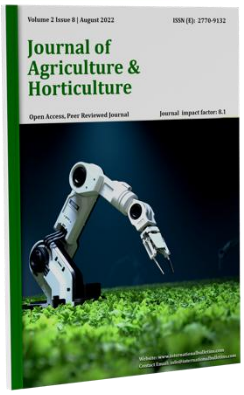

KINEMATICS OF THE ROLLER CULTIVATOR

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Abstract. This article highlights the theoretical and practical aspects of optimizing the process of sowing cotton seeds (cottonseed) using seeders. The equation of motion of the considered point of the roller cultivator in the XOZ coordinate system was calculated according to the scheme of complex motion of the roller cultivator during operation and its translational and rotation around its axis together with the seeder.

Keywords: sowing seeder, complex movement, roller cultivators, absolute elocity of a point, sliding rolling.

Introduction. Among the complex technological processes performed in the cotton growing process, pre-sowing soil cultivation, processes aimed at uniform distribution of sown seeds and guaranteed sowing to a specified depth, occupy a special place. Providing them at the level of agrotechnical requirements and quality will allow for further increasing cotton yields and improving overall economic indicators.The soil composition of all cultivated regions of Uzbekistan is also not uniform. Especially in the soils of Zone III, where cotton is grown, several types of agrotechnical measures are carried out before sowing seeds. The most important thing is the proper preparation of the soil for sowing cotton, which requires advanced and resource-saving equipment and technologies.

Problem statement. In the conditions of the Bukhara region, one of the solutions to the above-mentioned problems is the development of a seeder with an improved technological process of working, equipped with roller-type cultivators, for strip cultivation of the soil of the cotton sowing zone at a specified depth and width (Fig. 1), theoretical studies have been conducted to substantiate the parameters and operating modes of a seeder with an improved technological process of working, equipped with roller-type cultivators, and its optimal parameters have been calculated. Among the scientific innovations of the research, the development of a design diagram of a seeder and the substantiation of its technological process are also taken into account.

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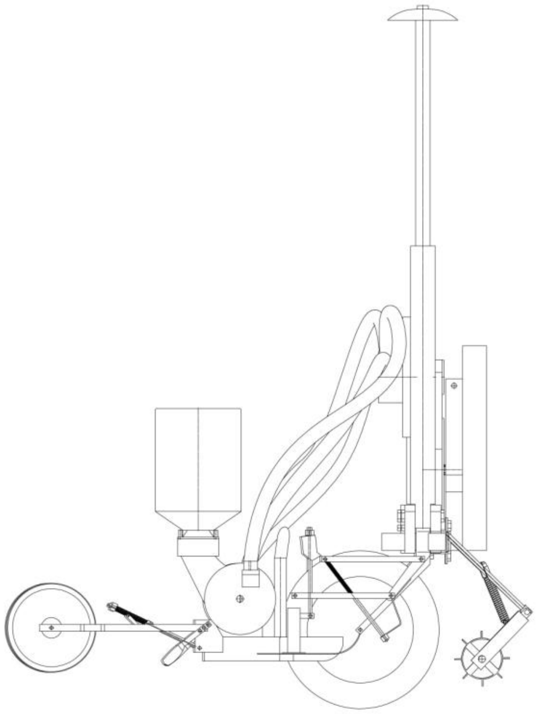

Figure 1. Improved cotton seeder

The technological process of operation of the improved seed drill proceeds as follows: when the seed drill moves forward with the tractor, the roller-type cultivators loosen the zones of movement of the seeding and burial sections of the seed drill and crush the clods present in them. The sowing and burial sections sow and bury cotton seeds at a specified depth in these loosened and crushed zones. In this case, the roller-shaped cultivator (Fig. 2) creates favorable conditions for high-quality sowing of cotton seeds at the required level and the emergence of seedlings. Several parameters of the improved seed drill have been adopted, the main parameters of which relate to the roller mechanism, which crushes soil fractions. The cultivators of the spool are pivotally connected to the front beam of the seed drill frame by means of rods equipped with pressure springs with rigidly mounted columns, and the sowing and burial sections are hinged to the front and rear beams of the seed drill frame, respectively, by means of parallelogram mechanisms and means. The roller cultivator, the sowing section, and the burial section are installed in a row on the frame. The roller cultivator is made in the form of a plank roller. The seeding section of the seeder with a seeding and sowing apparatus. The burial section is equipped with gates and a sealing roller.

Before calculating the remaining parameters of the roller cultivator, it is necessary to determine its kinematics. During operation, the roller cultivator performs complex movements: translational with the seeder and rotational around its axis, according to the scheme shown in Fig. 3, the equation of motion of the working point of the roller cultivator in the XOZ coordinate system has the following form [1; 7-11-b.]

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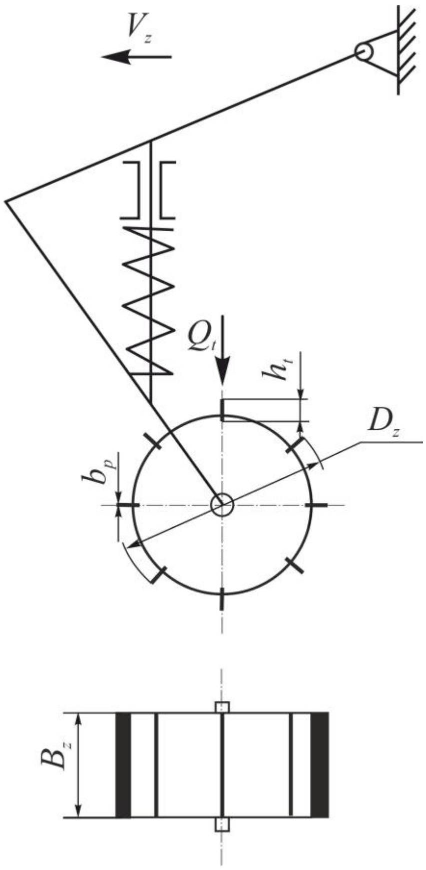

Fig. 2. Roller mechanism.

$$X_i = V_z t + R_i \cos \omega t \quad (1)$$

and

$$Z_i = -R_i \sin \omega t \quad (2)$$

where Xi, Zi - roller-type ripper
coordinates, m;
Ri - radius of the considered point i, m;
t - time, s;
ω - radius of the roller cultivator, m;
ωt - clock relative to the OX axis of the roller cultivator angle of rotation along the arrow, °.

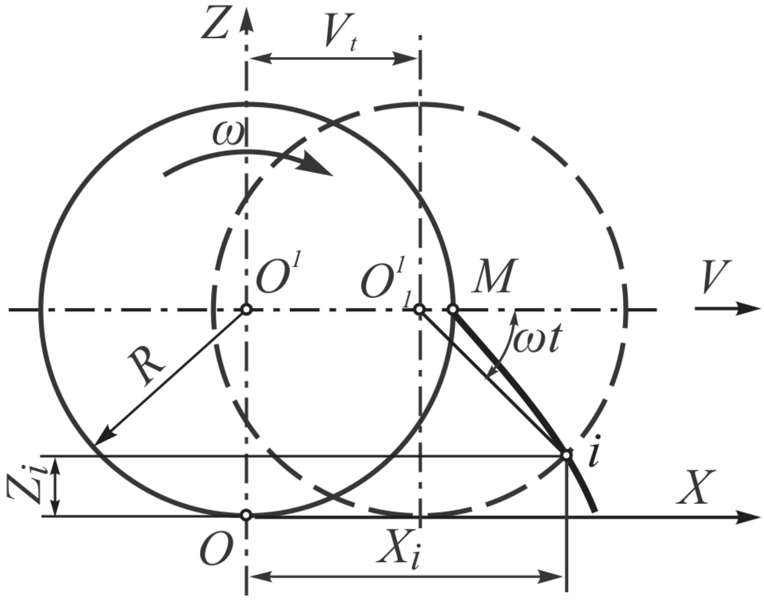

Figure 3. Diagram for the study of the movement of a roller cultivator

Absolute velocity of the point in question

$$V_{ia} = \sqrt{\left(\frac{dX_i}{dt}\right)^2 + \left(\frac{dZ_i}{dt}\right)^2} =$$

$$= \sqrt{\left(V_n - R_i\,\omega \sin \omega t\right)^2 + \left(-R_i\,\omega_i\,\cos \omega t\right)^2} =$$

$$= \sqrt{V_z^2 - 2V_z\,R_i\,\omega \sin \omega t + R_i^2 \omega^2 \sin^2 \omega t + R_i^2 \omega \cos^2 \omega t} =$$

$$= \sqrt{V_z^2 + R_i^2 \omega^2 - 2V_z\,R_i\,\sin \omega t} \qquad (3)$$

and acceleration

$$W_{ia} = \sqrt{\left(\frac{d^2X}{dt^2}\right)^2 + \left(\frac{d^2Z}{dt^2}\right)^2} =$$

$$= \sqrt{\left(-R_i\,\omega^2 \cos \omega t\right)^2 + \left(R_i\,\omega^2 \sin \omega t\right)^2} =$$

$$= \sqrt{R_i^2 \omega^4 \cos^2 \omega t + R_i^2 \omega^4 \sin^2 \omega t} = R_i\,\omega^2 \qquad (4)$$

Analysis of expressions (3) and (4) shows that the velocity of the working point of the roller cultivator, depending on the angle of rotation ωt, varies from Vz - Riω to Vz + Riω, and the acceleration is constant and equal to the centrifugal acceleration.

According to the literature [2; 57-60, 3; Pp. 273-274; 104-109-b.] during operation, the roller-type ripper rolls sliding, i.e., when rotating by one unit, it travels a distance greater than the circumference of its circumference, and its angular velocity is equal to [2; 61-b.]

$$\omega = \frac{V_z\left(1 - K_c\right)}{R_i}; \qquad (5)$$

where Kc - is the slip coefficient of the roller cultivator.

Taking into account expression (5), equations (1) - (4) have the form

$$X_i = V_z t + R_i \cos \frac{V_z \left(1 - K_c\right)}{R_i} t ; \qquad (6)$$

$$Z_i = -R_i \sin \frac{V_z \left(1 - K_c\right)}{R_i} t ; \qquad (7)$$

$$V_{ia} = V_z \sqrt{1 + \left(1 - K_c\right)^2 - 2\left(1 - K_c\right) \sin \frac{V_z \left(1 - K_c\right)}{R_i} t} ; \qquad (8)$$

$$W_{ia} = \frac{V_z^2 \left(1 - K_c\right)^2}{R_i} . \qquad (9)$$

According to the literature [3; 273-274, 4; 104-109]. The coefficient of sliding varies in the range from 0 to 1. When Kc=0, the roller-type cultivator rolls without slipping. In this case, equations (6) - (9) have the form

$$X_i = V_z t + R_i \cos \frac{V_z}{R_i} t ; \qquad (10)$$

$$Z_i = -R_i \sin \frac{V_z}{R_i} t ; \qquad (11)$$

$$V_{ia} = V_z \sqrt{2 \left(1 - \sin \frac{V_z}{R_i} t\right)} ; \qquad (12)$$

$$W_{ia} = \frac{V_z^2}{R_i} . \qquad (13)$$

and when Kc=1

$$X_i = V_z t + R_i ; \qquad (14)$$

$$Z_i = 0 ; \qquad (15)$$

$$V_{ia} = V_z ; \qquad (16)$$

$$W_{ia} = 0 . \qquad (17)$$

Conclusion. For the roller-type ripper to perform the specified technological process at the required level, its slip coefficient must be equal to 0 or very close to 0. Otherwise, a pile of clods lying on the field surface will be observed in front of it. As a result, their grinding deteriorates and the draft resistance of the roller ripper increases.

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