INVESTIGATION OF THE UNIFORMITY OF THE COURSE OF THE UNIVERSAL SOWER COULTERS IN THE DEPTH OF SOWING

Jahongirov Abdurashit*

*Samarkand Institute of Veterinary Medicine,
Samarkand, UZBEKISTAN
Email id: abdurashit52@mail.ru

DOI: 10.5958/2249-7137.2022.00098.2

ABSTRACT

The article presents the results of theoretical studies on the study of the uniformity of the coulter stroke of a universal seeder designed for wheat grain seeds on the opening area and row spacing of cotton in the depth of sowing and it is noted that for given working conditions and known parameters of the coulter, the uniformity of the depth of sowing at the required level is ensured by the correct choice of the moment of inertia of the coulter relative to the point of attachment to the frame, and consequently its mass and thrust length.

KEYWORDS: *Universal Seeder, Coulter, Sowing Depth And Its Uniformity, Moment Of Inertia, Mass, Traction Length.*

INTRODUCTION

From our side, we have developed a shallow seeder, which sows seeds both in open areas and between the rows of buds, and in this article it is investigated the issue of ensuring a smooth March of the sower on the depth of planting. Because if this indicator is at the required level the seeds are planted to the same depth, and the development and ripening of the plant is ensured to be uniform, the yield will increase.

Results of the study. Due to the unevenness on the field surface and between the rows of buds, as well as the variability of the physico-mechanical properties of the soil, during the movement of the sower, the vertical N_z and horizontal N_x forces acting on it by the soil (look at the picture) are constantly changing. Therefore sower in the process of work will V be in vibration motion in relation to the O_1 to ball joint in the longitudinal-upright plane in addition to the act of fastening. This naturally leads to a change in the planting depth of the seeds.

In itself, it is clear that in order for the seeds to be planted to a uniform depth, the amplitude of the oscillations of the sower in the longitudinal plane should be as small as possible. In order to determine that what factors can be satisfied with this demand, we draw up the differential equation of the oscillatory motion of the sower in the longitudinal-perpendicular plane. For this:

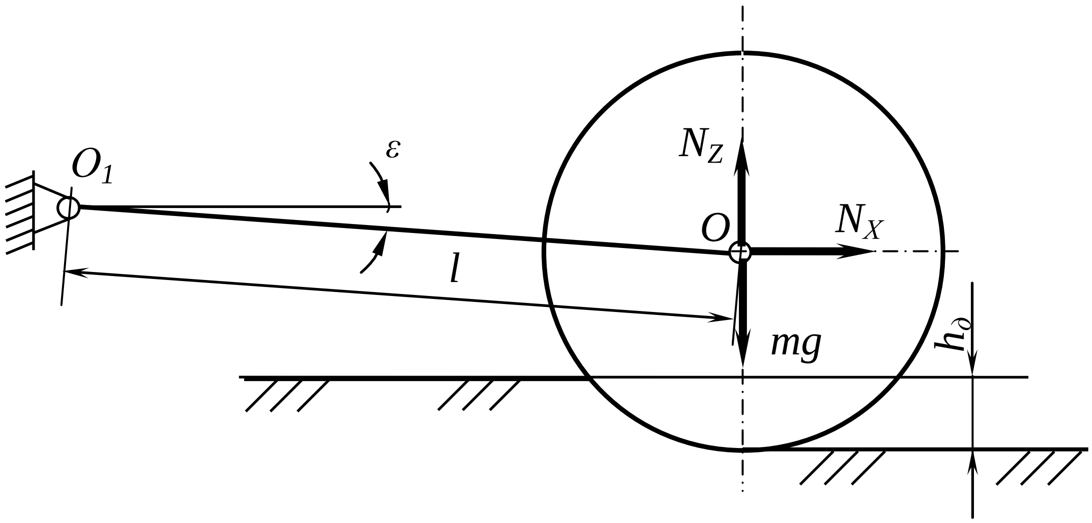
- universal seeder moves straight line with constant speed;

- O_1 the friction in the sharper is low and does not affect the vibrations of the sower;

- the vibrations of the frame of seeder do not affect the vibrations of the sower;

- the equilibrium position of the sower in the working process is horizontal, its deviation from this position is a small angle.

By taking the angle of deviation y from the horizontal position of the sower tortoise as a generalized coordinate and using the differential equation of the rotational motion of the rigid body around the fixed axis **[1, 2],** we obtain the following expression:



1-sower; 2-tow

The oscillation motion of the sower in the longitudinal-perpendicular plane scheme for the study

$$J\frac{d^2\varepsilon}{dt^2} = (mg - N_z)l\cos\varepsilon - l\sin\varepsilon, \qquad (1)$$

where *J* – is the moment of inertia of the impeller and the ball joint with sower to the tow O_1, kg·m^2;

m – the mass of the sower, kg;

g – free fall acceleration, m/s^2;

l – the length of the tow, m.

ε Since the angle is small, considering *sinε=ε*, *cosε=1*, we bring Equation (1) to the following form

$$J\frac{d^2\varepsilon}{dt^2} = mgl - N_x l\varepsilon. \qquad (2)$$

We assume that the vertical reaction force N_z acting on the sower is the sum of the elastic force $R_э$, the viscosity force $R_к$ and the variable N_z forces depending on the unevenness between the ro ws of cotton and the physical and mechanical properties of the soil **[3]**, that is

$$N_z = R_э + R_к + R_y. \quad (3)$$

With this in mind, expression (2) takes the following form

$$J\frac{d^2}{dt^2} = (mgR_э + R_к + R_y)l - N_x l\varepsilon. \quad (4)$$

In the case of static equilibrium of the sower, the following equations are valid [3]

$$R_э = h_∂ C; \quad (5)$$

$$R_к = 0; \quad (6)$$

$$R_y = 0, \quad (7)$$

where $h_∂$ – the depth at which the planter sinks into the ground, m;

C – the virginity of the soil, N/m.

When the cultivator tilts from the equilibrium position to angle ε [3]

$$R_э = (h_∂ + l\varepsilon)C; \quad (8)$$

$$R_к = bl\frac{d\varepsilon}{dt}; \quad (9)$$

$$R_y = -\Delta R_z(t), \quad (10)$$

where b – soil resistance coefficient, N·s/m;

$\Delta R_z(t)$ – a driving force that changes over time, N.

(4) to $R_э$, $R_к$, and R_y this (5)-(10) Pouring the values on the expressions we get the following

$$J\frac{d^2\varepsilon}{dt^2} = \left[mg - (h_∂ + l\varepsilon)\ C - bl\frac{d\varepsilon}{dt} + \Delta R_z(t)\right]l - N_x l\varepsilon. \quad (11)$$

When the injector is in static equilibrium position

$$mgl - h_∂ Cl = 0. \quad (12)$$

Given this expression, we write expression (11) as follows

$$J\frac{d^2\varepsilon}{dt^2}=\Delta R_z(t)l-Cl^2\varepsilon-bl^2\frac{d\varepsilon}{dt}-N_x l\varepsilon \qquad (13)$$

or

$$J\frac{d^2\varepsilon}{dt^2}+bl^2\frac{d\varepsilon}{dt}+\left(N_x+Cl\right)l\varepsilon=\Delta R_z\left(t\right)l. \qquad (14)$$

This equation represents the parametric oscillations with respect to ε because the force N_x is variable **[4].** However, due to the large damping properties of the soil, the cultivator is in a state of forced oscillation during operation, mainly under the influence of the excitatory force $\Delta R_z(t)$. Therefore, considering that the force N_x does not change and its mean value is equal to $N_{ўр}$, we consider the forced oscillations of the sower under the influence of the driving force $\Delta R_z\left(t\right)$. In this case, we assume that the force varies according to the following law $\Delta R_z\left(t\right)$

$$\Delta R_z\left(t\right)=\Delta R\sin\omega_\kappa t, \qquad (15)$$

where ΔR – amplitude of the driving force;

ω_κ – the rotational frequency of the driving force.

Considering (15), expression (14) looks like this

$$J\frac{d^2\varepsilon}{dt^2}+bl^2\frac{d\varepsilon}{dt}+(N_{ўр}+Cl)l\varepsilon=\Delta Rl\sin\omega_\kappa t \qquad (16)$$

or

$$\frac{d^2\varepsilon}{dt^2}+2n\frac{d\varepsilon}{dt}+k^2\varepsilon=G\sin\omega_\kappa t, \qquad (17)$$

In this

$$n=\frac{bl^2}{2J};\quad k=\sqrt{\frac{(N_{ўр}+Cl)l}{J}}\quad \text{ва}\quad G=\frac{\Delta Rl}{J}.$$

The solution of equation (17) representing the forced oscillations of the sower is written as follows [1,4]

$$\varepsilon\left(t\right)=\frac{G}{\sqrt{(k^2-\omega_a^2)^2+4n^2\omega_\kappa^2}}\sin\left(\omega_\kappa t-\delta\right) \qquad (18)$$

or given the accepted designations

$$\varepsilon(t)=\frac{\Delta Rl\sin(\omega_{\kappa}t-\delta)}{\sqrt{\left[(N_{\breve{y}p}+Cl)l-J\omega_{\kappa}^{2}\right]^{2}+(bl^{2})^{2}\omega_{\kappa}^{2}}}, \qquad (19)$$

in this

$$\delta=arctg\frac{bl^{2}\omega_{a}}{(N_{\breve{y}p}+Cl)l-J\omega_{\kappa}^{2}}.$$

The maximum deflection angle from the equilibrium position of the cultivator

$$\varepsilon_{\max}=\frac{\Delta Rl}{\sqrt{\left[(N_{\breve{y}p}+Cl)l-J\omega_{\kappa}^{2}\right]^{2}+(bl^{2})^{2}\omega_{\kappa}^{2}}}. \qquad (22)$$

As can be seen from expressions (19) and (20), the quality of work of the cultivator, that is a smooth stroke along the sowing depth, depends on its moment of inertia, traction length, pressure spring stiffness, amplitude of driving force and physical and mechanical properties of the soil. Certain parameters, a straight run along that its planting depth is ensured mainly due to the correct selection of the moment of inertia of the relatively to its connection point to the frame and hence its mass and traction length.

CONCLUSIONS

A smooth run of the developed seed drill along the planting depth is ensured by the correct choice of its moment of inertia relative to the point of attachment to the frame and, consequently, the length of the mass and traction.

REFERENCES

1. Butenin NV, Lunts YaL, Merkin DR. Course of theoretical mechanics. Dynamics. 3rd ed., Vol. 2, Rev. Moscow: Science; 1985. 496 p.
2. Tukhtakuziev A, Mansurov M, Karimova D. Scientific and technical solutions to ensure the stability of the working depth of tillage machines attached to the frame of the working bodies. Tashkent; 2019. 84 p.
3. Ibragimov A. Investigation of the angular oscillations of the seed drill for sowing small seed crops. Problems of mechanics. Tashkent, 2009;(5-6):105-108.
4. Panovko YaG. Introduction to the theory of mechanical oscillations. Moscow: Science, 1980. 272p.