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SUBSTANTIATION OF THE CRITERION FOR THE WASHING PROCESS FRUITS AND VEGETABLES

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Abstract. In this article it is described that a calculation algorithm is developed for modeling the process of washing the fruit, which allows you to change the parameters of the device in order to assess the quantitative change in the intensity of the mechanical interaction of the working body on the fruit surface. Parameters of the fruit washing machine, determined by the criterion the intensity of the mechanical interaction of the working bodies with the fruits When designing a machine, it is desirable to provide such process conditions under which the fetus makes 5 - 7 complete revolutions around its axis. This parameter is adjusted by changing the distance between brush cylinders, as well as the selection of parameters that provide the average value of the angular velocity of rotation of the fetus around its axis in within ω_{pl} = 0.5 - 0.7 rad/s.

Key words: washing process, brush cylinder, axis, vegetables, fruits, raw materials, velocity

Introduction. When designing and operating technological equipment for processing fruits and vegetables, one of the main operations of primary processing is washing. Modern machines for washing fruits and vegetables consume more than 2 m^3 for washing one ton of raw materials. For the conditions of Uzbekistan, this is wasteful. Therefore, in order to find the reserves of the process, the conditions for its implementation are analyzed. From the analysis of machine designs, it was revealed that brush machines have the best characteristics, since they have the highest intensity of mechanical interaction, which makes it possible to design machines with low energy consumption, metal consumption and relatively low water consumption [1-5].

Materials and methods. Let us consider the phenomena that accompany the washing process (Figure 1) when using a brush device.

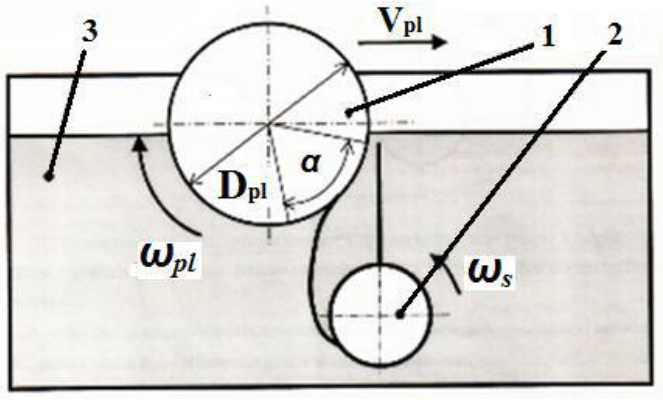

Figure 1. Scheme of the process of interaction of the working body with fruit surface: 1 - fruit; 2 - working body (brush bristles); 3 - washing liquid

Fruit 1 is in washing liquid 3. On the surface of fruit 1 he brush elements act - bristles 2. The brush is a cylindrical drum that rotates at a certain angular velocity ω_s. The fetus moves at a speed V_{pl}. When interacting with the bristles, the fruit receives rotation with an angular velocity ω_{pl}. Consider the process of mechanical interaction of the working body with the surface of the fruit. We believe that there are contaminants on the fruit surface, the appearance of which corresponds to the design scheme (Figure 2).

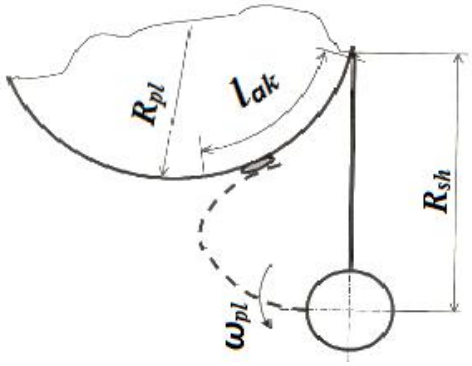

Figure 2. Scheme of the interaction of the brush with pollution

The individual bristles of the brush cylinder come into contact with the surface of the fruit as the shaft rotates. The interaction of the bristle with the surface is carried out along the path l_{ak}. We introduce: the angular speed of rotation of the brush cylinder - ω_s, the radius bristles - R_{sh}, fruit radius R_{pl}, - angular velocity of fruit rotation - ω_{pl}.

To assess the dynamics of the interaction of the working bodies with the surface, we introduce the concept of the intensity of the mechanical interaction, which evaluate the total effect of individual bristles on the surface fetus. The intensity of mechanical interaction can be estimated as the ratio of the actual acting forces to the cohesive forces between contamination and fruit surface. Cohesive forces estimated adhesive properties, are determined in a rather complex dependence on a number of operating factors:

area of the contact surface between detached particles;

viscosity of the liquid located in the space between the detached particles;

conditions for detachment of particles - adhesive or cohesive adhesion (adhesive adhesion is characterized by the fact that particles detach from each other without violating their individual shapes, and cohesive detachment is characterized by the fact that when particles detach from each other, there is a violation of the individual shape - detachment of individual elements from particles, destruction of the surface with the remains of parts of one element on the surface of another) [6-7];

the direction of the forces of the mechanisms separating particles from each other – at in the presence of only normal forces, the values of the forces are usually greater than with the presence of tangential forces.

Of course, it is quite a difficult task to take into account the totality of acting factors in the process of detachment of particles from the surface of fruits, but as the practice of washing fruits shows, an approximate solution of the task maybe.

On fig. 3 shows the design diagram of the process of interaction of pollution with the brush element. The brush element strikes the surface (its shape in the transverse section plane is assumed to be elliptical). Impact strength decomposes into components P_x and P_y, the component P_x tends to displace the seed from its place, which is prevented by the friction force P_m, determined by adhesive properties.

The P_y component forms a moment that tends to tear off the contamination from the surface, which is prevented by the force P_s. The process of mechanical interaction of the brush element on the surface of the contamination continues in for a certain time τ-, which depends on the angular velocity brush cylinder rotation ω_s and bristle radius R_{sh}, as well as linear dimensions of pollution (we believe that it is quite solid and has longitudinal section plane elliptical shape).

$$\tau = \frac{\omega r}{2a}, \tag{1}$$

where a is the length of the long semi-axis of the ellipse in the cross section of the contamination.

If in the initial period of interaction, the moment formed by the force Py is directed counterclockwise, then at the end of the interaction it directed clockwise. A similar process repeated many times leads to a gradual disruption of the connection between the seed and the surface contact. In the theory of destruction, the dependence of the critical conditions for the destruction of structures, which has an exponential form

$$P_{kp} = \alpha \cdot e^{-\frac{nP}{\beta}}, \tag{2}$$

where α, β - coefficients determined by the structural features destructible structure;

n - the number of periodic loaded;

P- is a periodically acting load.

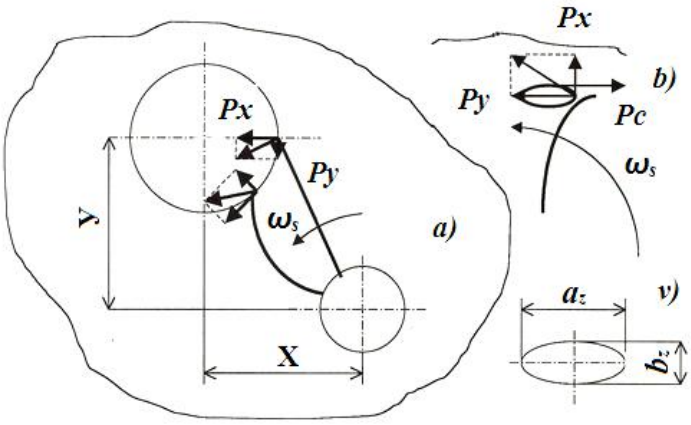

Figure 3. Scheme of the forces acting during the interaction of the bristles and the fetus: a - general scheme; b - interaction with pollution; v - pollution parameters

With an increase in n or P, as well as with their joint increase, the value of the critical fracture force decreases, there comes a moment at which P_{kr} becomes disproportionately small compared to the actual load, and there is a destruction of the structure, and in our case - a violation of the links between pollution and the material.

Based on the above as the intensity of the mechanical interaction, we take the ratio of the product of the acting force bristle impact on pollution P by the number of impacts n to the value critical breakout force P_{kp}

$$I_M = \frac{n\mathrm{P}}{P_{kp}} \tag{3}$$

Assuming that the force of separation of one pollution is within P_{kp} = 4 - 6 N, it is possible to determine the dependence of the intensity of mechanical interaction of the working body with the surface of the fetus in the contact zone in the form

$$I_{\text{M}} = \frac{\text{P}N_f n}{P_{kp}} \tag{4}$$

where N_f is the number of cycles of periodic impact of the brush cylinder on the fetus (the fetus rotates in the flow with an angular velocity ω_{pl}).

The question of the angular velocity of fruit rotation ω_{pl}, which depends on the conditions of interaction between the bristle and the surface, remains unclear. In general terms, the angular rotation of the fetus around its axis is created due to tangential forces acting on the surface.

The tangential force of the bristles is the sum of the forces acting on the bristles of the brush cylinder, which at a certain point in time are in contact with the surface of the fetus:

$$F_{Sh} = \sum_{i=1}^{i=n} F_i \cos\beta_i \tag{5}$$

where n is the number of bristles in contact with the fruit surface;

F_i - the force of action of a separate bristle on the surface, N;

β_i- angle of impact of the bristles on the fetus (between the radius and the force vector F_i), rad.

The force of hydraulic resistance to the rotation of the fruit in the liquid according to the recommendations can be defined as an inhibitory the effect of a continuous medium on a spherical body according to the formula:

$$F_j = \xi R_{pl} \frac{v}{2} \rho, \tag{6}$$

where v is the speed of rotation on the peripheral surface of the body, m/s;

p - liquid density, kg/m^3

Denote

$$k = \frac{\xi R_{pl} \rho}{4\pi^2 R_{pl}^2} = \frac{\xi \rho}{4\pi^2 R_{pl}^2} \tag{7}$$

then, equation (5) is transformed to the form

$$F_j = k\varphi \tag{8}$$

The moment of inertia of a rotating spherical body is defined as:

$$J = 0{,}4 m_{pl} R_{pl}^2 \tag{9}$$

The moment of inertia of a rotating spherical body is defined as:

taking into account the accepted notation, we write the equation of the relative rotation of the fetus in the fluid flow

$$\varphi'' J + k\varphi' - F_{sh} = 0 \tag{10}$$

This is a second order differential equation with variables coefficients. Such equations in general form are solved only by numerical methods, for example, the Runge-Kutta method.

You can simplify the solution of the equation and bring it to a homogeneous if we assume that the first term of the equation is equal to zero, in this form, the quasi-stationary equation of motion is solved. Another solution method is to accept the conditions that the coefficients are constant and do not change over time. Let us assume that the coefficients remain constant. Then, after appropriate transformations, we obtain

$$\omega = \frac{M_b}{k}(1 - e^{-n\tau}) \tag{11}$$

$$n = \frac{k}{a_{pl}}; \qquad M_b = F_{sh} R_{pl}$$

The resulting equation establishes the dependence of the angular velocity fruit rotation ω on the duration of brush bristle contact surface cylinder.

When the fetus moves in the zone of contact with the brush cylinder, a different number of bristles interact in different areas, and the angle between the bristle force vector and the fruit radius also changes. It leads to the fact that the magnitude of the force F_{sh} changes according to a rather complicated law. Therefore, the general solution of equation (11) is a particular case for the entire process.

To simulate the process of washing the fruit, a calculation algorithm has been developed, shown in Figure 4, which allows you to change device settings (Table 1) to evaluate the quantitative change in intensity mechanical interaction of the working body on the surface of the fetus.

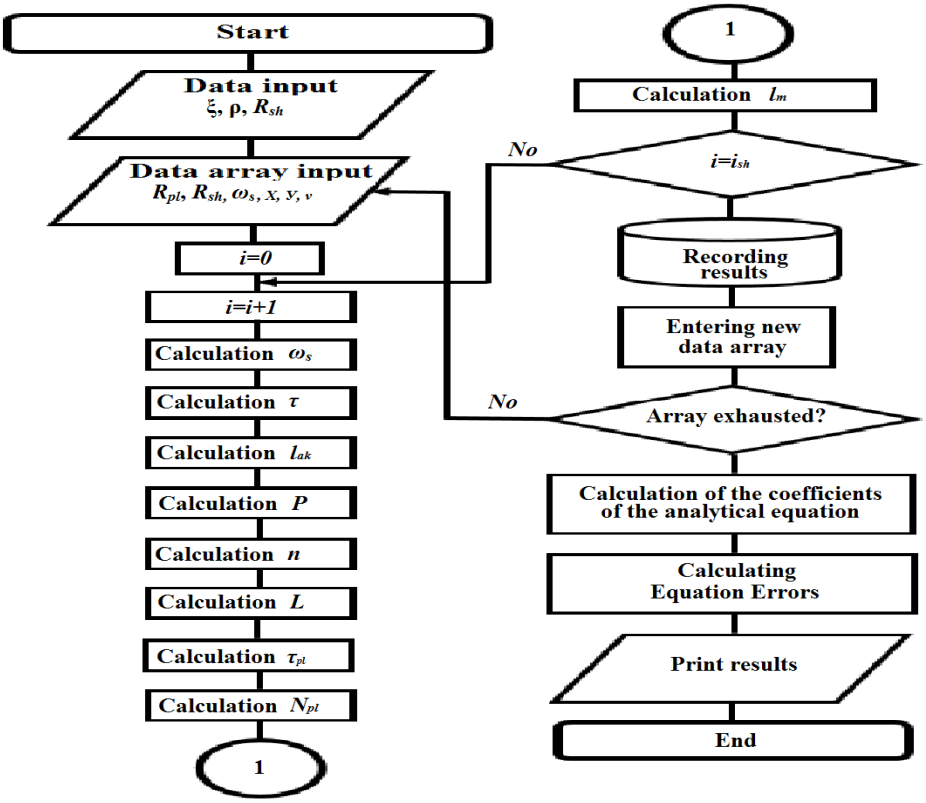

Figure 4. Block diagram for calculating the process of mechanical interaction brush working body with fruits

In the simulation, it was assumed that the washing machine fruits can have 1 or more brush cylinders, so the parameter is the number of working bodies of the machine. The number of bristles along the periphery of the cylinder is assumed to be 100 pcs.

To implement the program, the Excel-2019 software package was used, on on the basis of which, according to the recommendations, a dynamic calculation program was compiled that allows

you to change the parameters and obtain a result that characterizes the change in the intensity of the mechanical interaction of the working bodies with the fruit surface.

Table 1. Data array for the implementation of numerical simulation on a computer

Name of parameters	Dimensionality	Numerical values				
Fruit radius R_{pl}	m	0,02	0,03	0,04	0,05	0,06
Brush cylinder radius R_{sh}	m	0,03	0,04	0,05	0,06	0,07
Angular speed of rotation of the brush cylinder	rad/s	0,50	0,75	1,00	1,25	1,50
Distance between fetus and brush cylinder along the X axis	m	0,04	0,05	0,06	0,07	0,08
Distance between fetus and brush cylinder along the У axis	m	0,03	0,04	0,05	0,06	0,07
6. Fetal movement speed v	m/s	0,10	0,15	0,20	0,25	0,30
7. Number of brush cylinders	pcs	1	2	3	4	5

Results and discussion. As a result of the calculations, graphic dependences were obtained, characterizing the change in the intensity of mechanical interaction working bodies with fruits (Figure 5-8).

As can be seen from the presented dependencies, the intensity mechanical interaction varies over a fairly wide range from lm l_m= 30 - 35 to l_m = 180 - 200. For comparison, the analysis of the operation of the brush machine KUM-III showed that under standard loading the intensity of mechanical interaction in it does not exceed l_m = 35 - 40. This determines quite high specific consumption of washing liquid. Therefore, using proposed method of analysis, we can count on the creation of a device with higher rates of mechanical interaction intensity working bodies with the surface of the fruit.

As a result of the analysis of the results, analytical equations have been derived that make it possible to quantify the effect of the device parameters on the intensity of the mechanical interaction of the brush cylinder bristles with the fruit surface lm, as well as to determine the angular velocity of the fruit rotation relative to its axis ω_s.

$$I_м = 20{,}44 R_{pl}^{0.32} R_{sh}^{0.44} \omega_s^{0{,}13} X^{0{,}00012} Y^{-0{,}23} \nu^{-0.41} i_{sh}^{0.78}; \quad (12)$$

$$\omega = 0{,}34 R_{pl}^{0.12} R_{sh}^{0.27} \omega_s^{0{,}78} X^{0{,}015} Y^{0.036} \nu^{-0.14} i_{sh}^{0.74}, rad/s \quad (13)$$

To obtain the intensity of mechanical interaction between the working bodies and fruits I_m > 100, the fruit washing machine must be performed with the parameters shown in table. 2

Table 2.

Parameter name	Dimension	Featured values
Brush cylinder radius R_{sh}	m	0,05 ... 0,07
Angular speed brush cylinder ω_s	rad/s	1,25 ... 1,50
The distance between the fruit and the brush cylinder along the axis У	m	0,03 ... 0,04
Fetal movement speed v	m/s	0,10 ... 0,15
Number of brush cylinders	pcs	4 ... 5

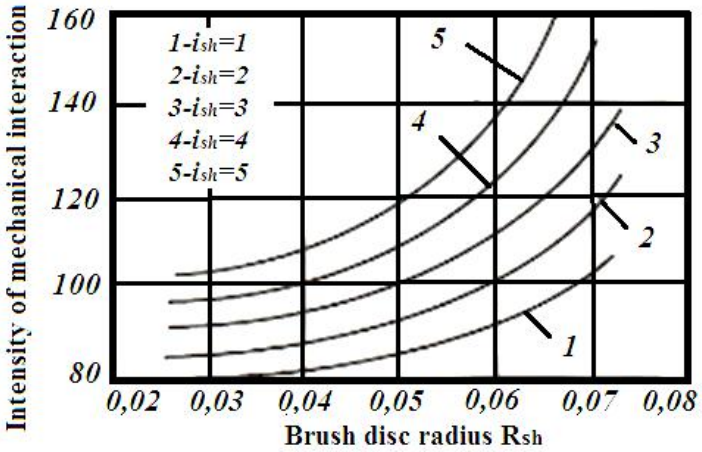

Figure 5. The intensity of the mechanical interaction of the working bodies with the fruits, depending on the radius of the brush cylinder and the number of brush cylinders at ω_s = 1,0 rad/s; X = 0,06m; Y= 0,05 m; v = 0,20 m/s; R_{pl} = 0,03 m.

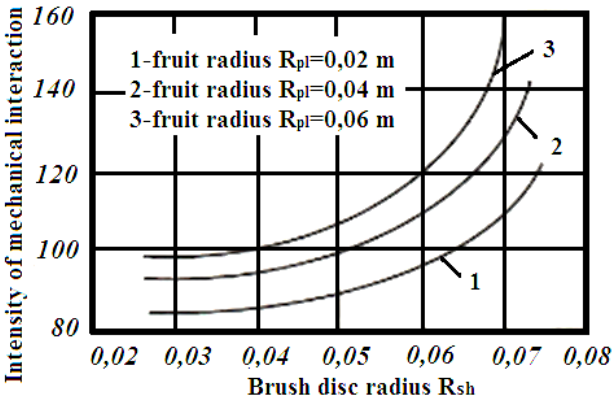

Figure 6. The intensity of the mechanical interaction of the working bodies with the fruits, depending on the radius of the brush cylinder and the radius of the fruits at:
ω_s = 1,0 rad/s; X = 0,06m; Y= 0,05 m; v = 0,20 m/s; i_{sh} = 3

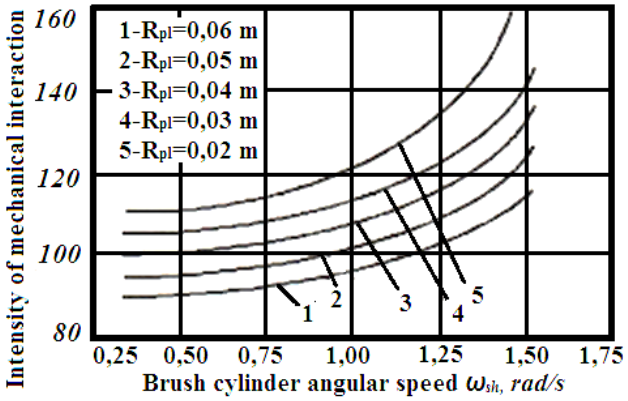

Figure 7. The intensity of the mechanical interaction of the working bodies with the fruits, depending on the angular speed of rotation of the brush cylinder and the radius of the fruit at:
R_{sh} = 0,35m; X = 0,116 m; Y= 0,05 m; v = 0,20 m/s; i_{sh} = 3

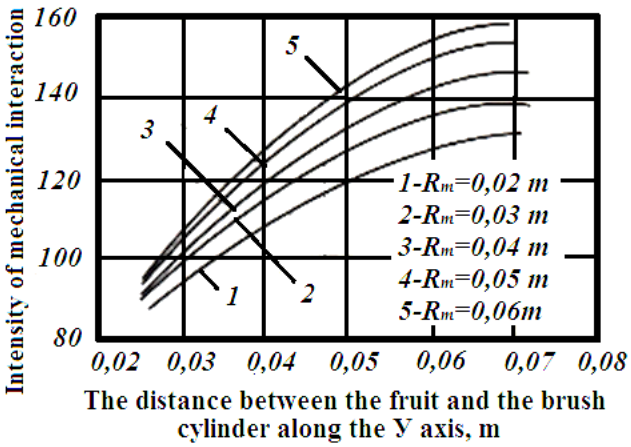

Figure 8. The intensity of the mechanical interaction of the working bodies with the fruits, depending on the distance between the fruit and the brush cylinder along the Y axis, as well as the radius of the brush cylinder at:

R_{sh} = 0,35m; X = 0,06m; ω_{sh} = 1,0 rad/s; v = 0,20 m/s; i_{sh} = 3

Conclusions. Parameters of the fruit washing machine, determined by the criterion the intensity of the mechanical interaction of the working bodies with the fruits When designing a machine, it is desirable to provide such process conditions under which the fetus makes 5 - 7 complete revolutions around its axis. This parameter is adjusted by changing the distance between brush cylinders, as well as the selection of parameters that provide the average value of the angular velocity of rotation of the fetus around its axis in within ω_{pl} = 0.5 - 0.7 rad/s

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CREATING PRE-SOWING STRIP MILLING OF SOIL, LAYING OF A DRIP IRRIGATION HOSE AND THE POSSIBILITY OF SOWING SEEDS

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Abstract. In this article it is presented that the results of a study on the design and operation process of a combined unit for pre-sowing strip milling of soil, laying of a drip irrigation hose and the possibility of sowing seeds. The proposed design of the machine is aggregated by row tractors of class 1,4 and 2, simultaneously performs operations of pre-sowing milling tillage with the formation of a ridge, laying a hose of a new design for drip irrigation, compacting the ridge and sowing seeds using various designs of seeders. The unit is designed to perform technological processes for both spring and post-harvest re-sowing, sweat functions it replaces the processes of harrowing and malavanii soil. The unit can be used in two versions: preparation of a comb for sowing with the laying of a drip irrigation hose and simultaneous sowing of seeds. The unit performs its function with traditional basic tillage and with innovative non-tillage. He can perform five operations with one pass, thereby being considered energy-resource-saving.

Key words: drip irrigation hose, sowing comb, pipe, tillage, cultivation, seed consumption, planting

Introduction. In modern technologies of soil processing and planting, the implementation of energy and resource-efficient processes is envisaged. There are technologies for plowing the soil of the main cultivation of the soil without turning over and overrunning. The next one is based on energy conservation. At the same time, this method is used to observe weed invasion of the field when processing the soil. In world practice, this technology involves the use of herbicides against weeds in large quantities. This, in turn, leads to an increase in energy and resource consumption, complicates the work of planting pre-sowing in the spring. Modern seed planting technologies aim to reduce seed consumption, ensure accurate planting and simultaneous germination of seedlings.

In agriculture, the possibilities of using combined aggregates are being used as one of the main methods of using energy-resource-efficient technologies and techniques. In these methods, it is carried out to simultaneously perform several operations on one pass of the aggregate in the cultivation and planting of the soil. At the moment, in the conditions of Uzbekistan, in the application of traditional and innovative planting modern technologies, double sanding and molting activities are carried out in order to eliminate weeds and soil layers. This leads to the fact that the aggregate compacts the soil, works several agricultural techniques and chop tractors.

In the following years, the practice of planting pink, based on advanced experiments, is on a wide network. The implementation of push-ups in Uzbekistan conditions in the autumn and spring seasons was tested in experiments. Its main disadvantage is that the top of the stem dries out under the influence of the rays of the hoof, during the sowing, the seed falls into dry soil and requires the

provision of seed water. In this regard, innovative irrigation methods including the use of drip irrigation are proving expedient [1,2,3,4]. However, in the current technology, drip pipes are being implemented with longitudinal placement in a wide range of plants. Although the water economy in this method is up to 50%, the inability of processing machines to enter the field between the rows negatively affects productivity.

Based on the experiments carried out, it is determined that the placement of drip cuttings near the plant on the stem and the implementation of irrigation will allow processing between the rows and, therefore, to prevent a negative impact on productivity. From our experiments in cotton production with this technology, it was found that yields are doubled and irrigation water consumption is reduced to 70%.

The main goal of our scientific research is to actively process the soil before planting to form a pushcut, place drip irrigation pipes next to the seeds planted on the pushcut, and create a combined machine structure for planting completely seeds.

Materials and methods. Analysis of the current state of the problem. The innovative planting that is currently in place and in use has received tillage technologies that allow the ground to be applied even when it is cultivated in the fall without overturning and overturning. In particular, soil grafting (ridge tillage) is not treated until planting in the soil in the technology of cultivation. 1/3 of the soil layer is treated with working weapons that clean the arrowhead or furrows, the pods are formed and planting is carried out. The planting height is carried out on cuttings of 10-15 cm. Herbicides are used in the fight against weeds and are carried out in combination with cultivation. In strip tillage (strip tillage) Technology, 30% of the soil surface, such as pitch tillage, is treated with milling machines, with disc working organs, or with passive softeners. According to the procedure, planting is usually carried out along with this process. Herbicides are used in the fight against weeds and are carried out in combination with cultwatsivation.

Tasks to be solved - actively processing the soil, loosening the soil at the required level and losing weeds, instead of the creeping and mola pressing processes that are carried out before planting; burying the drip irrigation pipe at a certain depth at the same time as the formation and compaction of the pot; sowing seeds; drastically reducing the number of cultivations or not completely conducting; targeted and flat moistening and fertilizing the

Results of studies performed. Depending on the soil climatic conditions of Uzbekistan, even when traditional and innovative technologies of basic cultivation were applied to the soil, a combined machine structure was created that allowed planting and processing (figure 1).

The machine consists of two parts: 1) the section of longitudinal placement of the stem forming and drip sludge pipe next to the row of seeds planted on the stem, having treated the soil with a milling machine; 2) the section of planting. In the case of planting technical crops in a wide range of rows (60 and 90 cm), various types of ecchichs are used - in rows and precision planting machines. In the proposed combination aggregate, the preparation and planting parts for the purpose of using different types of planters are located separately. By aggregation to chop tractors of different classes, the machine can be used in two different cases:

1) Prepare ridge before planting with only the first part and place a drip slaughter pipe;

2) Prepare ridge, place drip irrigation pipes on the pushta and plant biratola seeds.

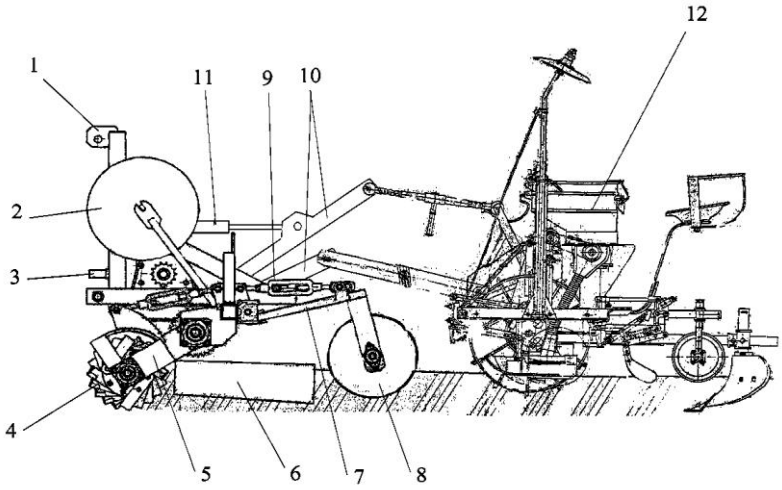

Figure 1. Planting took strip milling, completely placing a drip irrigation pipe and planting a possible combined aggregate:
1-milling frame; 2 - drip irrigation pipe winding Shaft; 3-milling extension reducer shaft; 4 - blade drum milling machine; 5 - blade drum bracket; 6 - ridge formwork sheath; 7 - pusher spool bracket; 8 - ridge spool; 9-clamping spool; 10-suspension device for planters (seeder); 11 - planters suspension gear hydraulic cylinder; planters 12 (seeder).

Both cases carry out spring planting and post-harvest replanting processes.

The front part of the machine hangs on the tractor at three points, the reducer of the milling machine is connected to the power supply valve of the tractor. The ejector is connected from three points through the suspension device 10 (Figure 1) of the front of the machine, in the suspension connector the ejector has a 9 adjustment device with respect to the horizon.

The machine aggregated to the tractor works as follows: when the tractor starts, the milling machine 1 is first started, the machine is lowered and the soil is processed and planted. Milling 1 (Figure 1) actively processes the soil, using a sheath 6 installed on it, a push is formed. Through a special device (not shown in the picture) from drip irrigation pipe winding Shaft 2, the pipe is buried on the pusher to a certain depth of 2-3 cm, and the top is closed. The formed ridge is compacted by the pushta compactor shaft 7, which is mounted on the bracket. After him, the wheels of the moving planter 12 are dragged, resting on the bottom of the pusher, with which the smoothness of movement is ensured. When sowing seeds, rowed or precision seeding machines can be used.

Since the rotary motion of the milling machine is directed in the direction of the line speed by the action of the aggregate, its resistance to creep is reduced. For this reason, analysis of the forces acting on the milling can help determine the resistance of the machine to creep. The drag resistance of the mounting planters are accepted from the description of their russet.

Analysis of the forces acting on the working bodies of the milling machine. Milling knives have a longitudinal axis located perpendicular to the movement of the aggregate, so the elementary forces acting on them can be brought to one common equal acting force Rxz. This force is placed under a certain angle ψ relative to the vertical plane on the longitudinal axis perpendicular to the aggregate motion (Figure 2 a).

The ψ angle and R_{XZ} Force values vary depending on the rotation angle of the milling drum to be within the beat of the beat of the $\varphi=\omega t$ (figure 2 b). The R_{xz} force value increases as soil shear occurs from the beginning of knife's entry into the soil, then the resistance decreases in a bottleneck

curve as the blade moves from bottom to top as it passes through the vertical plane of the drum axis. The increase in R_{xz} strength is of the angle of rotation of the drum, respectively. Will be in the range of values 15-25^0. Between these angles, the resistance of the drum to drag is reduced as a result of the action of the force R_{xz} due to forced rotations of the drum. Drag resistance increases when the drum's number of spins is 160 min^{-1}.

The R_{xz} force can be broken down into its organizers R_x and R_z. The horizontal organizer $R_x=R_{xz}\cos\psi$ is oriented in the direction of the aggregate and reduces the drag resistance of the machine, which makes it possible to work with tractors of the 0.9-1.2 class of the tractor.

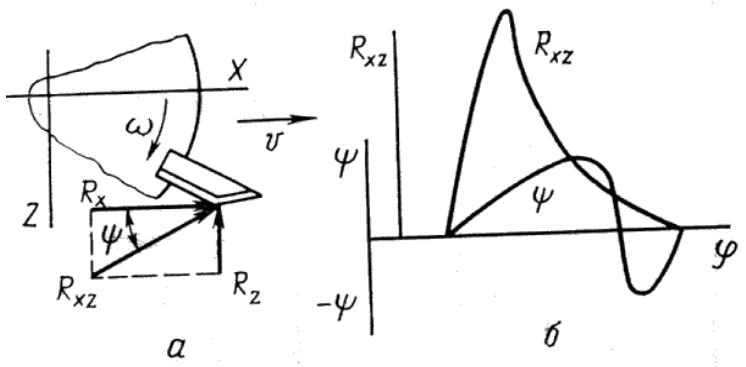

Figure 2. Description of the acting forces and power of the milling machine:

A is a scheme of forces acting on the blade; B is a graph of change depending on the RXZ force and the angle of rotation of the blade of the angle ψ.

In the vertical direction of the vertical organizing R_z=rxtan ψ, The Machine resists the deepening of the working organs into the soil, while in the downward direction it helps to deepen. As a result of all the values obtained, it was found that the change in angle is from +12 to -15^0. The R_z force has positive values in the upward direction and negative values in the downward direction.

The resistance values of rotational blades can be determined from the following simplified formula:

$$R_x=k_k\delta b, \quad (1)$$

here k_k *- coefficient of comparative resistance to shearing, N/m^2;* δ *- Wrinkle thickness, m;* b *– Wrinkle width, m.*

The comparative resistance of shearing depends on the mechanical composition of the soil (plant residues are also taken into account) and its condition, the dimensions of the shearing (the layer being transferred to the blade) and the rate of shearing, that is, the number of drum rotations. In the case of a small layer transfer from the data obtained, the specific resistance is large, while in the case of a thick layer transfer, the specific resistance is reduced. In this case, the transfer of a thick layer relative to a thin layer causes the soil to become less crumbling.

The power required for milling work is determined approximately as follows:

$$N = N_m + N_k + N_{up}, \quad (2)$$

here N_m *– the power of the machine to move across the field, kWt;* N_k *– power to scrape the soil (soil deformation), kWt;* N_{up} *– power for ironing scraps, kWt.*

The first constituent is defined from the following formula:

$$N_m \approx 10^{-2} fG\upsilon, \quad (3)$$

here G *– mass of engine, kg;* υ *– speed of engine's movement, m/s;* f *– rolling coefficient,* f = 0,15...0,2.

The second Constituent is calculated from the following formula:

$$N_k = 10^{-4} k_k \delta bazn/6, \quad (4)$$

Here *a – soil processing depth, 7-12 sm; z – total number of knives; n – milling cutter's drum number of turns, 160-200 minutes*$^{-1}$.

The third organizer is defined as follows:

$$N_{ir} = 510^{-4} k_0 G_T u_b, \quad (5)$$

here G_T *- the mass of the soil being ironed in one second, kg;* k_0 *– the coefficient of soil irradiation depending on The Shape of the working organ;* u_b *– drum spinning speed, m/s.*

The power consumption for soil treatment with a milling cutter is estimated by the comparative power efficiency, that is, by the power consumption per unit of workload (for example, dm^3).

From the analysis of the above forces, it can be seen that with a decrease in the transmission of the soil layer to the blade and an increase in the speed of advanced movement, the comparative work increases sharply, so that the rate of milling is relatively small - 1,1...1,4 m/s (4...5 km/h). In such an order of work, the height of the pusher at the desired level is formed from the volume of the soil being ironed. Resistance to compaction of the pink formed from this is reduced.

Analysis of the resistance forces acting on the rigde formation. The force of resistance acting on the ridge formation is equal to the sum of the resistance of the ground receiving shroud, the two side capers and the upper straight parts:

$$P_x = R_{1x} + 2R_{3x} + R_{nx} + R_{нx} + R_{2x}, \quad (6)$$

here R_{1x} – horizontal organizer of resistance to irradiated soil in shroud; R_{3x} – horizontal organizer of soil resistance to side limbers; R_{nx} – soil crushers front edge resistance forces horizontal organizers; $R_{нx}$ – horizontal organizer of resistance force to low edges of formwork crushers; R_{2x}– formation of the soil counterweight to the upper roof part horizontal organizer.

These resistance force values are determined analytically and in field conditions based on the results of dynamometric tenzometry experiments [8].

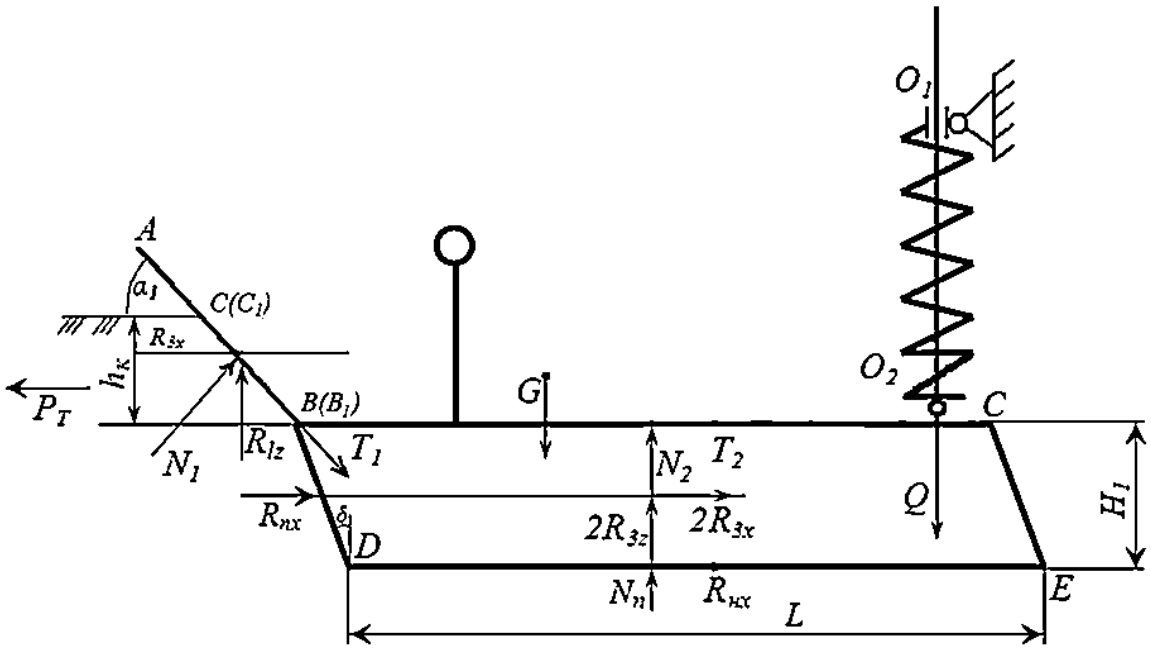

Figure 3. Scheme of forces acting on the ridge longitudinal-vertical plane

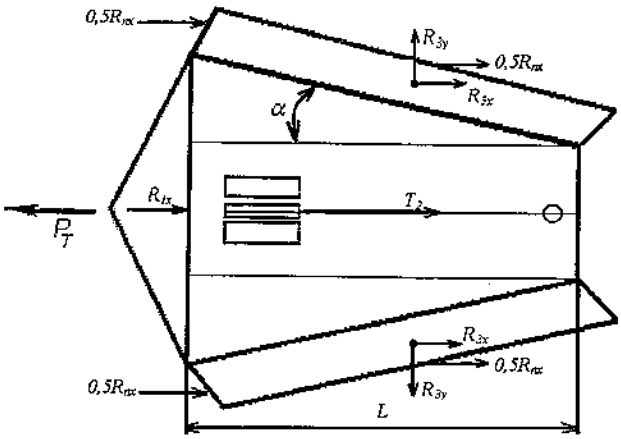

Figure 4. Scheme of forces acting on the ridge in the horizontal plane

The proposed drip irrigation pipe is made of elastic plastic, the water outlet holes are located on a certain distance on the longitudinal axis of the pipe. The water outlet holes are round holes, and the ratio of the hole diameter D to the pipe diameter D is as follows: $d/D = 1/(30…40)$, distance between holes in the pipe wall $L = 80…400$ mm.

Conclusions. 1. The developed combined machine allows you to plant seeds and fertilize seeds in early spring, forming a stem instead of traction and molting operations. 2. The machine, which is aggregated into the tractor, is used in two ways: forming a stem and placing a drip pipe on the stem; planting a single seed. 3. Agregate allows you to save energy and resources by performing several options in one pass.

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EFFICIENCY OF THE RAINFALL IRRIGATION METHOD OF AGRICULTURAL

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Abstract. This article provides information on irrigation of agricultural crops, especially carrots, cauliflower and soybeans, which is one of the most water-saving methods. At the same time, the effectiveness of the sprinkler irrigation method is presented, comparing the achieved result with other methods.

Key words: sprinkler irrigation, furrow irrigation, irrigation technology

Introduction. The development, improvement and widespread implementation of optimal economical irrigation methods for planting and caring for vegetable crops in the spring and summer periods in the conditions of water scarcity is considered one of the urgent issues in agriculture. In the 1990s, 18,000 m^3/ha were used for 1 hectare of irrigated land from water sources, but today this figure has decreased by 40%. Irrigation of land following these guidelines without water-saving methods is a complicated process. [1]

Rain irrigation has the following advantages compared to other irrigation methods: changing the soil moisture depth by reducing or increasing the irrigation rate as needed, increasing the relative humidity and lowering the temperature of the air near the ground, the ability to distribute water evenly across the field, not strictly requiring that the land be very flat, cold an effective measure against the impact and the fact that water resources are a cost-effective method in regions with poor water resources, there is no need to build irrigation ditches and temporary ditches, the possibility of transferring mineral fertilizers with dissolved water, etc. [2]

Field experiments on carrot irrigation by rain have not yet been conducted in our country, but when we study foreign experiences, we can see that this method is effective.

Setting the issue and the solution. KazSRIPVG conducted studies to assess the rain irrigation system (sprinkler irrigation) of "NaanDaanJain" (Israel), a leading company in the sphere of water-saving technologies. Finely dispersed irrigation or sprinkler irrigation using sprinklers (spray sprinklers) is one of the main methods of irrigation in areas with uneven terrain and with an acute shortage of irrigational water. Field experiments concerned vegetables such as carrot. The influence of sprinkler irrigation on the conservation of irrigation water, contamination of the fields, productivity and quality of vegetable crops was studied. [3,4]

Since vegetables are important sources of vitamins, minerals, micronutrients, carbohydrates, biologically active substances, as well as dietary fiber needed to full and balanced diet, yields of vegetable crops should be environmentally friendly and safe. In this regard the biochemical analyzes of the vegetable crops on the determination of their quality have been carried out at the laboratory of mass analysis of KazSRIPVG. Consequently, the positive impact of sprinkler irrigation technology on the biochemical indicators of vegetable crops should be highlighted (Table 1). The amount of dry matter, vitamin C and carotene carrots contain have all increased.

Particular attention should be paid to enhanced amount of carotene, for which the carrot is valued. In 2014, while sprinkler irrigation the carotene content (provitamin A) in the edible parts raised from 16.49 mg % to 16.7 mg%. In 2015, these rates varied from 16.5 mg % to 17.3 mg%. Dry matter content increased up to 15.08%. The nitrate content in carrot roots according to the irrigation methods was 86 and 144 mg per 1 kg of wet weight in 2014, and 93 and 85 mg/kg in 2015. If one

considers that acceptable levels of nitrates in carrot is 400 mg/kg of wet weight21 then the product can be considered as environmentally friendly.

Table 1. Effect of irrigation technology on biochemical indices of production in 2014-2015

Biochemical indicators	Irrigation technology			
	Furrow irrigation		Sprinkler irrigation	
	2014	2015	2014	2015
Dry matter, %	12,73	12,20	12,82	15,08
Total sugar, %	8,65	10,0	9,0	9,5
Vitamin C, mg%	9,95	9,4	8,7	9,5
Carotene, mg%	16,49	16,5	16,7	17,30
Nitrates, mg	86	93	144	85

In irrigated horticulture, great attention is paid to the productivity of vegetable plantations. Each hectare of irrigated land is very important, especially in the foothills of south-east Kazakhstan. Therefore breeding research and technological development mainly focus on increasing the productivity of vegetable crops. The main indicator for the assessment of new technological developments in horticulture has always been the yield of vegetable crops. According to the research conducted, sprinkler irrigation technology provided a significant increase in the productivity of vegetable crops. Finely dispersed irrigation compared with furrow irrigation helped to improve the yield of carrots by 12.3% and 16.3% in 2014 and 2015, respectively (Table 2).

Table 2. Influence of sprinkler irrigation on the yield of carrots (2014-2015)

Irrigation technologies	Research years	
	2014	2015
Furrow irrigation (control)	25.2	26.4
Sprinkler irrigation	28.3	30.7
Harvest difference t/ha	3.1	4.3

Analysis of results and examples. In contrast to the method of irrigation in the field, the water is controlled through taps in the cultivation of cauliflower in the method of economical irrigation. water and mineral fertilizers are spread evenly and the harvest is ensured at the same time. Cauliflower is a water-demanding plant, so it grew well and got a high yield as a result of being created in an optimal water and nutrient regime. Due to the fact that water does not go into the drain and the erosion process does not occur during irrigation, soil fertility naturally increases. Moisture is well maintained, the number of watering is 2-3 times. was less, the total water consumption was more.

Table 3. The norm of water spent in the care of cauliflower, m^3

Watering time	Before watering soil moisture relative to absolute dry soil ChDNS/%		Sprinkler irrigation m^3	Furrow Ir irrigation m^3
Day 1	15,0	75	336	530
Week 3	16,0	80	244	660
Week 5	16,6	83	300	610
Week 7	16,0	80	295	670
Week 9	15,8	79	340	600

Week 11	14.0	70	320	593
Week 13	15.6	78	298	634
Week 15	14.4	72	278	600
Week 17	14.6	73	266	654
Total			2677	5551
Middle	13.55	76.6	297,4	616,7
Water saved . %			+40,8	0
Water saved. м^3			2874	0

Conclusion. Today, not only in our country, but also in the whole world, in the conditions of water shortage, it is necessary to develop optimal irrigation procedures for resource-efficient sprinkler irrigation of soybean varieties, which are increasing in cultivated areas as the main crop, and to determine the water consumption of the plant. no scientific research was conducted. Rain irrigation method, number of irrigations, seasonal irrigation norm, soybean growth, development, grain yield are considered. Super elite seed varieties of soybean "Nafis" and "Uzbekskaya-6" were planted. In the analysis of the obtained data, it was found that the applied agrotechnical measures and rain irrigation of soybeans have good efficiency in cultivation, that is, soybean variety "Uzbekskaya-6" by rain irrigated soil moisture is 75-80-80 percent compared to CHDNS, seasonal irrigation rate is 2880 m3/ha, general irrigation rate is 3430 m3/ha, grain yield is 28.4 s/ha and the amount of water used for 1 s of crop was 120.8 m3, and the soil moisture before irrigation was 70-75-75 percent according to the CHDNS, when the variety of soybean "Uzbekskaya-6" was grown. in the increased option, the seasonal irrigation rate is 3130 m3/ha, the general irrigation rate is 3680 m3/ha, the grain yield is 23.8 s/ha, and the water consumption rate for 1 s is 154.6 m3, or 250 m3/ha in accordance with the above compared to the control option; 250 m3/ha; It was determined that 4.6 s/ha and 33.8 m3 less water was consumed. Based on one-year scientific observations in the conditions of gray grassland soils of Tashkent region, the soil moisture before irrigation is 75-80-80 percent compared to CHDNS, i.e. 13 times during the growing season of soybean varieties, each irrigation is 220-230 m3/ha, seasonal irrigation rate 2880 m3/ha, 27.6 s/ha of soybean variety "Nafis", and 28.4 s/ha of "Uzbekskaya-6" variety it is possible to get a harvest

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RESEARCHING THEORETICALLY OF THE RECEPTION OF GREEN STEM FORAGE BY THE FEEDERS AND TRANSFER TO THE CHOPPING DRUM

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Abstract. In this scientific article it is described that agricultural branch of Uzbekistan pays a lot of attention to fisheries, poultry and animal husbandry. In fish farming, poultry and livestock rearing, it has been recommended to give green feed as a supplementary feed, which reduces the accumulation of excess fat in fish. In this regard, a grinder was produced for cutting plants with blue content. The number of rotations of the feeders was studied theoretically and experimentally in order to meet the demand of the prepared feeds. According to the theoretical research, the cutting length of blue stalk feed is achieved by changing the number of revolutions of the shredder drum depending on the feed speed V_{uz} and the number of blades in the drum $N\,p$, and the number of revolutions of the feeder blades when the feed is transferred at an angle of 27^{O} is 101-207 r/ in the range of min, when the number of blades is in the range of 4-6 pieces, it is recommended that the number of rotations of the shredder drum be greater than 1358 r/min and 1478 r/min to ensure a cutting length of up to 10 mm.

Keywords: chopper, feeder blades, revolution of the copper, supplier, drum, barley, alfalfa, corn, legumes

Introduction. Achieving good results in the breeding of fisheries, poultry and livestock depends on the quality of the feed provided to them . The following nutritional feeds, concentrated feeds and additional feeds are used in the feeding of fisheries, poultry and livestock [1, 2, 3, 4, 5, 6]. Fisheries, poultry and livestock farms in excess of the norm, because excess fat accumulation is observed in fish. The use of the above-mentioned blue feed helps in the development of fisheries and rapid growth. Fish and poultry feed should be crushed. Taking into account the above, the analysis of today's available devices [7] was carried out to create a small and compact blue stem feed grinder. According to the research results, a feed grinding device for fisheries and poultry was developed.

Methods. Food grinder used in the study of the laws of the nutrient feeder installed in the device.

Verification of the compatibility of the obtained theoretical studies was carried out experimentally. In the experiment, alfalfa and corn stalks were crushed. The working quality of the device was determined by the ratio of fractions in the cut feed up to 5 mm , between 5 - 10 mm and 10 - 20 mm, and larger than 20 mm. For this, the processed feed was divided into parts with a size of up to 5 mm, a size of 5 mm to 10 mm, a size of 10 mm to 20 mm, and a size larger than 20 mm, and their fractional composition was determined on laboratory sieves. According to the specified

requirements, ground feed for fish and poultry should contain more than 50% of fractions with a size of up to 5 mm, more than 30% of fractions between 5-10 mm, and more than 20% of fractions with a size of 10-20 mm and larger.

Results and Discussions. It is important that during the operation of the grinding device, the green stem feeds transmitted through the inclined rod are received through the supply grooves and evenly transferred to the grinding drum. For this reason, the work of the supply chain was studied (figure 1).

In order to consider the process of absorption and transfer of blue stem nutrients by the plants in a simpler case, we will first consider it as an example of plants with a flat surface.

When the stems are received by the joists, they are affected by the normal pressure force N_j and friction forces F_{ishk}.

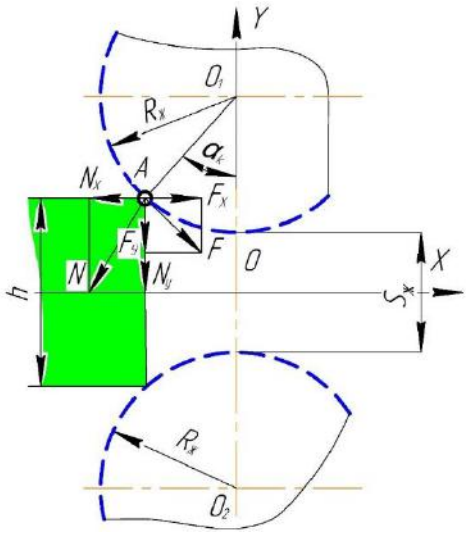


Figure 1. Acceptance of digested food by the sows

The pressure force N of the beams on the stems is always perpendicular to its surface. Separating the forces according to the compression of the stems and the direction of movement, we determine the N_x component of the normal pressure force N and the components of the friction force F_u. In this case, the component of the normal pressure force N_x serves to pull the stems out of the working slot of the grooves, and the frictional force N_u serves to pull the stem mass into the gap between the grooves.

Now let's consider the effect of these forces.

According to the scheme, the forces acting on the stem mass by one joist.

$$\begin{cases} N_x = N\sin\alpha_к \\ N_y = N\cos\alpha_к \end{cases} \quad (1)$$

$$\begin{cases} F_x = F\cos\alpha_к \\ F_y = F\sin\alpha_к \end{cases} \quad (2)$$

in which $\alpha_к$ - angle of coverage of beams, grad.

If we take into account the pair of transmission blades in the device, then the total normal pressure force N exerted by a pair of blades on the stem mass tries to push the transmitted stem mass back out of the receiving zone, while the total frictional force F_{is} directed to the rotating side of the blades, receiving the stem mass inward, tries to pull into the compression zone. The total friction

force of the grains F_u must be greater than the total normal pressure force N_u so that the grains receive the crushed stalks and transfer them from the working slot to the crusher drum.

Total normal compressive strength according to the scheme

$$N_y = 2N\sin\alpha_к \ . \tag{3}$$

We write it as follows

$$N_y^2 = 2N^2\sin^2\alpha_к \ .$$

or

$$\sin^2\alpha_к = \frac{1-\cos 2\alpha_к}{2} \ .$$

from being

$$N_y^2 = 2N^2\left(1-\cos 2\alpha_к\right) \ . \tag{4}$$

We write down the total frictional force of the joints as follows

$$F_y^2 = 2f^2N^2\left(1+\cos 2\alpha_к\right) \ . \tag{5}$$

(4) and (5), expression (6) will be as follows.

$$2f^2N^2\left(1+\cos\alpha_к\right) > 2N^2\left(1-\cos 2\alpha_к\right) \ . \tag{6}$$

or

$$f^2 > \frac{1-\cos 2\alpha_к}{1+\cos 2\alpha_к} \ . \tag{7}$$

(7) expression can be reduced to the following form

$$f^2 > \frac{1-\cos^2\alpha_к+\sin^2\alpha_к}{1+\cos^2\alpha_к-\sin^2\alpha_к} = \frac{\sin^2\alpha_к}{\cos^2\alpha_к} = tg^2\alpha_к \ , \tag{8}$$

since $f^2 = \text{tg}^2\varphi$

$$tg^2\varphi > tg^2\alpha_к \text{ or } \varphi > \alpha_к \ . \tag{9}$$

(8), the friction angle φ must be greater than the angle of reception of the grains a_k in order for the grains to receive the blue stem feed and bring it to the working slot .

As mentioned above, the minimum friction angle of corn and alfalfa stalks in the blue state is $\varphi_{\min} = 25-28^{\text{O}}$ in the interval, the reception angle of the beams is also a_k=30$^{\text{O}}$ should be.

In order to drag the stem mass covered by the grooves through the gap between the grooves, the traction force $T_{tor} > 0$ or the total frictional force F_u should be greater than the total normal compressive force N_u, i.e.

$$T_{mop} = F_y - N_y > 0 \ . \tag{10}$$

Can be seen from the expression (10) that the traction force that carries blue stem feed from the gap between the grooves is equal to the difference between the total frictional force F_u and the total normal pressure force.

Total friction force F_u and the total normal pressure forces into the expression (10).

$$T_{mop} = 2fN\sqrt{\frac{1+\cos 2\alpha_к}{2}} - 2N\sqrt{\frac{1-\cos 2\alpha_к}{2}} =$$
$$= 2fN\cos\alpha_к - 2N\sin\alpha_к = 2N\left(f\cos\alpha_к - \sin\alpha_к\right). \tag{11}$$

the friction coefficient f in the expression (11) by the friction angle φ , *i.e.*

$$f = tg\varphi = \frac{\cos\varphi}{\sin\varphi}. \quad (12)$$

(12) into account, performing some operations, we write the expression (11) in the next form

$$T_{mop} = \frac{2N}{\cos\varphi}\left(\sin\varphi\cos\alpha_к - \cos\varphi\sin\alpha_к\right). \quad (13)$$

or

$$T_{mop} = \frac{2N\sin\left(\varphi - \alpha_к\right)}{\cos\varphi}. \quad (14)$$

Can be seen from the expression (14) that the transfer of blue stem feed through the grooves to the grinding drum depends on the normal pressure force of the grooves, the angle of reception and the friction of the stems on the grooves.

Increasing the angle of stem acceptance in turn leads to an increase in grain diameter or metal consumption, while increasing the normal pressure force is not optimal from the point of view of crushing blue stem feeds.

For this reason, in order to improve the friction or adhesion properties of the blades, their working surface is corrugated, corrugated or covered with rubber material.

Although different types of fluted working surface saws have good pick-up and mixing characteristics, they are not optimal for use in blue-stalk feed grinders because they pre-shear or crush the blue-stalks with their edges. Making them from rubber is expensive.

For this reason, we will select the supplier's jaws with a corrugated surface for use in the device and conduct a theoretical study of them (figure 2).

The forces acting in the opposite direction on receiving blue stem feed on a corrugated mill with a working surface are as follows

$$N_y^e = N_1\sin\alpha_1 + N_2\sin\alpha_2. \quad (15)$$

$$F_{ишк}^e = f\left(N_1\cos\alpha_1 + N_2\cos\alpha_2\right), \quad (16)$$

where f is the friction coefficient.

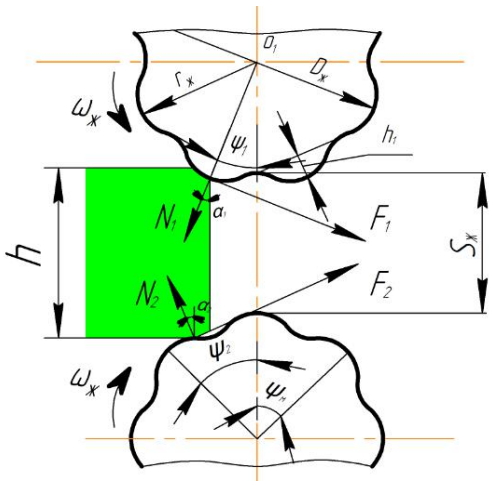


Figure 2. The reception of blue stem feeds with the working surface of corrugated boards

In this case, it is a condition that the stem mass is received by the corrugated joints

$$f\left(N_1\cos\alpha_1 + N_2\cos\alpha_2\right) > N_1\sin\alpha_1 + N_2\sin\alpha_2. \quad (17)$$

Expressing the coefficient of friction through the angle of friction, we write the above expression as follows

$$tg\varphi > \frac{N_1 \sin\alpha_1 + N_2 \sin\alpha_2}{N_1 \cos\alpha_1 + N_2 \cos\alpha_2}. \quad (18)$$

(18) although the normal compressive forces of the upper and α_2 lower beams are not equal $N_1 \neq N_2$, α_1 i.e.

$$N_1 \cos\alpha_1 = N_2 \cos\alpha_2. \quad (19)$$

In addition $\frac{\alpha_1 + \alpha_2}{2} = \alpha,$, it can be considered as an average coverage angle $\cos\alpha_1 + \cos\alpha_2 \approx 2\cos\alpha$.

α_1 and α_2 at small values of the angle the following condition is valid

$$tg\alpha_1 + tg\alpha_2 \approx 2tg\alpha < 2tg\varphi. \quad (20)$$

the stems are accepted by the plants $\psi_1 = \alpha_1$, then

$$\psi_2 = \alpha_1 + \frac{\psi_M}{2}, \quad (21)$$

in this ψ_1 and ψ_2 - of the gophers exposed to blue stem feed

the angle of deviation relative to the axis of the drum, grad;

ψ_M - the central angle describing the pitch of the corrugations, grad.

According to the scheme

$$\cos\psi_1 = \frac{D_j + S_j - h_r}{D_j + h}, \quad (22)$$

in which D_j - the diameter of the grooves, m;

S_j - gap between the grooves, m;

h_g is the height of the corrugations, m.

Also the following attitude is appropriate

$$D_j = h\cos\alpha - S_j + h_r + R_j(\cos\psi_1 + \cos\psi_2) - r_c(\cos\psi_1 + \\ + \cos\psi_2) + 2r_c\cos\alpha \quad (23)$$

where r_g is the radius of the corrugations, m.

If $\psi_2 = \psi_1$ and $\cos\psi_1 > \cos\psi_2$ taking into $\cos\psi_1 + \cos\psi_2 = 2\cos\psi_1$ account that, the expression (23) can be written as follows

$$D_j \leq h\cos\alpha - S_j + h_g + 2(R_j - r_g)\cos\psi_1 + 2r\cos\alpha \quad (24)$$

If we put the value of the expression (22) into the expression (24).

$$D_j \leq h\cos\alpha - S_j + h_g + \frac{2(R_j - r_g)(2R_j + S_j + h_g)}{2R_j + h} + 2r_g\cos\alpha. \quad (25)$$

(25) by performing some operations, we find the diameter of the beams in terms of corrugations

$$D_j \leq \frac{\left(h^2 + 2hr_g\right)\cos\alpha - (S_j - h_g)(h + 2r_g)}{(h + 2r_g)(1 - \cos\alpha)}, \quad (26)$$

where h_g =0.01 m; h = 0.02 m; C_j =0.01 m; r_g =0.01 m; If α= 35-40 ^{O}, it turned out that D_j should be ≤ 6.5 cm.

The main parameters of the groove are also its number of turns, width and gap between the grooves. These parameters are mutually determined depending on the performance of the device.

It is known that the mass transfer capacity of sawdust suitable for the performance of the grinding device can be determined as follows

$$q = \eta S_j B_j V_{ut} \rho, \tag{27}$$

where η - the coefficient of filling of the interval of jova;

V_j – the width of the grooves, m;

V_{ut} - the speed of the stalk feed passing through the grooves, m/s;

ρ - the density of stem nutrients, kg/m ^{3}.

Although the surface of the grooves is corrugated, but due to the fact that there is a slight slippage during the transmission of stem nutrients, the speed of the stem nutrients passing between the grooves is as follows

$$V_{ut} = k_T \omega_j R_j, \tag{28}$$

where k_T is the sliding coefficient;

ω_j – angular velocity of the beam, rad/s;

R_j is the radius of the beam, m.

(28), (27) is as follows

$$q = \eta S_j B_j k_T \omega_j R_j \rho. \tag{29}$$

(29), we find the angular velocity of the beams

$$\omega_j = \frac{q}{\eta S_j B_j k_T R_j \rho}. \tag{30}$$

On the other hand

$$\omega_j = \frac{\pi n_j}{30}, \tag{31}$$

where n_j is the number of revolutions of the gears, r/min.

By equating the expressions (30) and (31), we determine the number of rotations of the

$$q = \frac{n_j \pi \eta k_T S_j B_j R_j \rho}{30 k_{uz}}. \tag{32}$$

Expressing the radius R_j of the groove in this expression by the diameter D_j, we get the following

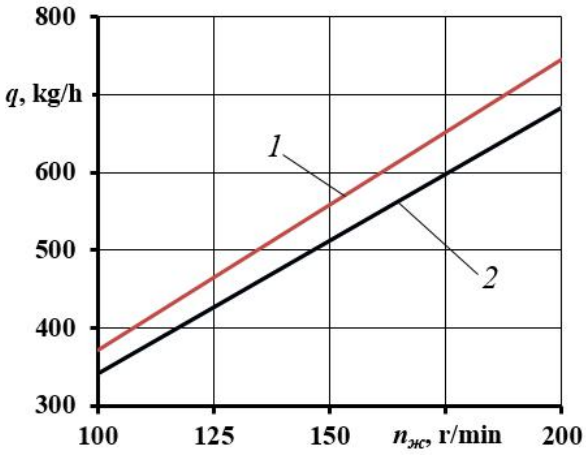
$$q = \frac{n_j \pi \eta k_T S_j B_j D_j \rho}{60 k_{uz}}. \tag{33}$$

It can be seen from the expression (33) that the number of rotations of the feed mill is directly proportional to its productivity, k_T, S_j, V_j, D_j and inversely proportional to the density of the ground food . ρ

(33) expression determines the interrelationship between the number of revolutions of the grinding device and other parameters of the grinding device.

Based on this expression q =0.142 kg/s; $k_{uz} = 0,5 - 0,8$; $\eta = 0,7 - 0,8$; $k_T = 0,8 - 0,9$; C $_j$ = 0.01 m; B $_j$ = 0.2 m; D $_j$ = 0.06 m; Based on the fact that it is $\rho = 118,2$ kg/m ^{3}, a graph was built showing the effect of the number of turns of the feeder on the productivity of the device, taking into account the density of corn and alfalfa stalks to be ground (figure 3).

As can be seen from the graph, depending on the density of corn and alfalfa stalks, to ensure the productivity of the device of 600 kg/h, S_j = 0.01 m; B_j = 0.2 m; When $Д_j$ = 0.06 m, k_{uz} = 0.5 – 0.8; η = 0.7 – 0.8; Considering that k_T = 0.8 – 0.9 varies, it was found that the number of revolutions of the gears should be in the range p_j = 101-207 r/min.



1 – corn stalk; 2 – clover stem

Figure 3. The effect of the number of revolutions of the grinding device feeder on the performance

Conclusions. The transmission speed of the stalks transmitted to shredding to ensure the cutting length of blue stalk feed at the level of the specified requirements is achieved by changing the number of revolutions of the shredder drum depending on the number of knives in the drum V_{uz} and the number of knives in the drum, and the number of revolutions of the feeder blades when the feed is transferred at an angle of 27^O is in the range of 101-207 r/min , the number of revolutions of the shredder drum should be greater than 1358 r/min and 1478 r/min to ensure a cutting length of up to 10 mm when the number of blades is in the range of 4-6 pieces.

The time change of the speed of movement of the cut stem piece along the blade under its influence when the radius of the drum is 75, 100, 125 and 150 mm shows that the speed of the stem pieces constantly increases during its movement along the blade towards its upper part and 4.5-6 from the upper part of the blade It shoots out with a speed of m/s.

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ОЗУҚАБОП ПОЯЛАРИНИНГ ЭГИЛИШГА ҚАРШИЛИГИНИ ЎРГАНИШ

Я. Жуматов

“Тошкент ирригация ва қишлоқ хўжалигини механизациялаш мухандислари институти” Миллий тадқиқот университети

Аннотация. Мақолада тадқиқот объекти сифатида озуқабоп ўсимликлар пояларини ўриш ва майдалаш ишчи органларини танлаш, соддалаштириш ва яратиш нуқтаи назаридан озуқабоп ўсимликлар пояларининг физик-механик хусусиятларидан бири эгишга қаршилигини дала шароитида ўрганиш натижалари ва олинган натижалар асосида маккажухори пояси мисолида қаттиқлиги моделлари келтириган.

Таянч сўзлар: ўсимлик, озуқа, поя, ўриш, майдалаш, эгиш, қаршилик, қаттиқлик, модел, ишчи орган.

Аннотация. В статье приведены результаты одно из физико-механических свойств стеблей кормовых растений сопротивление к отгибу в полевых условиях с точки зрения выбора, упрощения и создания машин и рабочих органов для уборки и измельчения кормовых стеблей как объекта исследования и теоретические модели, полученные по результатам полевых опытов.

Ключевые слова: растения, корм, стебель, кошение, измельчение, отгиб, сопротивление, жесткость, модель, рабочий орган.

Abstract. The article presents the results of one of the physico-mechanical properties of the stems of fodder crops the point of view of selection, simplification and creation of working bodies for harvesting and grinding of fodder stems as an object of study and theoretical models obtained from the results of field experiments.

Key words: plants, feed, stem, mowing, grinding, limb, resistance, stiffness, model, working body.

Кириш. Маълумки, Ўзбекистон иссиқ иқлимида парвариш қилинадиган экин маҳсулотлари хоссалари Европа шароитида ўстирилган шундай экин кўрсаткичларидан фарқланади. Республикамизда дон учун ўстирилган маккажўхори пояларининг қобиғи қалинроқ ва қаттиқроқ бўлиб, унинг металл билан ишқаланиш коэффиценти бирмунча оз бўлиши экспериментларимизда аниқланган. Дастлабки кузатувлар натижасида маккажўхори поясининг илдиз томонидаги қисми (12-15 см) нинг қобиғи қаттиқ бўлиши туфайли унга пичоқ тиғининг ботиши бирмунча қийинлашади.

Озуқаларни тайёрлаш технологик жараёнлари металл ва энергия сиғими катта машиналар базасида амалга оширилади. Озуқаларни озиқлантиришга тайёрлаш сезиларли даражада озуқаларнинг туйимдорлигини, ейимлилигини ва чорва молларининг маҳсулдорлигини кўтаради. Натижада чорвачилик маҳсулотларини етиштиришда иқтисодий самарадорликга эришилади. Юқорида қайд этилганлардан келиб чиқиб қуйидаги масалаларни ечишда муаммолар мавжуд: майдалаш жараёнини интенцификациялаш, нисбий энергия сарфларини камайтириш, ишчи органларни соддалаштириш.

Ҳозирги вақтда ва яқин келажакда қишлоқ хўжалиги ҳайвонлари учун озуқа хом-ашёсига ишлов бериш усулларидан асосийси – механик усул бўлиб қолади. Шу билан бирга озуқага ишлов беришнинг турли хил усулларининг самарадорлиги (майдалаш, қирқиш, эзиш ва бошқалар) мавжуд машина ва жихозларнинг ўзига мос ишчи органларининг иш режимлари

ва параметрларини ишлаб чиқишда асосан майдаланиладиган хом-ашёнинг физик-механик хоссаларининг ўзига хос жиҳатларини энг қулай усулда қўлланишига боғлиқдир.

Тадқиқот объекти ва услубияти. Ўсимлик хом-ашёсининг мутонасиблигининг ўзига хослиги, анизотроп ҳоссасининг кескин ифодаланиши, катакчалари орасидаги намликнинг мавжудлиги, поялрнинг қаттиқлик ҳоссаларининг ночизиқлиги ва унинг юкланиш режими тезкорлигига боғлиқлиги уларнинг деформацияланиш жараёнини математик ифодалашни мураккаблаштиради.

Қишлоқ хўжалиги экинларининг физик-механик хоссаларини тадқиқ қилишга кўплаб ишлар, айниқса экспериментал тавсифдаги ишлар бағишланган. Асос бўладиган ишларга Горячкин В.П., Желиговский В.А., Гутьяр Е.М., Босой Е.С., Резник Н.Е. ва бошқалар, чет элларда олиб борилган ва кўпроқ маълум бўлган ишлардан Asher J., Chancellor W.I., Elfes L.E., Feller R, Herrmann K., Schulze K.H., Stroppel Th., Marly, Schmerwitz C., Sellegren G. ишларини киритиш мумкин. Маълумки, кўп сонли ишлар қишлоқ хўжалик материалларининг деформацияланиши ва қаттиқлик тавсифлари аспектларини қирқиш, майдалаш, зичлаш ва шунга ўхшашларнинг турли хил жараёнларини ва амалга ошириш усулларини ўрганишга бағишланган. Кўпчилик ишларнинг алоҳида ажралиб турадиган хусусиятлари шундан иборатки, улар асосан олдиндан танлаб олинган ишчи орган ва материалларга ишлов бериш усулларига мосланиб олиб борилганлигидадир. Материалларнинг деформацияланиш ва майдаланиш жараёнини моделлаштириш жуда истиқболи порлоқ йўналиш ҳисобланади. Мисол учун, Резник Н.Е. ишларида деформацияланишнинг механик ўхшашлигини («Гук жисими», «Максвелл жисими», «Кельвин жисими» ва бошқалар) қўллаш йўли билан материални сиқиш жараёнини моделлаштириш усубининг умумий кўриниши қаралган [1].

Бундай ёндошиш, яъни механик ўхшашликларнинг турли даражада қўшиб олиб борилиши, етарлича мураккаб, эластик-пластик ва қайишқоқлик хоссаларини бирга қўшиб, материаллар деформацияланишини моделлаштириш имконини беради. Бунда, жараённи математик изоҳлаш сезиларли даражада соддалашади. Математик-физика соҳасидаги ишлар назарий жиҳатдан ўзининг юқори даражалиги билан ажралиб туради, улар турли хил жисмларнинг мураккаб кучланиши холатини тадқиқ этишга бағишлангандир.

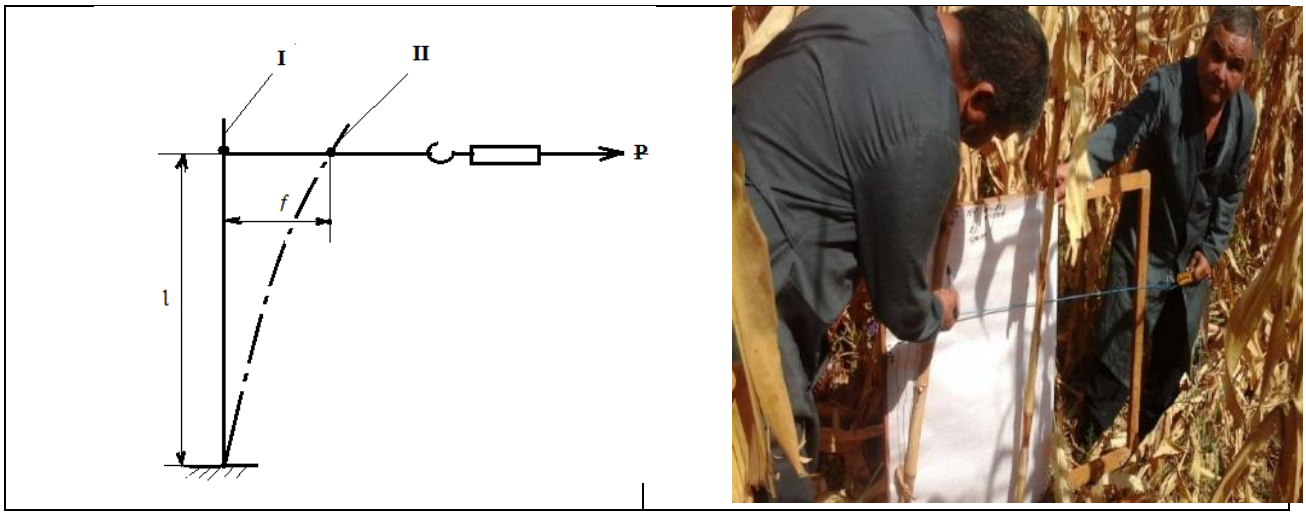
Моделлаштириш ва аналитик натижалар бўйича бажарилган ишларнинг дастлабки таҳлили шуни кўрсатадики, муаллифлар тадқиқот вазифаси малакасини қўйишда, қоидага биноан, объектни ифодалаш катта қийинчилик туғдиради ва ҳисоблашнинг мураккаблиги билан боғлиқ бўлган омилларни ҳисобга олувчи жараённинг ечимини соддалаштириш мақсадида бир қатор шартлар ва гипотезалар қабул қилишган. Шуни ҳам айтиб ўтиш жоизки, натижалари эҳтимоллилик модели кўринишида тақдим этилган. Поясимон ва донли материалларнинг деформацияланишини моделлаштириш бўйича ишлар сони етарлича эмас. Дала шароитида маккажўхори поясини эгиш бўйича ўтказилган тажрибалар шуни кўрсатадики, узунлик ўлчамлари бир хил бўлган поялар қиймати бир хил эгувчи момент билан юкланганда, уларнинг қаттиқлиги бир биридан тубдан фарқ қилади. Бундан кўриниб турибдики, жараённи ифодалаш учун эҳтимоллик назаридан ёндошиш керак, детерминистик ёндошиш эса жузий холлардагина ҳаққонийдир.

Шундай қилиб, асосий озуқа экинлари турлари поясининг мустахкамлик тавсифларини тадқиқ қилиш бўйича бажарилган ишлар сонининг нисбатан камлиги, йўналиш доирасининг қисқалиги, деформацияланиш ва майдаланиш жараёнининг тўлиқ ва аниқ тасвирини олиш имконини бермайди. Айнан ушбу холат озуқа тайёрлаш машиналарининг технологик жараёнини ва ишчи органларини такомиллаштиришда катта қийинчилик туғдиради, ишлаб чиқарувчини эса аниқ аналитик усулларга таяниб иш кўриш ўрнига, ички ҳиссиёти ва мантиқий усуллар, қоидалар мажмуасини шакллантирувчи қобилиятларига бўйсиниб иш бажаришига ундайди.

Тадқиқот натижалари. Озуқаларга ишлов бериш технология ва техникаларини танлашда озуқабоп ўсимликларнинг физик-механик хусусиятлари ҳисобга олиш мухим ҳисобланилади.

Қишлоқ хўжалиги ўсимликлари учун уларни егишда қаттиқлик доимийлиги EJ га риоя қилинмайди. Бу, материал ички тузилишининг мураккаблиги билан тушунтирилади. Поя конструкциясини яна унинг юқори мустаҳкамликга эга тугун буғинлари сезиларли кучайтиради. Аммо, поя мустаҳкамлиги деформациянинг ҳар хил йўналишида сезиларли фарқ қилади. Бу холат энг аввало поя тугун буғинлари толаларининг бўйлама ва кўндаланг сиқиш ва чўзиш мустаҳкамлик модулларига тегишлидир. Пояларни эгишда мустаҳкамлик модулларидаги сезиларли фарқ поя нейтрал ўқининг чўзилган толалар томон сурилишига, кесим момент инерциясининг ўзгаришига, максимал кучланишнинг нотекис ўсишига олиб келади, агарда улар томонидан бўзиш қийматига етадиган бўлса ёки толаларнинг узилиш ҳисобига ёки уларнинг езилиши ҳисобига поя синиши содир бўлади.

Маккажўхори поясининг мустаҳкамлик хусусиятларини дала шароитида ўрганиш учун биз томондан маккажўхори поялари (нави) билан пишиш фазасида тегишли тажрибалар ўтказилди. Ҳар хил диаметрли пояларни эгиш эгат ўқи бўйлаб ва кўндалангига ўн марта такрорлашлар билан ўтказилди. Эгиладиган куч *(P)* пояга дала юзасига нисбатан горизонтал текисликда *(l)* баландликда параллел динамометр билан қўйилди (1а-расм).



а) б)

1-расм. Пояни эгишни ҳисоблаш схемаси (а) ва дала тажрибасидан кўриниш (б):
I-поя бошланғич холати; II-поянинг куч таъсирида эгилиш холати; *l*-эгиш кучини қўйиш баландлиги; *P*-қўйилиш кучи; *f*-эгиш катталиги

Эгиш катталиги *(f)* поянинг вертикал холатидан куч қўйилиш холатига мос холати (поя синишигача) поя толасининг чўзилган томонидан махсус экранга фламестер билан фиксация қилиниб борилди (1б-расм). Эгиш поянинг эзилиш ёки синиш холатигача ўтказилди. Эгиш кучини қўйиш бошланғич баландлиги *(l)* 60 см атрофида олинди, ушбу баландлик бўйича поя диаметрида сезиларли фарқи бўлмаслиги таъминланди.

1-жадвалда мисол тариқасида томир буғини қисмда ўлчанган диаметрлари 25, 26, 28 ва 30 мм тўртта маккажўхори поясини синаш натижалари келтирилган. Жадвалдан кўриниб турибдики, ҳисобланган кесимларда пояларнинг қаттиқлиги диаметрига боғлиқ, мустаҳкамлик деформацияси чегарасида максимал қийматга эга бўлади, сўнг бузилиш моментигача пасайиб боради.

Қаттиқликнинг f ва P лар боғликлигини жадвалдан таҳлил қилиш кўп хадли иккинчи даражали кўринишда аналитик моделларни олиш мумкинлигини кўрсатди:

$$EJ(f)=a_0f^2 + a_1f + a_2,$$

$$EJ(p)=C_0P^2 + C_1P + C_2.$$

Бунинг учун файл Polyfit(*x*,*y*,*z*) фойдаландик, бу ерда $y=EJ$, $x=f$ ёки $x=P$. Бу файл MatLAB тизимида модел коффициентларини энг кичик квадратлар усулида олиш учун хизмат қилади [2]. Мисол учун, диаметри d=2,5 см поя учун EJ=[16 369 11 000 7 000 5 000]; f=[4 13 30 54]; P=[1 2 3 4] эга.

Моделлар коэффициентлари:

$Pa(f)$: $a_0 = 0{,}0057*10^3$ $Pa(P)$: $c_0 = 0{,}75*10^3$

$a_1 = -0{,}5405*10^3$ $c_1 = -7{,}45*10^3$

$a_2 = 17{,}7209*10^3$ $c_2 = 22{,}5*10^3$

1-жадвал.

Дала шароитида маккажўхори пояларининг эгишга қаршилигини аниқлаш натижалари

	Поя	диаметри	2,5 см		
Эгиш кучи *P*, кГс	1	2	3	4	
Эгилиш қиймати *f*,см	4	13	30	54	
Қаттиқлиги EJ,кГс,см^2	16 363	11 000	7 000	5 000	
	Поя	диаметри	2,6 см		
Эгиш кучи *P*, кГс	2	3	4	5	
Эгилиш қиймати *f*,см	8	12,5	19,5	30,6	
Қаттиқлиги EJ,кГс,см^2	18 000	17 300	14 770	12 000	
	Поя	диаметри	2,8 см		
Эгиш кучи *P*, кГс	3	4	5	6	7
Эгилиш қиймати *f*,см	10,8	16,5	32	44	56
Қаттиқлиги EJ,кГс,см^2	21 000	17 400	11 000	981	892
	Поя	диаметри	3,0 см		
Эгиш кучи *P*, кГс	4	6,5	7,5	8,5	10
Эгилиш қиймати *f*,см	7	18	26,5	37,5	46,5
Қаттиқлиги EJ,кГс,см^2	41 142	27 500	20 370	16 300	15 483

Келтирилган маълумотларда эгиш елкаси l = 60 см, эгиш кучи *P* дала юзасига параллел текисликда қўйилди, қаттиқлик $EJ = \frac{Pl^3}{3f}$ формула билан аниқланди.

Натижада қидирилаётган моделларни олдик:

$$EJ(f)_m=(0{,}0057*f^2 - 0{,}5405*f + 17{,}7209)*10^3;$$

$$EJ(P)_m=(0{,}75*P^2 - 7{,}45*P + 22{,}75)*10^3.$$

Тажриба малумотлари EJ_{on} ва EJ_m тенглама билан ҳисобланилган маълумртлар орасидаги фарқ ҳар бир кесимда фоизда ва модул бўйича максимал қиймат танланилди:

$$\Delta EJ=\max\{\frac{EJon-EJm}{EJon}\}100.$$

Жумладан, қаралаётган мисол учун

$$\Delta EJ(f)_{max}=2{,}14\% \text{ и } \Delta EJ(p)_{max}=6{,}1\%.$$

Ҳар хил диаметли поялар учун анологик тенгламалар олинди:

а) d=2,6 см:

$$EJ(f)_m=(0{,}0068*f^2-0{,}6872*f+23{,}2641)*10^3,$$

$$EJ(p)_m=(0{,}7351*P^2-8{,}8750*P+39{,}9805)*10^3.$$

б) d=2,8 см:

$$EJ(f)_m=(0{,}0072*f^2-0{,}7276*f+27{,}1859)*10^3,$$

$$E\mathcal{J}(p)_m=(0,7857*P^2-10,9571*P+47,1714)*10^3.$$

в) d=3,0 см:

$$E\mathcal{J}(f)_m=(0,0206*f^2-1,7499*f+52,257)*10^3,$$

$$E\mathcal{J}(p)_m=(0,5550*P^2-12,2902*P+81,6603)*10^3.$$

Шу билан бирга барча тенгламалар бўйича максимал хатоликлар 6,3 % дан ошмайди, бу назарий моделларнинг тажриба маълумотларига жуда яхши яқинлашганини билдиради.

Эгиш бошланишида f ва P нинг нисбатан катта бўлмаган қийматларида $E\mathcal{J}$ катталиги максимумгача, яъни мустахкамлик холатининг чегарасигача, синишгача ўсиб боради. Дала тажрибалари ўтказиш жараёнида поя қаттиқлигига намлиги, тугун буғинлари сони, поя узунаси бўйича диаметри таъсири кузатилди.

Хулоса. Дала тажрибалари натижалари асосида маккажўхори поялари қаттиқлиги бўйича олинган назарий моделлар дағал пояли ўсимликларни ўриш ва майдалаш машина ва ишчи органларини конструкциялашда геометрик параметрларини ҳисоблашга асос қилиб олиниши мумкин.

Фойдаланилган адабиётлар.

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