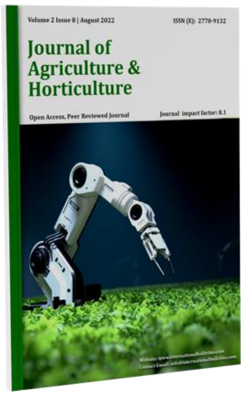


# JUSTIFICATION OF THE KINEMATIC MODE OF OPERATION OF THE ROTARY WORKING BODY OF THE MACHINE FOR OPENING THE VINEYARD.

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**Annotation**

The article describes the functions and role of a machine for opening the cover shaft of vines. It is shown that the value of the kinematic mode of operation (λ) of the rotary working body is one of the main factors determining the active movement of the soil mass from the cover shaft towards the row spacing. It determines the dependence of other factors influencing the change in the value of the kinematic mode of operation and theoretical determinations optimal value for meeting the set agro technical requirements.

**Keywords:** rotary, soil trailer, kinematic mode, dump, soil, movement, trajectory, row spacing, cover shaft, working hours, movement, and radius.

**Introduction** A review of the literature data and principles study of the operation of vineyard opening machines shows that a modern high-performance machine has one of the main working organs: rotary working bodies(RWB). When opening vines with a rotary working body, it provides active movement of the soil from the covering shaft to the row spacing with the implementation of a complex translational movement. $V_n$-place aggregate and rotational angular velocities $\omega$

**Methods and research** The technological process of operation of the rotary working body can be divided into three main interrelated moments: the introduction of the blade into the soil, the descent of the soil from the surface of the blade and the flight of soil particles dusted from the working body [1, 2, 3, 4, 5].

One of the characteristic indicators of the rotary working body that determine the activity of their impact on the soil is the kinematic mode of operation λ, determined by the formula [6, 7, 8, 9, 10, 11, 12].

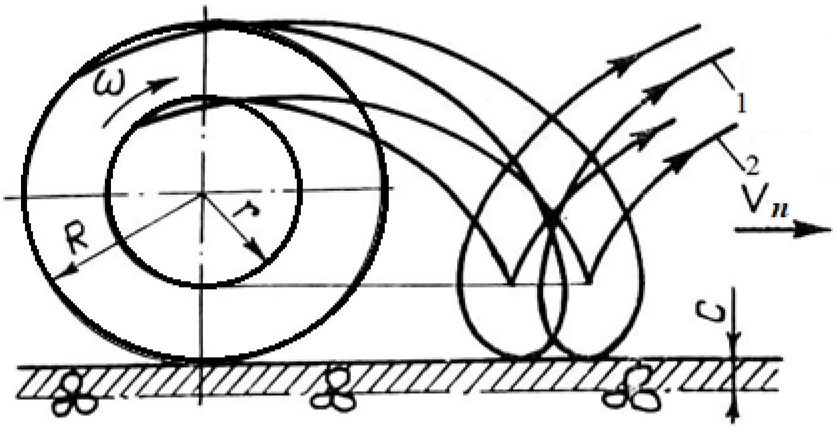
$$\lambda = \frac{\omega R}{V_n} \qquad (1)$$

where $\omega$- angular velocity of the rotary working body (RWB);$\omega$

R- is the radius of the circle passing through the extreme point dumps of RWB;

$V_n$ - speed of movement of the unit.

When using the proposed RWB (Fig.1) its rotation occurs due to the interaction with the soil of the soil trailers that perform the function of driving the working body.




Rice.1. Technological scheme of operation of the rotary working body

1. 1-Dumps, 2-pochvozatsepy.

The angular velocity of the RWB is determined by by the ratio:

$$\omega = \frac{K_t V_n}{r} \qquad (2)$$

where $r$ - radius of the circle passing through the attachment points soil trailer;

$K$ - the coefficient of braking of the working body, due to the impact of a natural agricultural background (lumps, rocks and plant remains). Based on preliminary research $K_t$ = 0,70...0,95 [13]. For calculations, we accept

For high-quality performance of RWB (R = 400 mm; r =223mm and accepted numeric values $K_t$ 0.90) the calculated value of the kinematic operating mode is λ = 1,64.
Based on (1) formula (2) has the following form:

$$\lambda = \frac{K_t\,(V_n/r)R}{V_n} = \frac{RK_t}{r} \qquad (3)$$

The value of the kinematic mode is limited on one side. the radius. On the other hand, there are agro technical requirements for the quality of row spacing alignment and soil movement from protective zones. ridges to the middle of the row spacing.

From the above dependencies $\lambda = f(r)$ it can be seen that with an increase in a decrease in the value of the kinematic mode λ is observed for the radius of the attachment point of the trailer (fig.2). This is because between radii $r$ and R, i.e. the active zone of the blade decreases.

So, for example, if the width of the row spacing is 250 and 300 sm diameter RWB it should be within the range of 780-810 mm, then the value of $\lambda = f(r)$
it should not exceed 1.8 ( otherwise, the technological process is not feasible due to the limitation of the radius $r$ of attachment of soil trailers). In agricultural terms, the value of λ is limited by the absolute speed of the blade: $\lambda = f(V_к)$.

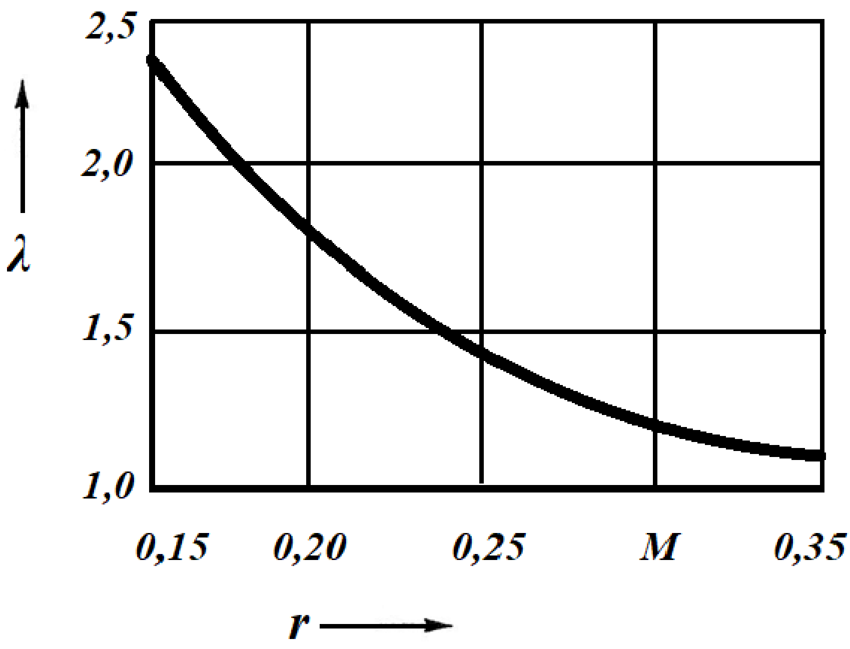


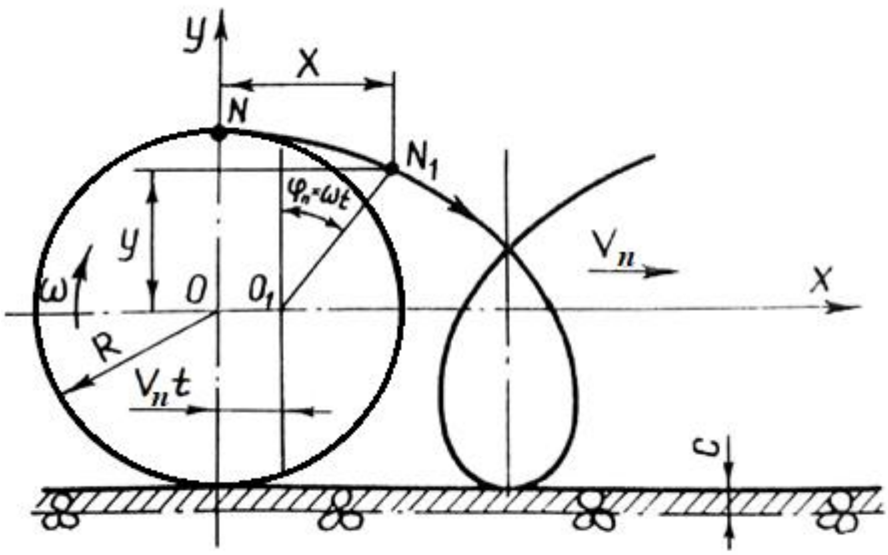

Figure 3 Kinematic mode dependence

For justification $\lambda = f(V_к)$ you need a graphical and analytical interface. calculation of the absolute speed of the dump truck. For this consider the equation of the trajectory of the dumper of the working body.

RWB in the process of working simultaneously participates in the progressive and rotational movements, while performing a complex movement. The trajectory of the absolute movement of the blade is an elongated cycloid (Fig.4) [9, 11, 14, 15, 16].

The equation of the trajectory of the movement of dumps can be obtained if the movement of the working body is attributed to a fixed coordinate system YOX. In this case, the axis OX is located parallel to the field surface and coincides with the direction of movement of the unit, and the working body installed with protection zone C.

Path at the initial moment, the axis of rotation of the working element coincides with the origin of coordinates O.




Rice.4. Flow chart of the RWB dump

After a certain period of time when the unit is moving, the working body rotates by an angle $\varphi_n = ⍰t$. Then the parametric equation of the dump truck motion can be written in the following form:

$$\begin{cases} X = V_n t + R\,sin⍰t \\ Y = R\,cos⍰t \end{cases} \qquad (4)$$

where t -is the time of rotation of the working body by an angle $\varphi_n$

The components of the absolute blade velocity $V_x$ and $V_y$ can be determined if we find the time derivatives in system (4):

$$V_x = \frac{d_x}{d_y} = V_n + R⍰cos⍰t$$

$$V_y = \frac{d_y}{d_t} = -R⍰sin⍰t \qquad (5)$$

Absolute blade speed value $V_n$ equal to:

$$V_к = \sqrt{V_x^2 + V_y^2} \qquad (6)$$

Or after substituting the value of $V_x$ and $V_y$ from (2) and given that $⍰R = \lambda V_n$, we have:

$$V_{ot} = V_n\sqrt{1 + 2\,\lambda\,cos⍰t + \lambda^2} \qquad (7)$$

Performed calculations for (7) for different values of the kinematic mode parameter λ and translational speed

$V_n$= 1.40...2.0 m / s shows that in the active zone of the blade (near the cover shaft area), the absolute movement speed is significantly reduced. Taking into account the design features of the working body and agro technical requirements, we can conclude that the value of the kinematic mode parameter of the rotary working body λ is in the range of 1.6...1.8.

At λ = 1, the absolute speed of the dump is determined by the formula:

$$V_к = V_n\sqrt{2\,(1 + cos\varphi_n)} \qquad (8)$$

From the given dependence (8), it follows that, in this case, the dumps passively affect the soil in the protective zone of the row, and as a result, there is no active movement of the soil towards the row spacing.

**Conclusions**

1. To ensure the stable operation of the RWB, the radius of the location of soil trailers is important.
2. Performance indicators of the rotary working body largely depend on its kinematic mode of operation.

The movement of the required soil volume towards the row spacing axis is provided at λ = 1.6...1.8.

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