Determining soil-deepener the vertical distance from blade to lower suspension point of plug

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Abstract. The technology of intensive treating to soil is used to harvest 2 or 3 times from watered lands. Aggregations of the car–tractor pass many times through the surface of the field as a result of it. As a result, the soil layer surface turns to small pieces of dust, and the condensation of the underground layer empowers. Apart from that, when we treat the soil with a plug in the same depth for many years, extremely condensed compensation of plug appears under the field, and it hinders the improvement of plants' roots and the being soaked process of water. After that, the rate of productivity decreases. To solve this problem, economical ways of treating the soil and protective technologies for soil are spreading worldwide. To eliminate these shortcomings, in this article, the working process is improved in the process of plowing the land. To ensure that the plug with a submersible sink to a specified depth and runs smoothly at this depth, the vertical distance from the blade of the submersible to the lower hanging point of the plug and the vertical distance of the submersible plug in the longitudinal - vertical plane the results of theoretical studies on determining the forces affecting the plug are described.

1 Introduction

Consistent measures are being taken to increase the competitiveness of agricultural and land reclamation techniques produced in our republic and to provide producers of products with modern, high-quality agricultural techniques. At the same time, the incompatibility of certain agricultural and reclamation techniques entering from foreign countries with the soil and climatic conditions of the Republic creates several problems during the implementation of the established agrotechnical measures in the cultivation of agricultural crops. [1].

To effectively apply agricultural and reclamation techniques and their aggregates and components in the soil and climatic conditions of the regions of the Republic and to check their reliability, to conduct appropriate tests, to support innovative methods, programs, and promising ideas that promote the development of the industry, to implement effective scientific developments in the activities of local enterprises producing agricultural and

In addition, the main crop areas in agriculture are extremely compacted at the bottom of the plow when the plug is processed annually to a depth of up to a constant 30-35 CM, which leads to a deterioration in the development of the plant root and water absorption as a

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result of the appearance of a "berch heel". In such lands, from year to year, productivity decreases, and deterioration of the soil structure is observed [2].

2 Materials and Methods

To solve this problem, research is being carried out on a structure that allows you to soften the layer under the drive in the plowing process itself. After the main plug body of the grounding device and in the footsteps of the tractor wheel, it is installed deeper about it, and through it, the housing lemex is compacted, and the "plug heel" is reached by tilting and breaking. In this case, together with the loosening of the compacted layer, the development of the plant root and the water permeability of the soil are improved [3-6].

We base the steep distance from the ground cover plug to the bottom hanging point of the plug based on the conditions that the ground cover plug can work immersed to a specified depth and walk evenly at that depth. First of all, let's look at the forces acting on the earthenware plug in a longitudinal-upright plane.

In the longitudinal-upright plane, the following Forces act on the grounding plug (fig.1):

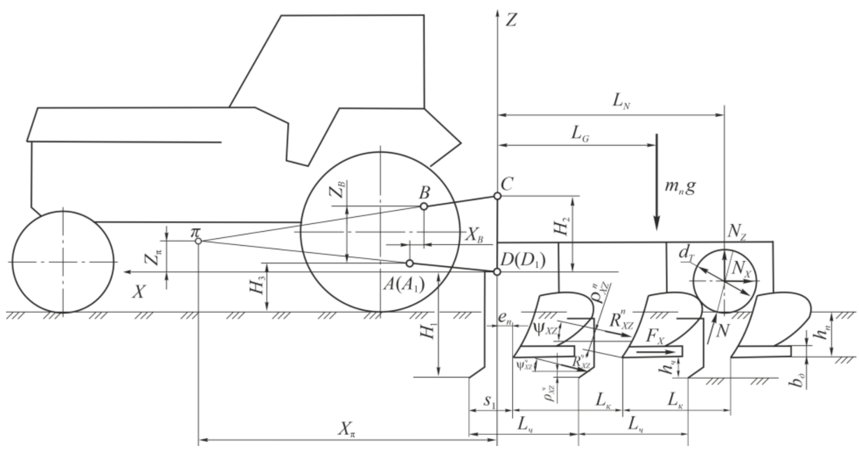

Fig. 1. Scheme of forces acting on a plug with a grounding device in a longitudinal-upright plane

$m_n g$ is the weight strength of the grounding plug, N; m_n is the mass of the earthenware plug, kg; $R^n{}_{XZ}$ is the longitudinal-an equal influencer of the forces acting on the lemexes and overturns of the grounding plug in an upright plane, kN; F_{XZ} is the equal influencer of the friction forces acting on the field boards of the grounding plug, kN; P_{XZ} is gravity placed by the tractor on the ground plate plug, kN; N_x, N_z are the force of the reaction exerted by the soil on the base wheel of the grounding plug of the longitudinal and steep organizers, kN.

The operation of the grounding plug immersed to a specified depth must be fulfilled, and the condition for a smooth ride to the same depth [4-15]. Because in this case, the support wheel of the plug is constantly pressed against the field surface, and its uniform walking at the specified depth is ensured.

We determine the strength using the scheme presented in Figure 1. In the longitudinal-perpendicular plane, the equilibrium equation of the forces acting equal to the Plumb of the earthenware will be as follows:

$$\sum M_\pi = \left(m_n g \left(X_\pi + L_G \right) + R^n_{XZ} \left(X_\pi + e_n + \frac{n_\kappa - 1}{2} L_n + \frac{\rho^n_{XZ}}{\sin \psi^n_{XZ}} \right) \sin \psi^n_{XZ} - \right.$$

$$-R_{XZ}^{n}\left(H_1+Z_\pi-h_ч\right)\cos\psi_{XZ}^{n}-F_{XZ}\left(H_1+Z_\pi-0{,}5b_\partial\right)+$$
$$+R_{XZ}^{ч}\left(X_\pi+e_n-S_1+\frac{n_ч-1}{2}L_ч+\rho_{XZ}^{ч}ctg\alpha_ч\right)\sin\psi_{XZ}^{ч}-R_{XZ}^{ч}\left(H_1+Z_\pi-\rho_{XZ}^{ч}\right)\cos\psi_{XZ}^{ч}-$$
$$-N_Z\left(L_N+X_\pi\right)-N_X\left(H_1-h_ч-h_n-0{,}5d_T+Z_\pi\right)=0 \quad (1)$$

in this-free fall acceleration, m/ s2;
X_π, Z_π are lower suspensions of the grounding plug, respectively points D (D1) from its longitudinal-perpendicular plane instantaneous horizontal and steep distances up to the center of rotation (π), m; L_G is from the lower hanging points of the grounding plug, its horizontal distance to the center of gravity, m; e_n is from the lower hanging points of the grounding plug, its longitudinal distance to the tip of the first Corps lemekhi, m; $n_к$, $n_ч$ are housings mounted on a plug with a grounding device, respectively and the number of Earths, PCs; L_n, $L_ч$ are the housings of the grounding plug, respectively, and longitudinal distances between soil insulators, m; ρ_{XZ}^{n} is the middle (conditional middle) body of the earthy pollinator plug from the tip of the lemehi to the line of action of the force distance, m; ψ_{XZ}^{n} – R_{XZ}^{n} is the direction angle of force relative to horizontal; H_1 is the bottom from the base plane of the grounding plug the steep distance to the hanging points, m; h_n is driving depth of the earthing plug body, m; F_{XZ} is soil, which acts on the field boards of the vertical plug equal influencer of friction forces, kN; b_∂ is ground plate plug width of field boards, m; $R_{XZ}^{ч}$ is longitudinal-grounding plug in an upright plane equal influence of the forces acting on the ground forces creator, kN; $\rho_{XZ}^{ч}$ is the middle (conditional middle)of the earthenware plug impact of force from the tip of the scaffold on the ground distance to the line, m; $\alpha_ч$ is the angle of entry of earthworms into the soil; $\psi_{XZ}^{ч}$ – $R_{XZ}^{ч}$ is the direction angle of force relative to horizontal; L_N is plug the base wheel from the bottom hanging point longitudinal distance to the center of rotation, m; $h_ч$ is the working depth of the soil deepening plug, m; d_T is the diameter of the base wheel of the earthing plug, m.

$N_X=\mu N_Z$(in that μ is the Rolling coefficient of the machine base wheel [4]. We determine N_z from (1) taking into account that

$$N_Z\geq\left\{m_n g L_G+R_{XZ}^{n}\left(\left(e_n+\frac{n_к-1}{2}L_n+\frac{\rho_{XZ}^{n}}{\sin\psi_{XZ}^{n}}\right)\sin\psi_{XZ}^{n}-\left(H_1-h_ч\right)\cos\psi_{XZ}^{n}\right)-\right.$$
$$-F_X\left(H_1-0{,}5b_\partial\right)+R_{XZ}^{ч}\left(e_n-S_1+\frac{n_ч-1}{2}L_ч+\rho_{XZ}^{ч}ctg\alpha_ч\right)\sin\psi_{XZ}^{ч}-R_{XZ}^{ч}\left(H_1-\rho_{XZ}^{ч}\right)\cos\psi_{XZ}^{ч}+$$

$$+\left(m_n g + R_{XZ}^{n}\sin\psi_{XZ}^{n} + R_{XZ}^{ч}\sin\psi_{XZ}^{ч}\right)X_{\pi} - \left(R_{XZ}^{n}\cos\psi_{XZ}^{n} + F_X + R_{XZ}^{ч}\cos\psi_{XZ}^{ч}\right)Z_{\pi}\Bigg\}:$$

$$:\left[L_N + X_{\pi} + \mu\left(H_1 - h_ч - h_n - 0{,}5d_T + Z_{\pi}\right)\right]\cdot \qquad (2)$$

(2) we express the XN and Zn in the expression through the size and parameters of the tractor suspension mechanism and the earthing device. Previously performed studies [4-15] on

$$X_{\pi} = \frac{H_2\sqrt{L_m^2 - \left(H_3 + h - H_1\right)^2}\left[\sqrt{L_m^2 - \left(H_3 + h - H_1\right)^2} - X_B\right]}{\left(H_2 - Z_B\right)\sqrt{L_m^2 - \left(H_3 + h - H_1\right)^2} - \left(H_3 + h - H_1\right)X_B} \qquad (3)$$

And

$$Z_{\pi} = \frac{H_2\left(H_3 + h - H_1\right)\left[\sqrt{L_m^2 - \left(H_3 + h - H_1\right)^2} - X_B\right]}{\left(H_2 - Z_B\right)\sqrt{L_б^2 - \left(H_3 + h - H_1\right)^2} - \left(H_3 + h - H_1\right)X_B}, \qquad (4)$$

in this case, the length of the lower traction of the L_t – tractor, m; X_V, Z_V are tractor suspension mechanism bottom and central traction longitudinal and perpendicular between the fixed a(A1) and *D* hinges distances, *m*; N_3 is from the base plane of the tractor, its suspension mechanism is lower the excitable spheres of gravity are steep up to A(A1) distance, m; h is general processing of the ground plate plug depth, m.

(3) and 4) taking into account the (2) expression will have the following appearance

$$N_Z = \Bigg\{ m_n g L_G + R_{XZ}^{n}\left(\left(e_n + \frac{n_к - 1}{2}L_n + \frac{\rho_{XZ}^{n}}{\sin\psi_{XZ}^{n}}\right)\sin\psi_{XZ}^{n} - \left(H_1 - h_ч\right)\cos\psi_{XZ}^{n}\right) -$$

$$-F_X^{n}\left(H_1 - 0{,}5b_д\right) + R_{XZ}^{ч}\left(e_n - S_1 + \frac{n_ч - 1}{2}L_ч + \rho_{XZ}^{ч} ctg\alpha_ч\right)\sin\psi_{XZ}^{ч} - R_{XZ}^{ч}\left(H_1 - \rho_{XZ}^{ч}\right)\cos\psi_{XZ}^{ч} +$$

$$+\left(m_n g + R_{XZ}^{n}\sin\psi_{XZ}^{n} + R_{XZ}^{ч}\sin\psi_{XZ}^{ч}\right)\times$$

$$\times\frac{H_2\sqrt{L_m^2 - \left(H_3 + h - H_1\right)^2}\left[\sqrt{L_m^2 - \left(H_3 + h - H_1\right)^2} - X_B\right]}{\left(H_2 - Z_B\right)\sqrt{L_m^2 - \left(H_3 + h - H_1\right)^2} - \left(H_3 + h - H_1\right)X_B} -$$

$$-\left(R_{XZ}^{n}\cos\psi_{XZ}^{n} + F_X + R_{XZ}^{ч}\cos\psi_{XZ}^{ч}\right)\times$$

$$\frac{H_2\left(H_3 + h - H_1\right)\left[\sqrt{L_m^2 - \left(H_3 + h - H_1\right)^2} - X_B\right]}{\left(H_2 - Z_B\right)\sqrt{L_б^2 - \left(H_3 + h - H_1\right)^2} - \left(H_3 + h - H_1\right)X_B}\Bigg\}:$$

$$:\Bigg[L_N + \frac{H_2\sqrt{L_m^2 - \left(H_3 + h - H_1\right)^2}\left[\sqrt{L_m^2 - \left(H_3 + h - H_1\right)^2} - X_B\right]}{\left(H_2 - Z_B\right)\sqrt{L_m^2 - \left(H_3 + h - H_1\right)^2} - \left(H_3 + h - H_1\right)X_B} +$$

$$+\mu\left(H_1-h_ч-h_n-0,5d_T+\frac{H_2\left(H_3+h-H_1\right)\left[\sqrt{L_m^2-\left(H_3+h-H_1\right)^2}-X_B\right]}{\left(H_2-Z_B\right)\sqrt{L_б^2-\left(H_3+h-H_1\right)^2}-\left(H_3+h-H_1\right)X_B}\right)\Bigg]>0. \quad (5)$$

(5) as can be seen from the expression, the steep pressure force of the plug support wheel on the soil varies depending on its location (L_N) diameter (d_T) weight ($m_n g$), of the plug with a grounding device, the point at which it is placed (L_G), the forces acting on the plug with a grounding device (R_{XZ}^n F_X $R_{XZ}^ч$) their directions (ψ_{XZ}^n, $\psi_{XZ}^ч$) and laid points, the parameters (e_n, S_1, L_n, $L_ч$), size and parameters of the hanging facility and hanging mechanics of tractor (H_1, H_2, H_3, L_m, X_B, Z_B) the tillage depth of driving(h_n) and the depth of treating ($h_ч$). However, given that the dimensions and parameters of the tractor suspension mechanism, as well as the steep distance (H_2) between the lower and upper suspension points of the plug suspension device, have been standardized [8-20], the parameters and weight of the grounding device plug are accepted mainly because it can reliably and qualitatively perform the specified technological process, that is, the operation of the grounding plug by immersion to the specified depth and uniform walking at this depth is largely ensured by changing its steep distance from the base plane to the lower suspension points.

H_1 to determine the values of the above condition providing fulfillment (5) by expression $Q_z=f(h)$ it is required to build a graphic link.

m = 900 kg, g = 9,81 m/s^2, L_G = 1.62 m, R_{XZ}^n = 34.3 kN, $R_{xz}^ч$ = 5.1 kN, e_n = 0.62 m, $n_к$ = $n_ч$ = 3, L_n = $L_ч$ = 1.0 m, ρ_{XZ}^n = 0.15 m, ψ_{XZ}^n = 12°, $h_ч$ = 0.15 m, F_{XZ} = 5.59 kN, b_d = 0.2 m, S_1 = 1.05 m, $\rho_{XZ}^ч$ = 0.04 m, $\psi_{XZ}^ч$ = 20°, $\alpha_ч$ = 25°, h = 0.5 m, μ = 0.2; h_p = 0.35 m, d_T = 0.4 m and for wheeled driving tractors of 3-4 class N_2 = 0.9 m, N_3 = 0.6 m, L_t = 0.926 m, X_V = 0.3 m, Z_V = 0.56 m taken as in figure 2 $N_z=f(H_1)$ a graph of the connection was built.

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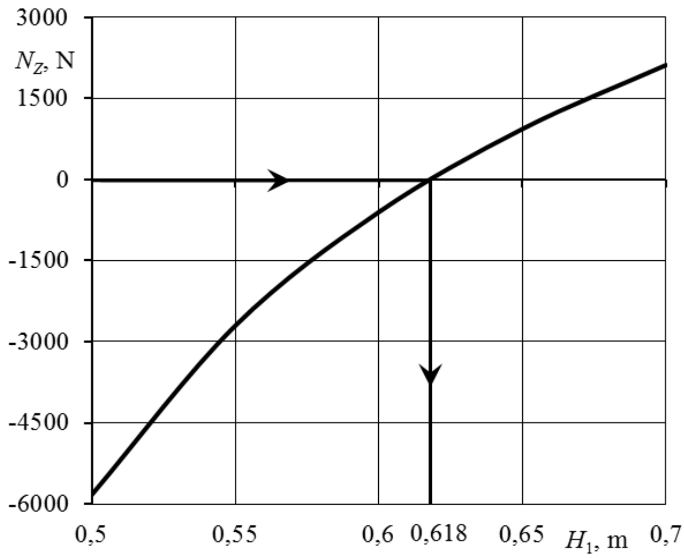

Fig. 2. Steeper organizer of the reaction force acting on the base wheel (N_Z), the perpendicular distance from the base plane of the grounding plug to the bottom tie point depends on the H_1 change graph

3 Conclusions

In conclusion, it was determined that to work immersed in the specified depth and walk evenly at this depth for a plug with an aggregated earthenware sprinkler with wheeled tractors of 3-4 class, the steep distance from the base plane to the lower suspension points should be at least 61.8 cm.

References

1. N.Murodov, U.Khasanov. Determination of resistance to gravity of working body with the pit softener installed in the two-layer plow during the main tillage, 2020 *IOP Conf.* Ser.: Mater. Sci. Eng. 883 012173, DOI 10.1088/1757-899X/883/1/012173.
2. U.I.Khasanov, R.Choriyev, A.A.Juraev, SH.M.Kayimov, and K.S. Sobirov "Determining the longitudinal of the distance from the soil-deepener mounted on the work-improved plug to the over turner behind it", Proc. SPIE 12296, International Conference on Remote Sensing of the Earth: Geoinformatics, Cartography, Ecology, and Agriculture (RSE 2022), 122960G (6 July 2022).
3. U.I.Khasanov, M.M.Makhmudova, A.A.Savriddinov, K.S.Sobirov, & SH.T.Safarov. (2022). The Results of the Study of the Compactions of the Bottom of the Furrow in Plowing by Plug Corpusies as well as Tractor Wheels. Texas Journal of Agriculture and Biological Sciences, 4, 62–67.
4. AB Babojanov, AK Dulliev, AR Turdibekov. Development of a seeder design for precise sowing of carrot seeds on a ridge, IOP Conference Series: Earth and Environmental Science. 1076 (2022) 012071.

5. A.Tuxtakuziev, U.I. Khasanov, M.Z. Ochilov. The results of experiments the width of the soil deeper like gougeand its impact on studying performance. ACADEMICIA: An International Multidisciplinary Research Journal, 2021.
6. Nusrat Murtazoyevich Murodov, Ulug Ibrohimovich Khasanov. Research analisys on the development of deep software plug structurem, 2020.
7. S Ostonov, M Ikramova, S Safarov. The value of a complex unit for the simultaneous use of a transverse surface and a longitudinal ridge when irrigating cotton , 2021.
8. Muradov N., Khasanov U. Determination of the tensile strength resistance of the working body with a deep softener installed on a two-layer plow during the main processing process / / mejdunarodnaya nauchnaya conference" stroitelstvo hydraulic vodn "resources" (Conmechydro), 23-25-aprelya Tashkent-2020. - P. 3-8.
9. Khasanov U. I., Savriddinov A. A., Sabirav K. S. the results of the experiment showed a deeper width of the soil, such as the angle of crushing, and its effect
10. on the study of activity/ / Journal of Applied Research doi RA:10.47191 / rajar / v7i10.07,size: 07 issue: 10 October 2021. - P. 2570-2573.
11. Tokhtakuziev A., Khasanov U. I., Ochilov M. Z. the results of the experiment are the breadth of a deeper soil like gouge and its impact on the study of performance // ACADEMICIA: International Journal of multidisciplinary research. ISSN:
12. 2249-7137, doi.org/10.5958/2249-7137.2021.01956.X.Vol.11 No. 9, September 2021. - P. 555-559.
13. A., Hasanov He Stalled.I. Energy-efficient construction improved soil-proof plug / / development of Science and technology. 2021. - B.18-22.(05.00.00; №24).
14. A., Hasanov He Stalled.I. Uzbekistan village and water farm. Special issue. 2021B. 47-48. (05.00.00; №8).
15. Muradov N., Khasanov U. determination of the tensile strength resistance of the working body with a deep softener installed on a two-layer plow during the main processing process / / "construction mechanics, hydraulics and water resource engineering" (conmechydro). - Membership fees, 2020. - P. 3-8.
16. Muradov N.M., Hasanov U.I., Ochilov M.Z. Scientific research on the construction of energyatejamkor plug / / Mejdunarodny nauchno-praktichesky magazine "globalnaya Nauka i Innovation 2020: Tsentralnaya Azia". - Kazakhstan, 2020. - B. 51-54.
17. Hasanov U.I., Ochilov M.Z. // Global Science and innovation 2021: international scientific and practical Journal of Central Asia. Kazakhstan, 2021. - B. 20-28.
18. Shodiyev Z, Shomurodov A, Rajabov O. The results of the experimental nature of the vibrations of the grid cotton cleaner. 2018/ 10.1088/1757-899X/883/1/012169.
19. Krutov A, Choriev R, Norkulov B, Shomurodov, A. Mathematical modelling of bottom deformations in the kinematic wave approximation. IOP Conference Series: Materials Science and Engineering (2021)/ 10.1088/1757-899X/1030/1/012147