modern requirements, such as efficient tillage of the soil, material and energy-intensive, and in many cases do not cultivate the soil to the required level in a single pass through the field. Based on this, our institute conducted research to increase the performance of chisel cultivators and reduce energy consumption, and on their basis developed an improved chisel cultivator [4-7]. The use of this developed chisel-cultivator improves the quality of tillage and reduces energy consumption for tillage.

It is known that if the depth of tillage is at the required level and its stability is ensured, that is, if the crops are evenly developed and matured and high yields are obtained, otherwise uneven growth and maturation of plants is observed, yield decreases by 12-15%. This has been proven in many studies conducted in our country and in other countries. For this reason, there are strict requirements and restrictions for each tillage machine on the depth of tillage and its deviations (unevenness) [8, 9].

The scheme and parameters of connection of all tillage machines (including plows) to the tractor in the longitudinal-vertical plane are determined mainly on the condition that they sink to the specified depth and ensure a smooth (stable) movement at that depth [10-12].

This article presents the complex results of the research conducted on the basis of the research on the operation of the improved chisel cultivator at a certain depth and to ensure its stable movement at this depth and to determine its overall traction resistance.

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For the improved chisel cultivator to sink to the specified depth and move steadily at this depth, the condition Nu> 0 must be met [2, 3, 8, 10] (where Nu is the total reaction force exerted by the soil on the base wheels of the chisel cultivator). 1-расмда келтирилган схемадан фойдаланиб қуйидагига эга бўлинди:

$$N_y = \sqrt{1+\mu^2} \times$$

$$\times\left\{\left[qBg+(\frac{B}{2a_k}+1)(K_{ю}+E_{ю}V^2)b_{ю}htg\psi_{ю}+\frac{B}{a_k}\eta(K_{ў}+E_{ў}V^2)b_{ў}htg\psi_{ў}\right]\Delta+\right.$$

$$+qBgl_2-\left[(\frac{B}{2a_k}+1)(K_{ю}+E_{ю}V^2)b_{ю}h+\frac{B}{a_k}\eta(K_{ў}+E_{ў}V^2)b_{ў}h\right]\Delta+$$

$$+(\frac{B}{2a_k}+1)(K_{ю}+E_{ю}V^2)b_{ю}h\left\{\left[h_1(ctg\alpha_{ю}+ctg\psi_{ю})-l_1\right]tg\psi_{ю}-H_1\right\}+$$

$$+\frac{B}{a_k}\eta(K_{ў}+E_{ў}V^2)b_{ў}(mh)\left\{\left[L_1+h_2(ctg\alpha_{ў}+ctg\psi_{ў})-l_1\right]tg\psi_{ў}-\left[H_1-h(1-m)\right]\right\}+$$

$$\left.+\frac{B}{a_k}\eta(K_{ў}+E_{ў}V^2)b_{ў}h(1-m)\left\{\left[L_1+l_2+h_3(ctg\alpha_{ў}+ctg\psi_{ў})-l_1\right]tg\psi_{ў}-H_1\right\}\right\}:$$

$$:\Delta-l_T+\mu\{\Delta+H_1-h-0{,}5d_T\}\};\qquad(1)$$

If $\Delta=\dfrac{H_2\sqrt{l_б^2-(H_3+h-H_1)^2}\left(\sqrt{l_б^2-(H_3+h-H_1)^2}-X_B\right)}{(H_2-Z_B)\sqrt{l_б^2-(H_3+h-H_1)^2}-(H_3+h-H_1)X_B}$;

$$E_{ю}=\rho\sin\alpha_{ю}tg(\alpha_{ю}+\varphi_1)(1+\frac{W}{100});$$

$$E_{ў}=\rho\frac{\sin^2\gamma_{ў}[\sin\alpha_{ў}+tg\varphi_1\sin\gamma_{ў}(ctg\gamma_{ў}+\cos\alpha_{ў})]}{ctg\alpha_{ў}-\sin\gamma_{ў}tg\varphi_1}(1+\frac{W}{100});$$

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μ – improved rolling resistance coefficient of the chisel-cultivator support wheels; q – mass of the improved chisel-cultivator corresponding to the width of each meter of coverage, kg / m; V - coverage width of the improved chisel-cultivator, m; g - acceleration of free fall, m / s^2; $K_{ю}$, $K_{ў}$ – the relative resistance of the soil to the softening and axial claws, respectively, Pa; V - speed of movement, m / s; h - processing depth, m; ē is a coefficient that takes into account the effect of the improved chisel-cultivator on the resistance to traction when working in open cutting conditions; l2 is the horizontal distance from the lower hanging points of the improved chisel cultivator to its center of gravity, m; N1 - vertical distance from the base plane of the improved chisel-cultivator to the lower hanging points, m; N2 is the bottom and top of the improved chisel cultivator

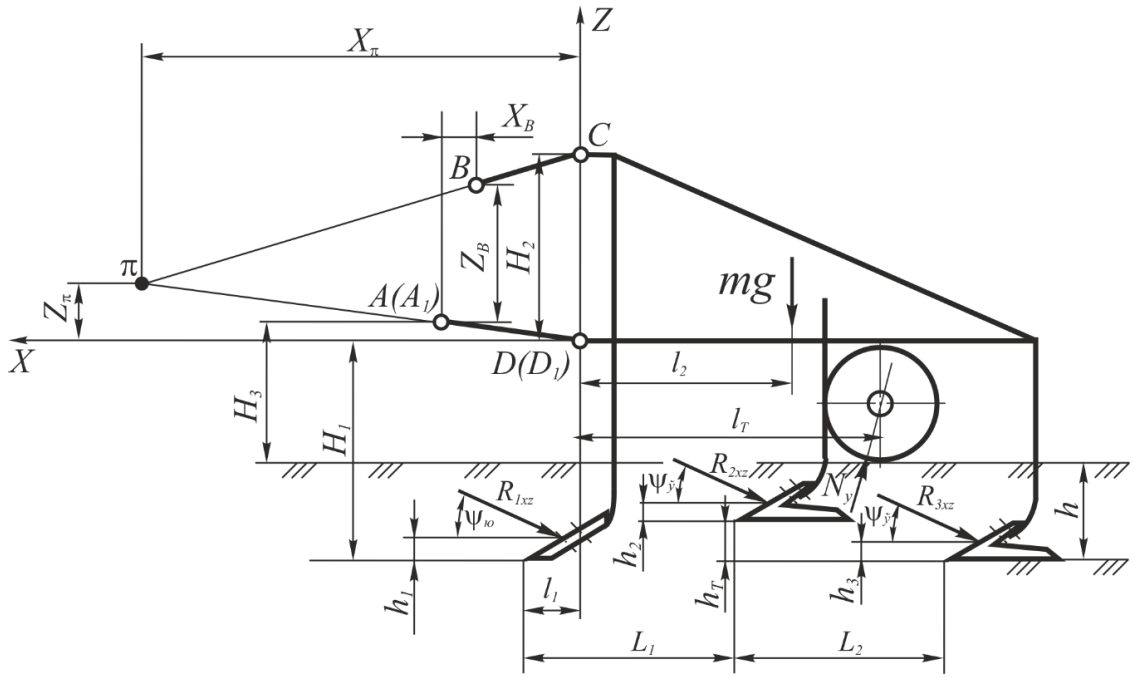

Figure 1. Scheme for determining the total reaction force acting on the support wheels of the improved chisel cultivator

vertical distance between hanging points, m; N3 is the vertical distance from the base plane of the tractor to the fixed hinges A (A1) of the lower traction of the suspension mechanism, m; l1 is the longitudinal distance from the lower hanging points of the improved chisel-cultivator to its working bodies located in the first row, ie to the blade of the softening claws, m; psyu, pso - directional (deflection) angles of the forces R1xz, R2xz, R3xz acting on the softening and axial claws of the taco-milled chisel-cultivator, degrees; R1xz, R2xz, R3xz - equal influences of resistance forces acting on the working bodies located in the first, second and third rows of the chisel-cultivator, respectively, improved, N;

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L1, L2 - longitudinal distances between the working bodies of the improved chisel-cultivator, m; lT is the longitudinal distance from the lower hanging points of the improved chisel-cultivator to the center of rotation of the base wheels, m; dT is the diameter of the improved chisel-cultivator support wheels, m; lb is the length of the lower traction of the tractor suspension mechanism, m; r is the density of the soil, kg / m3; W - soil moisture,%;

ph1 is the external friction angle of the soil, degrees.

(1) shows that the total reaction force acting on the base wheels of a chisel-cultivator improved by the soil is their location and diameter, the weight of the chisel-cultivator and the point at which it is placed, the parameters of the chisel-cultivator and its working bodies. forces and their directions and set points, depending on the size and parameters of the processing device, the suspension of the chisel-cultivator and the mechanism of suspension of the tractor. However, the size and parameters of the tractor hoisting mechanism and the distance between the lower and upper hanging points of the chisel-cultivator hoisting device are standardized and known to the tractor, the size and parameters of the chisel cultivator and its working bodies Given that the performance of the improved chisel-cultivator sinks to a specified depth and is stable at this depth, the vertical distance from its base plane to the lower hanging points is ensured mainly by changing N1.

To determine the value of N1 that satisfies the condition Nu> 0, a graphical link Nu = f (H1) was constructed according to expression (1) (Fig. 2) bottom suspension

it was determined that the vertical distance to the points should be at least 46.8 cm.

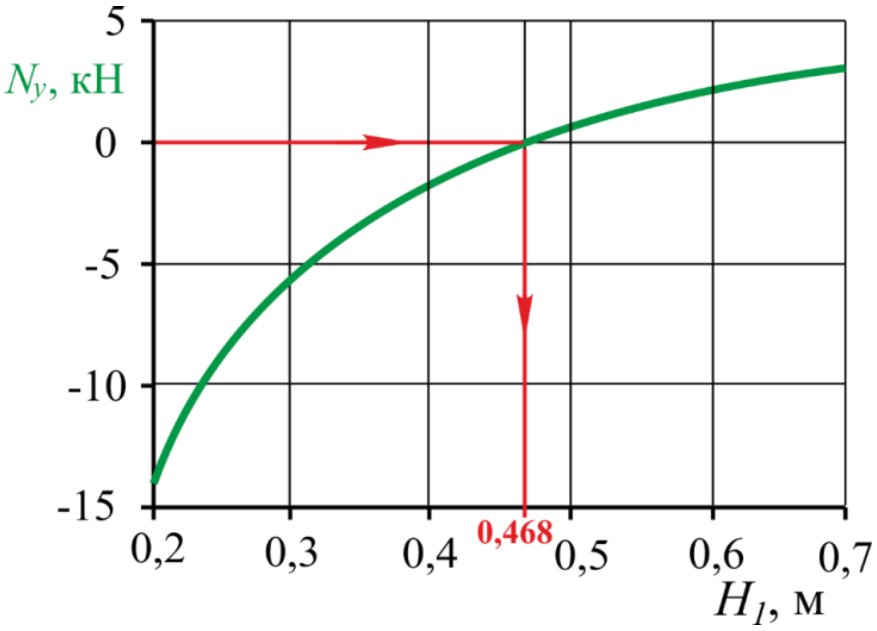

Figure 2. Graph of change of N_y depending on H_1

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The total resistance of the improved chisel cultivator to traction is equal to the sum of the resistance of the working bodies to traction and rolling of the support wheels and can be determined by the following expression:

$$R_y = (\frac{B}{2a_k} + 1)b_ю h(K_ю + E_ю V^2) + \frac{\eta B}{a_k} b_ў h(K_ў + E_ў V^2) + \mu \frac{N_y}{\sqrt{1+\mu^2}} \qquad (2)$$

Taking into account expression (1), calculations on expression (2) showed that the total tensile strength of the improved chisel cultivator at a speed of 1.7-2.2 m / s is 26.08-26.74 kN.

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