SUBSTANTIATION OF CONSTRUCTIVE PARAMETERS OF THE SEEDING MACHINE FOR SOWING OF NON-FLOWING GRASS SEEDS

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Abstract: The production and breeding of new varieties of high-quality seed material is connected with the sowing of a wide range of crops with different physical and mechanical properties of seeds. In existing seeding machines, the sowing devices are capable of sowing loose and medium-flowing seeds, such as wheat, barley, rye, etc. Further transport it to the working bodies for soil application. A characteristic disadvantage in the introduction of hard-flowing (non-flowing) seeds is the presence of a coagulation zone, which should be destroyed. In order to improve the quality of sowing non-flowing seeds, the design parameters of the sowing apparatus for seeding non-flowing grass seeds for moisture and energy-saving technologies in feed production will be substantiated and developed.

KEYWORDS: SOWING MACHINE, SEEDER, COULTER, ROLLER, FRAME, SEED TUBES, SUPPLY TANK

The transition to new technologies in the Republic without appropriate technical equipment and modernization of existing ones and the creation of new machines, taking into account domestic and foreign experience, is impossible today [1]. However, the analysis shows that the increment in the yield of agricultural products, the cost reduction from the introduced new varieties is measured in units of percent, as a rule, not more than 10-15%. More significant results of increased efficiency can be obtained when developing new original technologies and means of mechanization [2,3].

About 30-40% of the acreage is sown with seeders-cultivators of the CIS (UPC-2.1) and non-CIS countries (Flexi-Coil, John Deer, Concord, Amazonia, Horsch, Argentine seeder Crucianelli Pionera, etc.), as well as refitted appropriately commercially available seed drills are: grain planters SZ-3.6 and SZP-3.6; grain grass NWT-3.6 and SZU-3.6; grass-grass SLT-3.6; seeder IIM-4;

In this situation, it is necessary to under sow and sow fodder grasses of perennial and annual plants, including legumes and cereals.

The quality of sowing largely depends on the perfection of the design of the sowing apparatus, technical condition and correct adjustment. However, modern grain seeders provide pulsating flows, which is why there are groups of seeds and gaps in the grooves that exceed the calculated interval. This is used on the Argentine seeder Crucianelli Pionera, on grass seeders for sowing meadows and pastures Herbamat, on sowing equipment of the NWT series of the Ukrainian manufacturer Chervona Zirka (Red Star), etc. and the designers of seeders are constantly improving the machines [4, 5].

Despite their multiplicity and diversity, when sowing non-flowing seeds, continuous filling of seed boxes does not occur, due to the lack of regular supply of material to the blowers, therefore, to coils and spirals, due to their design, they are more suitable for transporting flowing and non-flowing materials than dosing.

The implementation of new technologies, their introduction into production on large areas, require the development of appropriate means of mechanization, which would meet the requirements and capabilities of the majority of agricultural producers in the conditions of Northern Kazakhstan both in quality and price. [6,7,8].

The proposed work is aimed at the development of effective technical means for the implementation of new technologies. With all the variety of designs of sowing machines, they are made almost according to a unified concept, containing the following main components: indicated in Figure 2.1.

In general, the process is as follows. Seeds located in the supply tank, flow by gravity or fed by force to the dosing device. Dosing devices form seed streams that fit into grooves made in the soil by coulters or working bodies. Packing working bodies, following the coulters, cover the seeds with soil and compact it.

The volume of the supply tank can be determined by the formula, [9, 10]:

\[ V = \frac{L \cdot B \cdot Q}{10^4 \cdot \gamma \cdot \eta}, \]

where L is the length of the rut from refueling to refueling, m; B-width of the machine, m; Q- seeding rate, kg / ha; Y- seed density, kg / m3; e - the utilization capacity of the tank.

The greater the capacity of the supply tank, the less often they stop the machine for refueling, but the more unproductive transportation of seeds or fertilizers across the field.

R.R Gavrilyuk and M. A. Nazarets [11,12], using the method of extreme values of functions, propose formulas for determining the basic dimensions for the most common forms of containers: rectangular, rolling at the bottom into trapezoidal.

To determine the basic dimensions of these forms of containers, the formulas of their volume (V) and the expression relating the capacity of the container (E) with the operational and technological indicators of the work of the sowing unit were used.
where \( W \) is the productivity of the sowing machine, ha / h; \( T \) - the duration of the machine until the next filling by the material, h.

Analysis of formula (2) shows that with an increase in the capacity of the compartment for seeds up to 800 dm3, the productivity of three-drill seed unit increases and most noticeably when working at elevated speeds, and at low speed, the effect of the capacity of the grain seeker capacity of serial seeders on productivity [13].

Thus, the analysis of research work on the justification of the volume of the capacity of the seed and solid fertilizer boxes shows that the capacity of the seed box should be within 200-250 dm3 per 1 m width of the seeding machine, and the capacity of the fertilizer box within 150-200 dm3 per 1 m width capture.

Among the huge variety of forage crops, a special group is occupied by seeds that are characterized by poor flowability. These are cereal grasses that have spines: grains, a variety of fescue, high rye grass, etc., uneven outer flowering scales (awnless scarf) or pubescence (bluegrass, meadow and marsh). For sowing of such seeds the seeders with blowers and Tedders are used; it is allowed to be sown with diluents: sifted by the granular superphosphate, sand, non-similar seeds of other crops, since the coefficient of friction of movement of these seeds is low, for example, the grass grain is 0.62-0.71, sainfoin 0.6-0.74, wheat grass 0.66 -0.69 and lawn fescue 0.61-0.71. In order to solve the problems of seeding non-flowing and conventional crops, we propose a sowing apparatus, Figure 2.2 [14].

According to Figure 2.2, three blades are installed on the device at an angle of 1200 relative to the lower part of the pump shaft, deflected from the vertical by 8-100, and components with a radius-vector of 10-150. The shaft of the supercharger is fixed to the upper part of the sowing cylinder by means of a threaded connection.

The sowing device works as follows, the sowing cylinder 5 with a helix and a blower (auger) 2 comes into rotational motion from the drive of the sowing apparatus 8. In this case, the spirals of the auger 2 seize the seeds and transport them in the direction of the blades 3. The blades 3 in turn take the seeds, moving them along the body of the cone to the helical spirals of the sowing apparatus 5. The helical spiral evenly distributes the seed flow over its surface and transports them to the periphery, in the direction of the sleeves 7, where the seeds are supplied airflow. Seeds, getting into the sleeves, with the help of the air flow are moved in the seed tubes to the openings distant from the sowing unit. The number of sleeves corresponds to the number of coulters on the planter.

Installation on the nipple sleeves for air flow on the sowing unit will ensure uniform sowing of non-flowing seeds with a large capture width of one sowing unit [14].

The technological process of sowing the seeds of the proposed sowing apparatus should be divided into the following stages: the movement of seeds from the seed bunker through the sowing window using a blower; the movement of seeds inside the supply cylindrical tube to the distribution cone under the action of the blades; disperse of their distribution cone along the periphery of the mantle; the seizure of the seeds of the spiral coils and their movement to the distribution head; separation of seed flow in the distributor head into separate flows and their direction to the seed tubes.

The uniform distribution of seeds by area is the final result of the movement of the seed flow in the working bodies of the sowing machine. The first stage of this movement is the formation of a seed flow in the seed box and its outflow through the sowing window under the action of a blower. The features of the first stage largely determine the final result of the sowing process.

Based on the experimental data, we have established that inside the vessel above the opening from which the seeds flow, a vault, which has the shape of a paraboloid, is formed [15]. For the destruction of the arch we have installed a blower. The seeds that form the arch are in a stastically unbalanced state, as a result of which the arch is continuously destroyed and re-formed. The formation of a dynamic unloading arch leads to the fact that the pressure on the lower surface does not depend on the total height of the bulk layer and is determined only by the height of the arch, which is in a state of unstable static equilibrium. To determine the height of the dynamically unloading arch, Protodyakonov M.M. gives the following expression [16, 17]:

\[
b = \frac{a}{2f},
\]

where \( b \) - the height of the arch; \( a \) - hole diameter; \( f \) - coefficient of internal friction.

When the height of the blower is equal to the height of the arch of seeds, the formation of the latter is excluded, that is, the height of the blower must be equal to or greater than 6-8 mm. The remaining parameters of the blower can be determined from the following expression [2]:

\[
\dot{x} = \frac{E + f \omega}{c_\omega} r_b \left( e^{c_\omega - t} - 1 \right),
\]

where \( E = -g \sin \alpha + f g \cos \alpha \) and \( C = 2f \cos \alpha \).

Here \( \alpha \) - angle of the screw of the blower, hail; \( \omega \) - rotation frequency of the blower, c\(^{-1}\); \( r_b \) - radius of blower screw.

Let’s consider the movement of seeds inside the supply cylindrical tube to the distribution cone under the action of the blades. Since the blades deviate from the vertical by 8-100, and are 10-150 with a radius-vector, they move the seeds down and from the center to the periphery of the yoke. Seed speeds along the blade are described by formulas (5), (6), (7) and (8).

\[
\vartheta_z = \sqrt{\vartheta_x^2 + \vartheta_r^2},
\]

\[
\vartheta_r = \sqrt{\vartheta_r^2 + \vartheta_z^2}.
\]
The movement of seeds in the distribution head and along the sleeves is similar to the movement of particles on an inclined plane and the expressions obtained in this article are not given, since they are fairly well known.

Thus, the theoretical dependences of the movement of seeds at various stages in the proposed sowing apparatus, by using of which the necessary technological and structural parameters of the apparatus, providing high quality sowing of non-freeze grass seeds were established. To check the correctness of the choice of the parameters of the sowing apparatus, it is necessary to conduct extended laboratory and field research.

LIST OF USED SOURCES

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7 Yurchenko V.A., Khamitov M.B. Fodder cultivation technology. AgroAlem 30.08. 2017

Using these expressions at a given seed speed along the blade, we establish the necessary technological and design parameters of the blade.

The next stage is the movement of seeds by a distribution cone along the periphery of the mantle.

The equation describing the relative speed of the grain along the cone, takes the form

$$\chi = \frac{E \omega^2 (r - d) (1 - e^{-\omega \cdot t})}{C \omega}$$

$$D = (f_1 - f_2) \cdot g \sin \xi$$

14 Protodyakonov M.M. The Theory of Dynamic Unloading Code, Moscow, 1909

$$E = g \sin \alpha, M = (2 \omega f + g \cos \alpha) \frac{f}{\sigma_k}.$$