UDC 631.33.02

DETERMINING THE SPEED OF THE SEED DISTRIBUTOR IN OPENER FOR SUBSOIL-VARIATION MODE SOWING

M.L. Zaets, Ph.D.
Zhytomyr National Agroecological University
M.M. Zhyvega, MA
Vinnitsa National Agrarian University

consider determine the optimal shape of the distributor and the process of distribution of seeds in the form of a combined distributor

curved prisms. From the shape of the distributor depends on the quality of seed distribution across the width of the strip that sown. Uniformity location on the seeds Shovel width will be characterized by the speed of flow of seed in a sloping area distributor.

Speed, sowing, distributor, generators uniformity.

Formulation of the problem. The essential difference between the existing drill machine and drills for subsurface variation-way design is sowing coulters, including their switching. Shovel-drills for subsurface variation of sowing in most cases in the form of cultivators paws with different width [5]. Distributor of seeds is a key element opener, which directly affects the uniformity of distribution of material on the area of technological fields and increased bandwidth that sown. Various forms of reflectors and constructions of distribution devices for subsurface Shovel-variation mode of sowing due to increased uniform distribution of seeds on the area of the field.

Analysis of recent research. The researchers [1-4] proved the superiority of distributors curved forming on the work surface where the seeds gradually change its direction of movement and with minimal loss of kinetic energy in the coming pidsoshnykovyy space and planted on the bottom grooves.

To speed of the seeds reached the maximum value at the point of descent of the curve, the curve must meet the conditions of the fastest moving particles over a period of time. Such a curve is by definition brachistochrone curve.

Theoretical and experimental research on seed movement dedicated to creating curved job Kirov AA [3]. He considers brachistochrone curve as a set of straight sections and circles of constant radius r, and the movement of seed for generating curvilinear movement regards as seeds in this circle.

The purpose of research. Given that the process of distribution of seeds in the subsoil-seeding method of spreading it is random, as determined by a lot of factors that can not be fully taken into account, it can be treated in accordance with the laws of probability theory [2]. In this regard are various types of technological schemes switching shovels to design and manufacture them for further study.

Results. The formula rate East (1) of forming a curved section V of acceptable accuracy can be adopted to calculate the trajectory and speed of the seed after the descent of the curved section of the distributor:

$$V = \sqrt{e^{-\pi \cdot f}\left(V_0 \cdot \cos^2 \gamma_0 - \frac{6 \cdot g \cdot r \cdot f}{1+4 \cdot f}\right) + 2 \cdot g \cdot r \cdot \frac{1-2 \cdot f^2}{1+4 \cdot f^2}} \quad (1)$$

where: f - coefficient of friction against steel grain; Vo - the rate of seed flow in curvilinear generatrix section, m / s; γ0 - the angle between the vertical axis and in the direction of the initial velocity Vo; g - acceleration of gravity, m / s2.

However, in reality brachistochrone curve radius of curvature varies by law. The difference between the actual radius brachistochrone curve radius of the circle leads to the fact that the actual speed of movement of the curved generatrix will be different from the calculation. And because the speed of the seed after the descent of the curved section of the distributor will depend stock of kinetic energy, which causes a range of distribution of seeds in pidsoshnykovomu space, then consider this question is important and necessary stage of theoretical research. Consider the motion of a single seed in brachistochrone curve, which is generatrix distributor (Fig. 1).

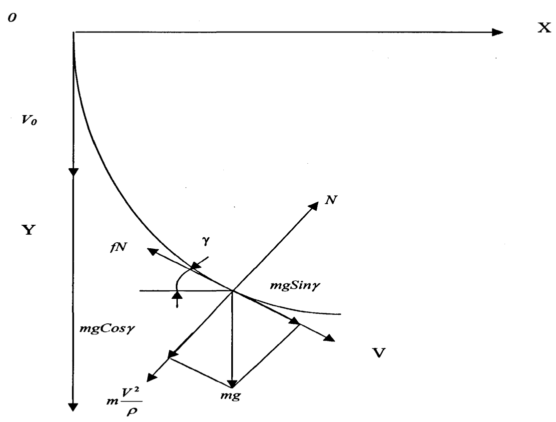

Fig. 1. Scheme of forces acting on a material point when driving on brachistochrone curve.

The proportion of seed enters the curved surface with an initial velocity Vo. When driving on a curved surface for seeds are: gravity, friction, centrifugal force and the force of normal pressure. Projecting power to normal and tangent, we write the system of differential equations:

$$m \cdot \frac{dV}{dt} = m \cdot g \cdot \sin\gamma - f \cdot N \text{ , } N = m \cdot \frac{V^2}{\rho(\varphi)} + m \cdot g \cdot \cos\gamma \text{ , (2)}$$

where: m - mass of seeds kg; V - velocity seeds m / s; N - normal pressure force, N; γ - angle of the tangent to the horizon, radian; t - the movement, c; ρ (φ) - brachistochrone curve radius of curvature, depending on the angle of rotation generatrix circle (φ).

We know that brachistochrone curve formed a circle, rolling in a straight line without slipping. Thus, for any point brachistochrone curve radius of curvature is equal chord range speakers (Fig. 2). At one end of the chord will belong to the line on which the rolling circle.

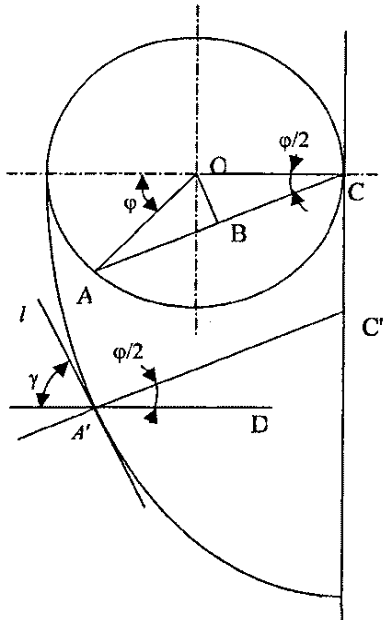

Fig. 2. Scheme for determining the radius of curvature brachistochrone curve.

Connect points A and C of the center circle A. Consider received an isosceles triangle AOC. With the triangle we obtain:

$$\triangleleft\, OCA = \frac{\varphi}{2} \text{ And (3)}$$

where: φ - angle, which range back when rolling on time t.

From the right triangle ATS define:

$$BC = OC \cdot \cos\frac{\varphi}{2} = \frac{d}{2} \cdot \cos\frac{\varphi}{2} \text{ And (4)}$$

where: d - diameter circle generatrix city.

Thus, the desired radius of curvature brachistochrone curve AS:

$$\rho(\varphi) = d \cdot \cos\frac{\varphi}{2} \text{ And (5)}$$

Transfer the AU itself parallel to its intersection with brachistochrone curve (A'S) and through the intersection A hold horizon A'S and tangent l, then:

$$\gamma = \frac{\pi}{2} - \frac{\varphi}{2}. \quad (6)$$

Consider that at time t circle back to the angle φ, ie:

$$dt = \frac{d\varphi}{V}\rho(\varphi) = \frac{d\varphi}{V} \cdot d \cdot \cos\frac{\varphi}{2}.$$

Substitute value (4), (5) and (6) the system of equations (2), after transformations we obtain:

$$V \cdot \frac{dV}{d\varphi} + f \cdot V^2 = g \cdot d \cdot \cos^2\frac{\varphi}{2} - g \cdot d \cdot \frac{\sin\varphi}{2}. \quad (7)$$

The resulting differential equation is a Bernoulli equation.

The general solution of equation

$$V^2 = g \cdot d \cdot \left[\frac{\cos^2\frac{\varphi}{2}}{f} + \frac{2 \cdot f \cdot \sin\varphi - \cos\varphi}{2 \cdot f \cdot \left(4 \cdot f^2 + 1\right)} - \frac{2 \cdot f \cdot \sin\varphi - \cos\varphi}{4 \cdot f^2 + 1}\right] + e^{-2 \cdot f\varphi} \cdot C, \quad (8)$$

where: C - constant integration

Constant integration determined from the initial conditions: at the corner turn brachistochrone curve generating circle corresponding to the point of falling on curvilinear generating seed distributor:

$$\varphi = \varphi_0 - \varphi_1, V = V_0.$$

$$C = e^{2 \cdot f \cdot \varphi_1} \cdot \left(V^2{}_0 - g \cdot d\left[\frac{\cos^2\frac{\varphi_1}{2}}{f} + \frac{2 \cdot f \cdot \sin\varphi_1 - \cos\varphi_1}{2 \cdot f \cdot \left(4 \cdot f^2 + 1\right)} - \frac{2 \cdot f \cdot \sin\varphi_1 - \cos\varphi_1}{4 \cdot f^2 + 1}\right]\right). \quad (9)$$

Given the fact that φ0 = π, we can write:

$$\varphi = \pi - \varphi_1. \quad (10)$$

Substituting the value of the constant of integration C (expression 9) and the angle φ expression (10) in equation (8), having the appropriate transformation, we obtain a formula for determining the speed east seeds with curved generatrix distributor:

$$V_{cx} = \sqrt{g \cdot d \cdot \left[\frac{\cos^2\frac{\pi - \varphi_1}{2}}{f} + \frac{2 \cdot f \cdot \sin\varphi_1 + \cos\varphi_1}{2 \cdot f \cdot \left(4 \cdot f^2 + 1\right)} - \frac{2 \cdot f \cdot \sin\varphi_1 + \cos\varphi_1}{4 \cdot f^2 + 1}\right] +}$$

$$\overline{+e^{2\cdot f(2\cdot\varphi_1-\pi)}\left(V^2{}_0-g\cdot d\cdot\left[\frac{\cos^2\frac{\pi-\varphi_1}{2}}{f}+\frac{2\cdot f\cdot\sin\varphi_1-\cos\varphi_1}{2\cdot f\cdot\left(4\cdot f^2+1\right)}-\frac{2\cdot f\cdot\sin\varphi_1-\cos\varphi_1}{4\cdot f^2+1}\right]\right)}. \quad (11)$$

When installing the divider at an angle to the horizon, the expression (11) is written as follows:

$$V_{cx}=\sqrt{g\cdot\cos\alpha\cdot d\cdot\left[\frac{\cos^2\frac{\pi-\varphi_1}{2}}{f}+\frac{2\cdot f\cdot\sin\varphi_1+\cos\varphi_1}{2\cdot f\cdot\left(4\cdot f^2+1\right)}-\frac{2\cdot f\cdot\sin\varphi_1+\cos\varphi_1}{4\cdot f^2+1}\right]+ \atop +e^{2\cdot f(2\cdot\varphi_1-\pi)}\left(V^2{}_0-g\cdot\cos\alpha\cdot d\cdot\left[\frac{\cos^2\frac{\pi-\varphi_1}{2}}{f}+\frac{2\cdot f\cdot\sin\varphi_1-\cos\varphi_1}{2\cdot f\cdot\left(4\cdot f^2+1\right)}-\frac{2\cdot f\cdot\sin\varphi_1-\cos\varphi_1}{4\cdot f^2+1}\right]\right)}. \quad (12)$$

Angle φ1 is determined by the following formula:

$$\varphi_1=\arccos\left(1-\frac{2\cdot a}{d}\right), \quad (13)$$

where: a - the distance from the axis of the distributor to the point of falling seeds m (Fig. 3).

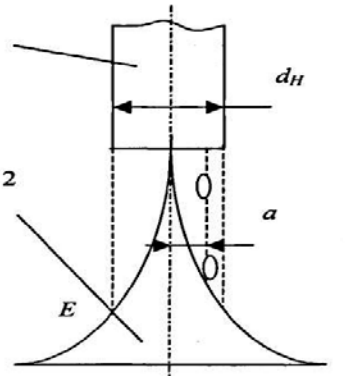

Fig. 3. Scheme for seed flow distributor 1 - napravlyach 2 - distributor.

To analyze the velocity to the east of the coefficient of friction substitute dependent (12) value of f = 0,2 ... 0,5, with a constant sense but also conduct calculations. From the resulting dependence V (f) (Fig. 4) shows that the coefficient of friction slightly (f changes within the change rate is 5.5 ... 5.9%) affects the speed of the east.

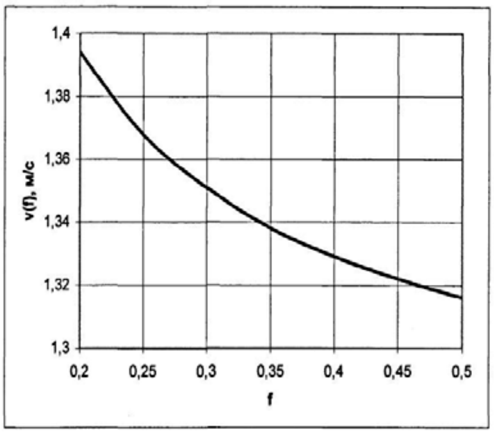

Fig. 4. Theoretical dependence of East nasinnyny the coefficient of friction.

The main factor affecting the speed of the east, is the diameter of a circle generatrix brachistochrone curve. The optimal diameter of the circle and, consequently, the geometric size of the distributor will be defined in terms of adequacy speed east section of curved generatrix distributor. For the analysis depending on the speed of the falling seeds coordinates on curved surfaces substitute dependent (13) and value = 0 0.02 ... and conduct calculations for dependence (12).

The calculations build graphical dependence on the speed of the falling seeds coordinates on curved surfaces distributor V (a) (Fig. 5).

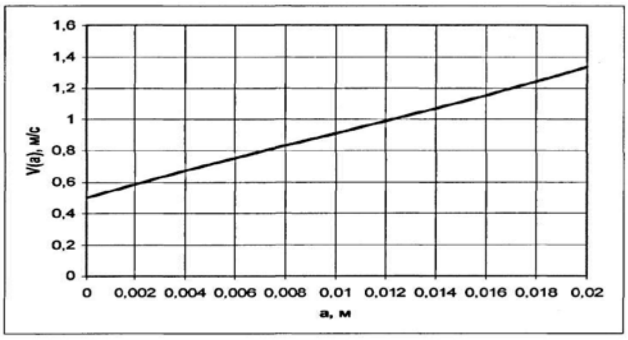

Fig. 5. Theoretical dependence of the velocity of seeds from seed entering the coordinates on curved surfaces distributor.

The highest rate sunrise will be those seeds that fall to the distributor at the far point (E) projection napravlyacha seed (Fig. 3), because these seeds will take less distance on a curved surface and therefore the loss of kinetic energy to the work of friction will lower. In this case, the angle φ1 defined by the following relationship:

$$\varphi_1 = \arccos\left(1 - \frac{d_н}{d}\right) \quad (14)$$

where: Dn - inner diameter napravlyacha city.

Thus, using dependences (12) (13) (14) can determine the speed of the seeds of curvilinear generatrix depending on the design parameters (diameter of the generating circle diameter intersection initial napravlyacha or nasinnyeprovodu) distributor and coordinates falling seeds on curved surfaces distributor. To increase the range of distribution of seeds for bandwidth that is sown shoe, the distributor must be used with the inclined plane, which is its foundation.

Conclusions

1. One way to increase the range of seed distribution across the width of screening is to use shoe distributor, which is a combination of curved generatrix divider in the form brachistochrone curve, and an inclined surface, the distribution, and is the basis distributor.

2. Theoretical dependences to determine the design parameters of the combined distributor: speed descent of the curvilinear generatrix on the diameter of the circle generatrix brachistochrone curve; range distribution of seeds (in parametric form) of the design parameters of the sloping area (length and angle of the sloping site installation to the horizon), which use to determine the optimum parameters distributor and sloping areas for screening seeds in width capture opener with the necessary range and consistency.

3. Speed of seeds with curved generatrix distributor depends on the diameter of the circle generatrix brachistochrone curve and the coordinates of falling seeds on curved surfaces.

List of references

1. *Hnylometov VG* Study and Improvement tehnolohycheskoho process seyalok-kultyvatorov in terms Volga Medium: Dis ... Cand. Sc. Science. - Kinel, 1981. - 226 p.
2. *Yesipov VI* Study kachestvennыh indicators bodies kombynyrovannыh workers at posevnыh agregatov DIFFERENT ways osnovnoj obrabotku soil. - Kuybishev, 1976. - 212 p.
3. *Kirov AA* Rationale ravnomernoho apportionment process semyan Square in the fields and parameters distributor opener for podpochvennoho razbrosnoho poseva: Dis ... Cand. Sc. Science. - Kinel, 1984. - 218 p.
4. *Ivan T. Kovrikov* Basic principles of design rozpodilyuyuchyh devices subsurface variation of share-grain seeders / Ivan T. Kovrikov // tractors and agricultural machinery. - 1983. - №5 - S. 13-14.
5. *Khomenko MS* et al. poseva mechanization of cereals and grasses. Directory / MS Khomenko, VA Zyryanov, VA Nasonov. ─ K .: Harvest, 1989. ─ 168 p.

Rassmatryvaetsya Definition optymalnoy forms and distributor apportionment process semyan kombynyrovannыm video distributor in kryvolyneynoy pryzmы. That forms dependent distributor Quality apportionment semyan the width bar only, kotoraja zasevaetsya. Location of Ravnomernost semyan on Shovel width will be

harakteryzovatsya skorostyu postuplenyya semyan on naklonnuyu uchastok distributor.

Speed, posev, distributor, obrazuyuschaya, ravnomernost.

We consider the determination of optimal shape of the distributor and the process of distribution of seeds combined distributor in the form of curved prisms. From the distributor form depends on the quality of seed distribution across the width of the strip that sown. The uniformity of seeds on the location Shovel width will be characterized by the speed of flow of seeds on a sloping plot distributor.

Speed, sowing, distributor, generators uniformity.