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Model for Determining the Parameters of the Distribution Drum of the Sowing Seeder Hopper of Seeds of Desert Fodder Plants

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Abstract— The article provides evidence that about 20 million hectares of desert pastures of Uzbekistan allocated for livestock. To improve the condition of desert pastures, methods for determining the parameters of the distribution drum of the hopper of an innovative sowing seeder that satisfy the agrotechnical requirements for sowing seeds of desert fodder plants are presented.

Keywords: desert, semi-deserts, livestock, domestic animal, pasture, fodder plant, seed, seed mixture, agricultural crops, distribution apparatus, hopper, distribution drum.

I. INTRODUCTION

The total area of Uzbekistan is 44.78 million hectares. Of these, 32 million hectares of land consists of deserts and semi-deserts[1]. About 20 million hectares of desert pastures of Uzbekistan allocated for livestock. Domestic animals take 95-100% of the required useful feed in natural pastures. When feeding domestic animals, desert fodder plants play a significant role in her physico-mechanical properties of seeds and seed mixtures of desert fodder plants are very different from seeds and seed mixtures of agricultural crops. As a result of the low density and low friability of seeds and the high content, the remainder of plants and other satellite elements in the composition of the seed mixture and as a result of the existence of winged seeds cause problems during mechanized sowing of seeds.

II. FORMULATION OF THE PROBLEM

At present, one of the main problems in the field of sowing seeds is not obtaining the expected result during sowing of desert fodder plants with the help of seeders intended for sowing seeds of agricultural crops. The reason for this is the mechanical pressure of the distribution apparatus of the hopper of the seeder sowing seeds of agricultural crops on small, not friable, with winged seeds. As a result of sowing with the help of seeders intended for agricultural crops, seeds of desert fodder plants are injured, crushed and lose biological fertility. These seeders do not satisfy the agrotechnical requirements for sowing seeds of desert fodder plants. One of the main tasks is the development of a seeder satisfying agrotechnical requirements for sowing seeds of desert fodder plants. As a result of many years of scientific and experimental work on sowing seeds, technology has been created and an innovative seeder has been invented that does not mechanically affect seeds, producing high-quality sowing of seeds of desert fodder plants [3]. The novelty of the innovative seeder is the changes in the design of the seeder and the installation of a seed distribution drum in the hopper. During the work of the seeder, the distribution drum installed in the hopper prevents the breaking and crushing of seeds, almost mechanically does not affect the seeds. As a result of this, high-quality sowing and increased seed fertility are achieved. The recommended seeder meets the agrotechnical requirements for sowing desert fodder plants.

III. DECISION & RESULTS

The determination of the parameters of the seed distribution drum is based on the physical and mechanical properties of the seeds. To solve this problem, according to the instructions of a number of scientists [2, 3, 4, 6, 7, 8], in accordance with the technical requirements for the quality sowing of seeds of desert fodder plants, the average seed density is taken $\gamma = 0.25$ g / cm^3; it is planned to sow seeds with a radius of the distribution drum of the seeder from r_0=2.5 cm to 12.5 cm in increments of 2.5 cm; with a rotation frequency from v= 0.5 m / s to 15.5 m /s in increments of 0.5 m /s; with the width of the normalizing box from z = 0.3 cm to 1.5 cm in increments of 0.3 cm;

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with the height of the normalizing box from h = 0.3 cm to 1.5 cm in increments of 0.3 cm; with the length of the normalizing box from l = 5 cm to 25 cm in increments of 5 cm; with the tractor speed from v_t =0,8 m / s to 2.4 m / s in increments of 0.4 m / s; with seed purity from u_t = 10% to 70% in increments of 5; with the fill factor of the normalizing box is from t_k = 10% to 100% in increments of 10%.

The article deals with the task of sowing seeds of iszen, saxaul, teresken in a distance of 1 meter. To solve this problem, a "Program for remote-automatic control and monitoring of the sowing process of seeds of desert fodder plants (izen, saxaul and teresken) was created and CERTIFICATE No. DGU 06575 (13. 06.2019) was received from the intellectual property agency under the Ministry of Justice of the Republic Uzbekistan [9]. The task determines the number of seeds in each normalizing box of the distribution drum of the seeder hopper and the linear speed of rotation of the drum. The total volume of seeds in the box of the distribution drum is calculated by the formula:

$$V_u = \frac{u_t \cdot t_k \cdot z \cdot h \cdot l}{10000} \quad (1)$$

Here, u_t – fill factor of the normalizing box with; t_k –seed purity,%; z –width of the normalizing box, m; h – height of the normalizing box,m; l – length of normalizing box, m.

The total mass of seeds in the box of the distribution drum is calculated by the formula:

$$m_u = \gamma \cdot V_u \quad (2)$$

Here is the γ-average seed density (bulk density).

The number of seeds in the box of the distribution drum is calculated by the formula:

$$n_u = \frac{1000 \cdot m_u}{m_{u_1}} \quad (3)$$

Here m_{u_1} is the mass of one seed.

The cyclic frequency of rotation of the drum (angular velocity) is calculated by the formula:

$$\omega = 2 \cdot \pi \cdot \nu \quad (4)$$

Here π=3,14; ν - drum rotation frequence (m/min);

The linear speed of rotation of the drum is calculated by the formula:

$$v_b = \omega \cdot r = \frac{2 \cdot \pi \cdot \nu \cdot r}{6000} = \frac{\pi \cdot \nu \cdot r}{3000} \quad (5)$$

Here r - drum radius, m. The difference in the sowing time of seeds of two adjacent normalizing boxes is equal to the time where the subsequent normalizing box takes the place of the position of the previous normalizing box. This time period is calculated by the formula:

$$t = \frac{z}{100 \cdot v_b} \quad (6)$$

Distances where the subsequent normalizing box takes the place of the previous normalizing box equal to the width of the normalizing box. Sowing distances of seeds contained in one normalizing box is calculated by the formula:

$$s = v_t \cdot t \quad (7)$$

Here v_t – tractor speed.

To determine the number of seeds sown per 1 meter, we compose the following proportion:

$$\frac{s}{1} = \frac{n_u}{x} \quad (8)$$

From this proportion, we determine the number of seeds x located in 1 m according to the formula:

$$x = \frac{n_u}{s} = \frac{n_u}{v_t \cdot t} \quad (9)$$

The novelty of the innovative seeder is the installation of a distributor drum in the hopper of the sowing section. In the technological process of work, the distribution drum prevents the destruction and crushing of seeds, and has almost no mechanical effect on them. As a result, high-quality sowing of seeds and increase their germination will be achieved

IV. METHODOLOGY

Solution Method to determine the parameters of the proposed wide-seeding sowing unit, a theoretical study was conducted. When determining the parameters of the distribution drum, the indicators of the physical and mechanical properties of desert fodder seeds are taken as a basis.

The average volumetric weight of the sown seeds of desert fodder taken γ = 0,25 g/cm3, the radius of the distribution drum from R_b = 2,5 cm to 12,5 cm in increments of 2,5 cm, the value of the number of revolutions of the drum n = 0,5 rpm to 15,5 rpm in increments of 0.5 rpm; width of a measuring cell from z = 0,3 cm to 1,5 cm in increments of 0.3 cm; its height is from h = 0,3 cm to 1,5 cm in increments of 0.3 cm; length from 5 cm to 25 cm in increments of 5 cm; tractor speed v_t = 0.8 m/s. Up to 2.4 m/s in 0.4 m/s increments. Seed purity for 30% of seeds = 30% to 70% in 5% increments;

The following table shows the parameters of an innovative seeder that provides the process of sowing seeds of desert fodder plants.

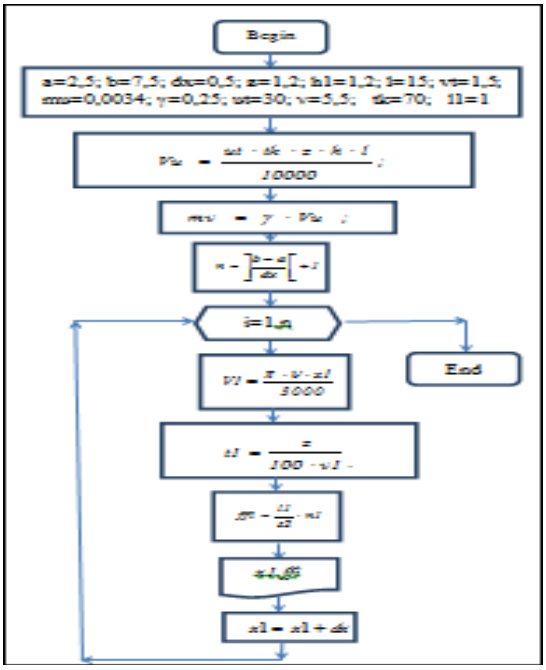
Table- I: The parameters of an innovative seeder.

№	Name of the parameters	Unit of measurement	Unit
1	The radius of the distribution drum	mm	25
2	The length of the distribution drum	mm	75
3	Rotation frequency of the distribution drum	m/s	1,0
4	The width of the normalization box	mm	0,5
5	The height of the normalization box	mm	15

6	The length of the normalization	mm	15
7	The diameter of the distribution drum together with the normalizing box	mm	75
7	Saturation coefficient of the normalization box	%	90
8	The speed of the tractor	m/s	50-75

As an example, we consider the dependence of sowing seeds on the change in the radius of the distribution drum of the seeder from r_b=2,5 cm to 7,5 cm in increments of 0,5 cm.

a. Block Diagram



The following mathematical modeling algorithms are represented by block scheme

V. RESULT

The figures below show a graph of changes in seed sowing per meter distance, depending on the radius of the drum and the speed of the tractor. Figures 1 and 2 show that with the tractor speed and drum rotation speed at your request, you can sow seeds one meter away from 1 to 100 pieces.

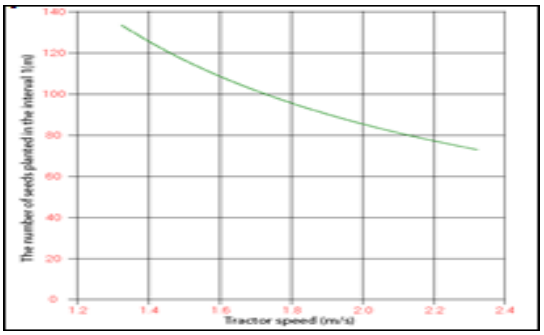


Fig. 1. The graphical result of sowing seeds depending on tractor speed.

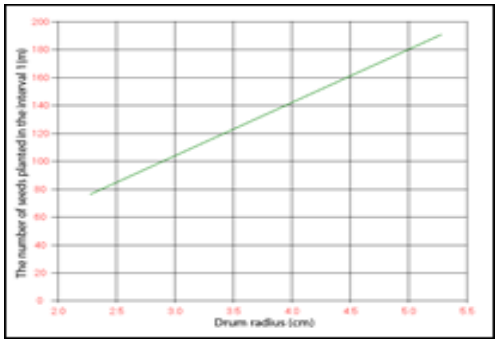


Fig. 2. The graphical result of sowing seeds depending on the radius of the drum.

This shows that the number of seeds planted in 1 m increases proportionally with an increase in the radius of the distribution drum of the seed hopper.

VI. CONCLUSION

The parameters of the distribution drum of the hopper of the recommended innovative seeder are determined. When sowing seeds of desert fodder plants with the help of innovative seeders, the hopper distribution drum prevents the breaking and crushing of seeds and almost does not affect the seeds mechanically. As a result, the seeds are sown qualitatively, their fertility is increased. Such seeders satisfy the agrotechnical requirements of desert fodder plants supplied for sowing.

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