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Movement of Fertilizer Pieces on the Braker Drum of a Device that Installes Organo-Mineral Fertilizer Compounds on a Single Way During Pillowing, Theoretical Study

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Annotation: The results of studies conducted on the theoretical study of the movement of fertilizer particles in the paddle drum of a device that provides local application of a mixture of organo-mineral fertilizers to the soil layer where plant roots develop during ridge formation are presented. According to the results of the conducted studies, at a blade length of 6 cm, the fertilizer transfer time was 0.135 seconds, and the transfer rate was 0.885 m/s.

Keywords: organo-mineral fertilizer mixture, fertilizer apparatus, bladed drum, centrifugal inertial force, Coriolis force, normal force, friction force.

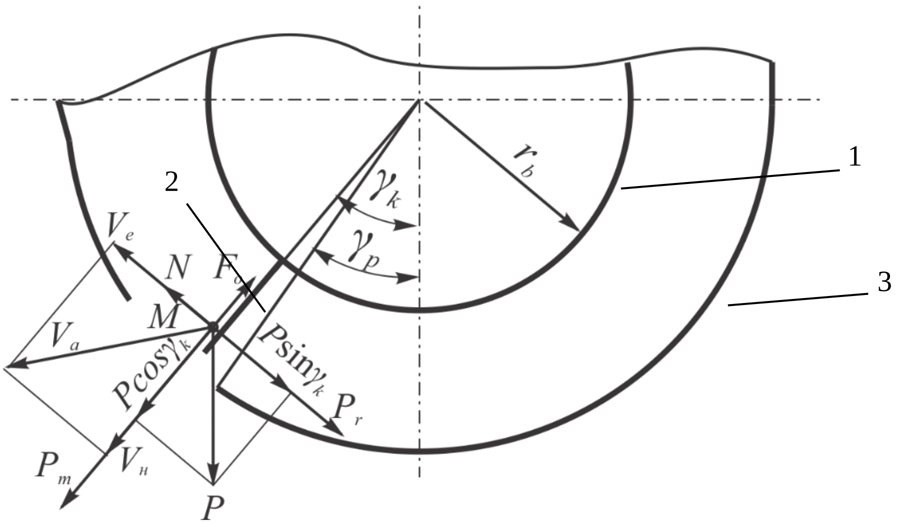
In order to increase soil fertility, the application of organic fertilizers is of great importance. Because they contain many trace elements such as nitrogen, phosphorus, and potassium [1, 2].

However, if the scattered organic fertilizer remains on the surface for several days, the carbon and nitrogen in its composition are released into the air, and its effectiveness, that is, the beneficial properties of organic fertilizer, decrease. In addition, existing manure spreading machines and devices cannot evenly distribute manure on the field surface. Their manure spreading unevenness exceeds 25% and does not meet agrotechnical requirements [1, 2].

As mentioned above, research on the mechanization of the combination of organic and mineral fertilizers, as well as the removal of soil layers, the supply of plant roots, and the evolution of plant structures into local production, was conducted by scientists at the Agricultural Research Institute and the Andijan Agrotechnological Furrow [3].

In this article, the results of a survey conducted on the movement of the fertilizer particle blade in the device drum are theoretically investigated through citations.

The amount of fertilizer required for the application of organic fertilizers should be removed from the apparatus window. For this, you will need to choose the size of the window. Production of fertilizer is carried out by removing its batch from use on the drums of the patch window apparatus. In this case, we will mainly consider the movement of the fertilizer blade (Fig. 1).



1-drum; 2 - shovel; Case 3

Figure 1. Sections of forces acting on the fertilizer application scheme

On the working surface of the fertilizer blade M, the following fragment forces act:

$P=mg$ – weight power;

$P_m = m\omega^2(r_b+\xi)$ – The drums rotating around their center-generated axis turn away from the inertia force;

$P_r = 2m\omega\xi'$ – The drum, formed by rotating the angle with Coriolis force along the blade, relative and fertilizer ($\xi' = V_и$);

$N = mg\sin\gamma_k + 2m\omega\xi'$ – shovel fertilizer for dismantling the working surface by influencing the standard strength;

$F_0 = f\ N = f\left[mg\sin\gamma_k + 2m\omega\xi'\right]$ – friction power;

thus, m – the mass of the pieces of the fertilizer;

g – free fall is tezlanish;

ω – shovel angular speed of the drums;

ξ – to move to a distance of shovel fertilizer;

ξ' – to move the fertilizer shovel speed (relative speed);

f – coefficient of friction of the fertilizer blade against the working surface.

Thus, mainly, as can be seen from the wheel, the support-motor drums are shovels.

$$\omega = \frac{V_a z_1}{D_m z_2}, \quad (1)$$

thus, z_1, z_2 – , accordingly, the drums of the support-motor blade located on the roller sprocket depend on the number of teeth on the wheel.

Taking into account the relative mobility of the particle, the effect established in the fertilizer will be in the form of the following differential equation.

$$\xi'' = (r_b + \xi)\omega^2 + g\cos\gamma_k - fg\sin\gamma_k - 2f\omega\xi'. \quad (2)$$

$\gamma_k = \gamma_p + \omega t$ (it γ_p – apparatus window located at the bottom point of the housing relative to fertilizer production) and we write expression (2) as follows.

$$\xi'' + 2f\omega\xi' - \xi\omega^2 = g(\cos\gamma_p - f\sin\gamma_p)\cos\omega t -$$

$$-g(\sin\gamma_p + f\cos\gamma_p)\sin\omega t + r_b\omega^2 \quad (3)$$

This expression is a differential equation the second permanent coefficient unisexual orderly.

(3) the left side of the equation consists of the following distant characteristic equation:

$$\lambda^2 + 2f\omega\lambda - \omega^2 = 0. \quad (4)$$

Also $\lambda_1 = \omega\left(-f + \sqrt{1+f^2}\right)$,

$$\lambda_2 = \omega\left(f + \sqrt{1+f^2}\right)$$

stems from the fact that.

(3) the solutions of the left side of the expression follows [5]

$$\xi_1 = C_1 e^{\lambda_1 t} + C_2 e^{\lambda_2 t},$$

thus, C_1, S_2 – integrated constant.

(3) we can write the solutions of the equation in the following special form.

$$\xi_2 = A(\cos\gamma_p - f\sin\gamma_p)\cos\omega t - B(\sin\gamma_p + f\cos\gamma_p)\sin\omega t + D, \quad (5)$$

thus, A, B , and D – unknown koeffisientlar.

A, B , and D to determine coefficients ξ_2 we can Derivative twice

$$\xi' = -A\omega(\cos\gamma_p - f\sin\gamma_p)\sin\omega t - B\omega(\sin\gamma_p + f\cos\gamma_p)\cos\omega t \quad (6)$$

and

$$\xi'' = -A\omega^2(\cos\gamma_p - f\sin\gamma_p)\cos\omega t + B\omega^2(\sin\gamma_p - f\cos\gamma_p)\sin\omega t. \quad (7)$$

(5), (6) and (7) of the expression (3) to put expression, here you're going to have

$$-A\omega^2(\cos\gamma_p - f\sin\gamma_p)\cos\omega t + B\omega^2(\sin\gamma_p + f\cos\gamma_p)\sin\omega t -$$

$$-2Af\omega^2(\cos\gamma_p - f\sin\gamma_p)\sin\omega t - 2Bf\omega^2(\sin\gamma_p + f\cos\gamma_p)\cos\omega t -$$

$$-A\omega^2(\cos\gamma_p - f\sin\gamma_p)\cos\omega t + B\omega^2(\sin\gamma_p + f\cos\gamma_p)\sin\omega t - D\omega^2 =$$

$$= g\cos\omega t(\cos\gamma_p - f\sin\gamma_p) - g\sin\omega t(\sin\gamma_p + f\cos\gamma_p) + r_b\omega^2 . \quad (8)$$

To construct two numbers on each side of this equality, it is necessary that *coswt* and t s be equal to each other, respectively, in front of the coefficients. These A, B, and D s allow us to define the following expression:

$$-A\omega^2\cos\omega t\left(\cos\gamma_p - f\sin\gamma_p\right) + 2Bf\omega^2\cos\omega t\left(\sin\gamma_p + f\cos\gamma_p\right) -$$

$$-A\omega^2\cos\omega t\left(\cos\gamma_p - f\sin\gamma_p\right) = g\cos\omega t\left(\cos\gamma_p - f\sin\gamma_p\right),$$

$$B\omega^2\sin\omega t\left(\sin\gamma_p + f\cos\gamma_p\right) - 2Af\omega^2\sin\omega t\left(\cos\gamma_p - f\sin\gamma_p\right) +$$

$$+B\omega^2\sin\omega t\left(\sin\gamma_p + f\cos\gamma_p\right) = -g\sin\omega t\left(\sin\gamma_p + f\cos\gamma_p\right),$$

$$-D\omega^2 = r_b\omega^2$$

From these

$$A = \frac{g\left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(f\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega^2\left(\cos\gamma_p - f\sin\gamma_p\right)\left(1+f^2\right)},$$

$$B = \frac{fg\left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega^2\left(\sin\gamma_p + f\cos\gamma_p\right)\left(1+f^2\right)} - \frac{g}{2\omega^2}$$

and

$$D = -r_b$$

stems from the fact that.

A, *B* and *D* are above the value of (2.12), we have to put (2.10) of the solutions of the following equation will have private appearance

$$\xi_2 = \frac{g\left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(f\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega^2\left(1+f^2\right)}\cos\omega t -$$

$$-\frac{fg\left[f\left(\sin\gamma_p+f\cos\gamma_p\right)-\left(\cos\gamma_p-f\sin\gamma_p\right)\right]\sin\omega t}{2\omega^2\left(1+f^2\right)}+$$

$$+\frac{g\left(\sin\gamma_p+f\cos\gamma_p\right)\left(1+f^2\right)\sin\omega t}{2\omega^2\left(1+f^2\right)}-r_b \quad (9)$$

Therefore (2.10) the general solution of the equation will have the following appearance

$$\xi=\xi_1+\xi_2=C_1e^{\lambda_1 t}+C_2e^{\lambda_2 t}+$$

$$+\frac{g\left[f\left(\sin\gamma_p+f\cos\gamma_p\right)-\left(f\cos\gamma_p-f\sin\gamma_p\right)\right]}{2\omega^2\left(1+f^2\right)}\cos\omega t-$$

$$-\frac{fg\left[f\left(\sin\gamma_p+f\cos\gamma_p\right)-\left(\cos\gamma_p-f\sin\gamma_p\right)\right]\sin\omega t}{2\omega^2\left(1+f^2\right)}+$$

$$+\frac{g\left(\sin\gamma_p+f\cos\gamma_p\right)\left(1+f^2\right)\sin\omega t}{2\omega^2\left(1+f^2\right)}-r_b \quad . (10)$$

The expression of S_1 and S_2 to determine the integrated constant ξ from t we can derivative

$$\xi'=C_1\lambda_1e^{\lambda_1 t}+C_2\lambda_2e^{\lambda_2 t}-$$

$$-\frac{g\left[f\left(\sin\gamma_p+f\cos\gamma_p\right)-\left(f\cos\gamma_p-f\sin\gamma_p\right)\right]}{2\omega\left(1+f^2\right)}\sin\omega t-$$

$$-\frac{fg\left[f\left(\sin\gamma_p+f\cos\gamma_p\right)-\left(\cos\gamma_p-f\sin\gamma_p\right)\right]}{2\omega\left(1+f^2\right)}\cos\omega t+$$

$$+\frac{g\left(\sin\gamma_p+f\cos\gamma_p\right)\left(1+f^2\right)}{2\omega\left(1+f^2\right)}\cos\omega t \quad (11)$$

(10) and (11) the expression of the constant integrated from S_1 and S_2 to $t = 0$ when$\xi = \xi' = 0$ will largely determine the condition. Mainly in terms of quotes (10) and (11) appearance comes in the following equation

$$\begin{cases} C_1 + C_2 + \dfrac{g\left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(f\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega^2\left(1+f^2\right)} = 0 \\ C_1\lambda_1 + C_2\lambda_2 + \dfrac{fg\left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega\left(1+f^2\right)} - \\ \qquad -\dfrac{g\left(\sin\gamma_p + f\cos\gamma_p\right)\left(1+f^2\right)}{2\omega\left(1+f^2\right)} = 0 \end{cases} \quad (12)$$

This system of equations from S_1 and S_2 we will identify s

$$C_1 = r_0 - \left\{ \frac{\lambda_1 g\left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(f\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega^2\left(1+f^2\right)} + \right.$$

$$+\frac{fg\left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega^2\left(1+f^2\right)} -$$

$$\left. -\frac{g\left(\sin\gamma_p + f\cos\gamma_p\right)\left(1+f^2\right)}{2\omega^2\left(1+f^2\right)} - r_0\lambda_1 \right\} :$$

$$:\left(\lambda_2 - \lambda_1\right) - \frac{g\left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega^2\left(1+f^2\right)} \quad (13)$$

and

$$C_2 = \left\{ \frac{\lambda_1 g\left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(f\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega^2\left(1+f^2\right)} + \right.$$

$$+\frac{fg\left[f\,\mathrm{s}\left(\mathrm{in}\,\gamma_p + f\cos\gamma_p\right) - \left(\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega^2\left(1+f^2\right)} -$$

$$\left. +\frac{g\left(\sin\gamma_p + f\cos\gamma_p\right)\left(1+f^2\right)}{2\omega^2\left(1+f^2\right)} - r_0\lambda_1 \right\} : \left(\lambda_2 - \lambda_1\right). \quad (14)$$

S_1 and S_2 s this value (10) and (11) the expression to put fertilizer in the distance and the speed will determine to move shovel

$$\xi = L_{\kappa} = \Bigg\{ r_b - \Bigg\{ \frac{\lambda_1 g\left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(f\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega^2\left(1+f^2\right)} +$$

$$+ \frac{fg\left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega^2\left(1+f^2\right)} -$$

$$- \frac{g\left(\sin\gamma_p + f\cos\gamma_p\right)\left(1+f^2\right)}{2\omega^2\left(1+f^2\right)} - r_b\lambda_1 \Bigg\} : \left(\lambda_2 - \lambda_1\right) -$$

$$- \frac{g\left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega^2\left(1+f^2\right)} \Bigg\} e^{\lambda_1 t} +$$

$$+ \Bigg[\Bigg\{ \frac{\lambda_1 g\left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(f\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega^2\left(1+f^2\right)} +$$

$$+ \frac{fg\left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega^2\left(1+f^2\right)} -$$

$$- \frac{g\left(\sin\gamma_p + f\cos\gamma_p\right)\left(1+f^2\right)}{2\omega^2\left(1+f^2\right)} - r_b\lambda_1 \Bigg\} : \left(\lambda_2 - \lambda_1\right) \Bigg] e^{\lambda_2 t} +$$

$$+ \frac{g\left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(f\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega^2\left(1+f^2\right)} \cos\omega t -$$

$$- \frac{fg\left[f\left(\sin\gamma_p + f\cos\gamma_0\right) - \left(\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega^2\left(1+f^2\right)} \sin\omega t +$$

$$+ \frac{fg\left(\sin\gamma_p + f\cos\gamma_p\right)\left(1+f^2\right)}{2\omega^2\left(1+f^2\right)} \sin\omega t - r_b \qquad (15)$$

and

$$\xi' = V_{н} = \left\{ r_b - \left\{ \frac{\lambda_1 g \left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(f\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega^2\left(1+f^2\right)} + \right.\right.$$

$$+ \frac{fg\left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(\cos\gamma_0 - f\sin\gamma_p\right)\right]}{2\omega^2\left(1+f^2\right)} -$$

$$\left. - \frac{g\left(\sin\gamma_p + f\cos\gamma_p\right)\left(1+f^2\right)}{2\omega^2\left(1+f^2\right)} - r_b\lambda_1 \right\} : \left(\lambda_2 - \lambda_1\right) -$$

$$\left. - \frac{g\left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega^2\left(1+f^2\right)} \right\} \lambda_1 e^{\lambda_1 t} +$$

$$+ \left[\left\{ \frac{\lambda_1 g \left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(f\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega^2\left(1+f^2\right)} + \right.\right.$$

$$+ \frac{fg\left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega^2\left(1+f^2\right)} -$$

$$\left.\left. - \frac{g\left(\sin\gamma_p + f\cos\gamma_p\right)\left(1+f^2\right)}{2\omega^2\left(1+f^2\right)} - r_0\lambda_1 \right\} : \left(\lambda_2 - \lambda_1\right) \right] \lambda_2 e^{\lambda_2 t} -$$

$$- \frac{g\left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(f\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega\left(1+f^2\right)} \sin\omega t -$$

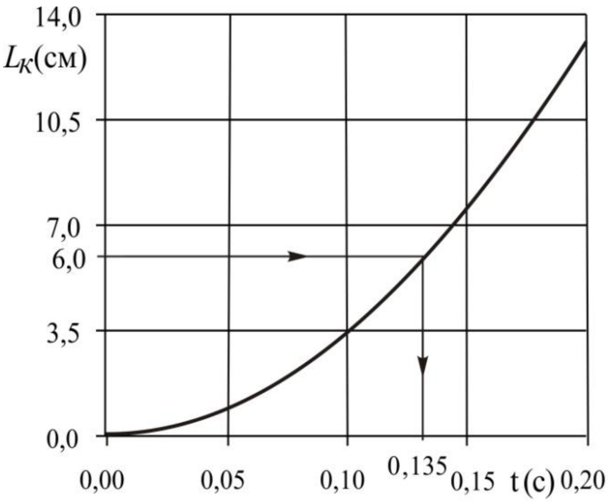
$$- \frac{fg\left[f\left(\sin\gamma_p + f\cos\gamma_p\right) - \left(\cos\gamma_p - f\sin\gamma_p\right)\right]}{2\omega\left(1+f^2\right)} \cos\omega t +$$

$$+ \frac{g\left(\sin\gamma_p + f\cos\gamma_p\right)\left(1+f^2\right)}{2\omega\left(1+f^2\right)} \cos\omega t. \quad (16)$$

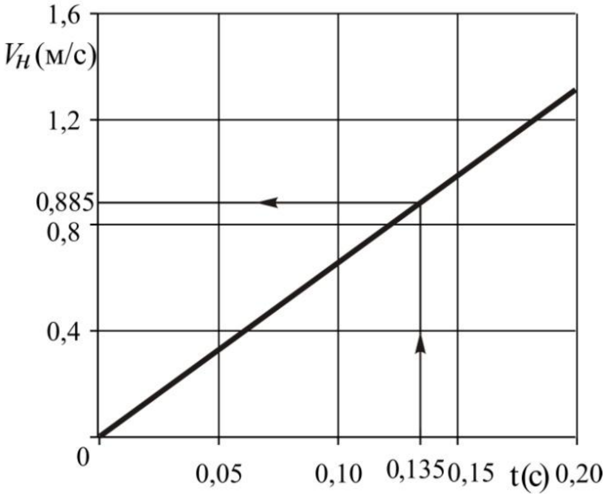
(2) the expression given in (15) and (16) as seen from the analysis of the expression, the fertilizer of fertilizer to put the pieces of the apparatus of the drum shovel to move along the surface of the

working distance and speed units speed (V_a), gear chain transmission, due to number (z_1/z_2), drums refuse r_b, the friction of the working surface to the fertilizer kurakcha koeffitsenti f and erect the installation of window angle than the production of fertilizer γ_p is connected.

The speed of work units V_a = 1,8 m/s, the number of the gear chain star z_1 = 20, z_2=15, the diameter of the wheel musculoskeletal D_t = 0,64 m accepted, (15) and (16) on the expression*of* l_k and V_n s t depends on the construction of the graph is to change on the basis of (2-picture).



a)



b)

2-picture. Shovel to move fertilizer in the distance (*a*) speed and (*b*) related to the time chart

Fertilizer shovel parabola with qonuniyat be moved in and moved out to speed on a straight line while you are growing. According to this chart allows you to determine the distance and speed of the move fertilizer. Constructive shovel the size (length) according to the time and speed to move out of it that will determine fertilizer. Thus, when the length of 6 cm kurakcha 0,135 second time to move (2,*a*-picture), moved to 0,885 speed m/s (2,*b*-picture) is far came out.

USED LITERATURE

1. Xodjiev A., Xaydarova Sh.Z. The inter-row cotton organoid-mineral fertilizer fertilizer conducting the basis of the parameters of the local governing soshnik bo'g'iz // Agro-science, №2(65), 2020. – B. 99.
2. The effective use of different types of organic fertilizer Niyazaliev i. b. factors. – Tashkent: UzPITI, 2009. – B. 246-250.

3. To'xtaqo'ziev A., m. m. khalilov, h. b. Samsaqova Pushta getting organoid-the combination of mineral fertilizers that held the machine // the problem of raising the level of technical innovation and the use of technology in agriculture and the solution of: the republic scientific-practical conference on materials. – Tashkent, ToshDAU, 2024.
4. P. m. vasilenko any theory dvijeniya chastisi po sheroxovatim poverxnostyam selskoxozyaystvennix car. – Kiev: UASXM, 1960. – 283 s.
5. Xadjiev h. a., A. tukovisevayutshix zadelivayutshix organov i apparatov rabochix udobriteley Dadaxodjaev Utochnit parameters. Nauchno-tex. Sai Otchet. – Yangiyul, 1979. – S. 84-120.