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ЛЕНТОЧНО-ТРАНСПОРТЕРНЫЙ ВЫСЕВАЮЩИЙ АППАРАТ ДЛЯ ВНЕСЕНИЯ МИНЕРАЛЬНЫХ УДОБРЕНИЙ
BELT CONVEYOR FOR A MINERAL FERTILIZER APPLYING MACHINE

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Abstract

A seeding machine is proposed to make the main dose of mineral fertilizers. It can provide any increase in the rate to make the main dose. The lack of a fed-batch facilitates the uniform distribution of a fertilizer in the soil. The uniform distribution of the fertilizer on the belt conveyor, as well as in the soil depends on the patterns of distribution of the pins on the belt surface. We justify the optimal distribution of the pins on the treadmill belt.

Key words: mineral fertilizers, seeding machine, belt conveyor, dosing helix.

INTRODUCTION

One of the main ways to improve crop yield is the uniform application of mineral fertilizers in the soil. Regularly return nutrients to the soil as a fertilizer, which have been derived from it, together with the harvest. The soils of the Central and Northern Kazakhstan differ phosphorus deficiency. Studies have shown that 50% of the cultivated area in the region lack of this element. Recent data agrochemical analysis showed that the soils in the region are experiencing as a lack of nitrogen elements especially in the deep, root zone. As a result, there is a regular decrease in yield and quality.

The efficiency of mineral fertilizers to increase yields of crops, in particular wheat, depends on the uniformity of their distribution in the soil. In the traditional moldboard plowing scatter fertilizer on the soil surface, then use dump plow body, they are buried. In this method takes band application of fertilizer, as under the influence of the body of the plow layer of soil at its previous covers moving at an angle 35-45°. In general, this method is effective, owing to the relatively uniform distribution of the phosphorus fertilizer in relation to the root system of the plant. However, due to the widespread exposure to soil Central and Northern Kazakhstan wind erosion, moldboard plowing in the region does not apply. There is widespread subsurfaceflat- cuttingprocessing. Therefore, the method given above can not be used.

Given the urgency of the consideration of the problem in 2008-2014 Kazakh Agro technical University. S. Seifullin developed technology of the tiered introduction of mineral fertilizers and Chisel plow. For its implementation conducted a laboratory and field experiment. The working parts of chisel plows fulfilled based on the «Paraplau». From the hopper in the working parts of the material is transported using a pneumatic system. Basic qualitative indices of land application of fertilizers is low unevenness of their distribution in the root zone. The higher uniformity of distribution, the more efficient the fertilizer. Uneven fertilizing leads not only to reduce the biological yield and quality. Because it is uneven ripening of plants, which leads to unexpected losses during harvesting.

Common to the above-Chisel fertilizert but GUN-4 are their dosing organs - pin-reel machines. Studies have shown that they do not provide agricultural requirementsof uniformity and stability of the application is not fully provide increased seeding rate.

Basic qualitative indices of land application of fertilizers is low unevenness of their distribution in the root zone. The higher uniformity of distribution, the more efficient the fertilizer. Every plant in this sector should receive the same amount of nutrients.

The diversity of the distribution of fertilizer will lead to a diversity of plant development, were killed and their impact on the diversity of soil environment.

The end result of the uneven distribution of fertilizer are to reduce the yield and quality of the resulting product. Observations made in 20 different areas of the Russian Federation showed that due to uneven fertilizing a crop of barley, wheat, corn and sugar beet decreased to an average of 13%. It is also observed an uneven application of phosphate fertilizer reduces the efficiency of 15-20%, 45-50% of nitrogen, potash and compound by 15-20%. In field experiments in the province Limburgerhov Germany increasing uniformity of nitrogen fertilization from 15 to 30% would increase the harvest of spring wheat from 21.8 to 31.2% of winter barley - from 8.0 to 13.7%, and spring barley - 10.1 to 17.1%. According to the experimental station of Great Britain uneven application of mineral fertilizers per year reduces the yield of sugar beet by 13%, potatoes and wheat - by 10% and the forage grass - 16%.

Uneven fertilizer leads not only to reduce the biological yield and quality. Because it is uneven ripening of plants, which leads to unexpected losses during combine-harvesting.

Agrochemical research of soils of Northern Kazakhstan area has proven that in order to maintain and increase its fertility is necessary to make every 3-5 years basic starting dose of fertilizer to 600 kg per hectare. However, the existing fertilizer distributing parts can not provide introduction of such application rate.

Therefore, the problem of dosing the fat through the development of the seed unit, ensuring the introduction of increased application rates and distribution of its low non-uniformity, is relevant in the field of mechanization of agricultural production.

MATERIALS AND METHODS

To solve the problem, it is necessary theoretical and experimental study of effective metering and distribution agency. As a result of analytical work at the Department of Technical Mechanics KATU named after S.Seifullin developed and patented the conveyor belt sowing apparatus for mineral fertilizers, Fig.1.

In the fertilizer box 1 is rotating agitator 2. A shutter 3 fertilizer enters the compensating chamber 4. The cross-section of the chamber 4 situated exciter 5. Its purpose - to contain a fertilizer in the chamber in stable excited state, so that the particles are distributed uniformly in a given volume. As a result, a uniform distribution of particles in the chamber, a conveyor belt outputs there from fertilizer uniformly expanded in its width. A spring balancer 7 does not pass nugget particles and contributes to their grinding. On the surface of the conveyor belt arranged pins 8. They may be cylindrical, semi-cylindrical, diamond-shaped, rectangular, square, etc. shapes. Their shapes and laws the location established based on the technological requirements. Fertilizer, derived from the compensating chamber conveyor belt enters the receiver 9, the width of which are divided into equal sections A, B, C ... They are connected with the vomer that are close up fertilizer in the soil.

The apparatus operates as follows. The fertilizer that is in constant agitation agitator under the influence of fertilizer box through the damper enters the compensating chamber. Under the influence of agent fertilizer uniformly fills the inner volume of the chamber and maintaining a constant pressure is stably excited. Restlessness fertilizer evenly covering the surface of the belt and the pins 8 and 7 equalizer promote more uniform distribution of it, which is then fed to the receiver. Uniform distribution of fertilizer on the surface of the belt is the key to getting the same amount of it into sections A, B, C ... receiver.

It was noted that the work of the unit is determined by seeding uniformity of dosage of fertilizers. It depends on the machine settings and physico-mechanical properties of the fertilizer.

The workflow of the proposed conveyor pin sowing unit, the quality of his work is largely dependent on the pins, which are located on its surface. This is due to the fact that the appointment of the conveyor is not only the transportation of mineral fertilizers. It should facilitate uniform distribution of the transported material on its surface, which is characteristic of the same weight of material is possible at every square centimeter. This work is performed by the pins arranged on the conveyor surface. For the purpose of this qualitative performance of the pins must be placed in the longitudinal and transverse directions and uniformly as possible, each pin has to go on his trail.

In order to fulfill the above requirements to the location of the pins, it is appropriate to take into account the geometric method of S.Y.Rozman used for the design of spike-tooth harrow.

RESULTS AND DISCUSSION

Having on the cylinder surface to the diameter d of the helical line with a pitch t is possible to obtain the length of its scan:

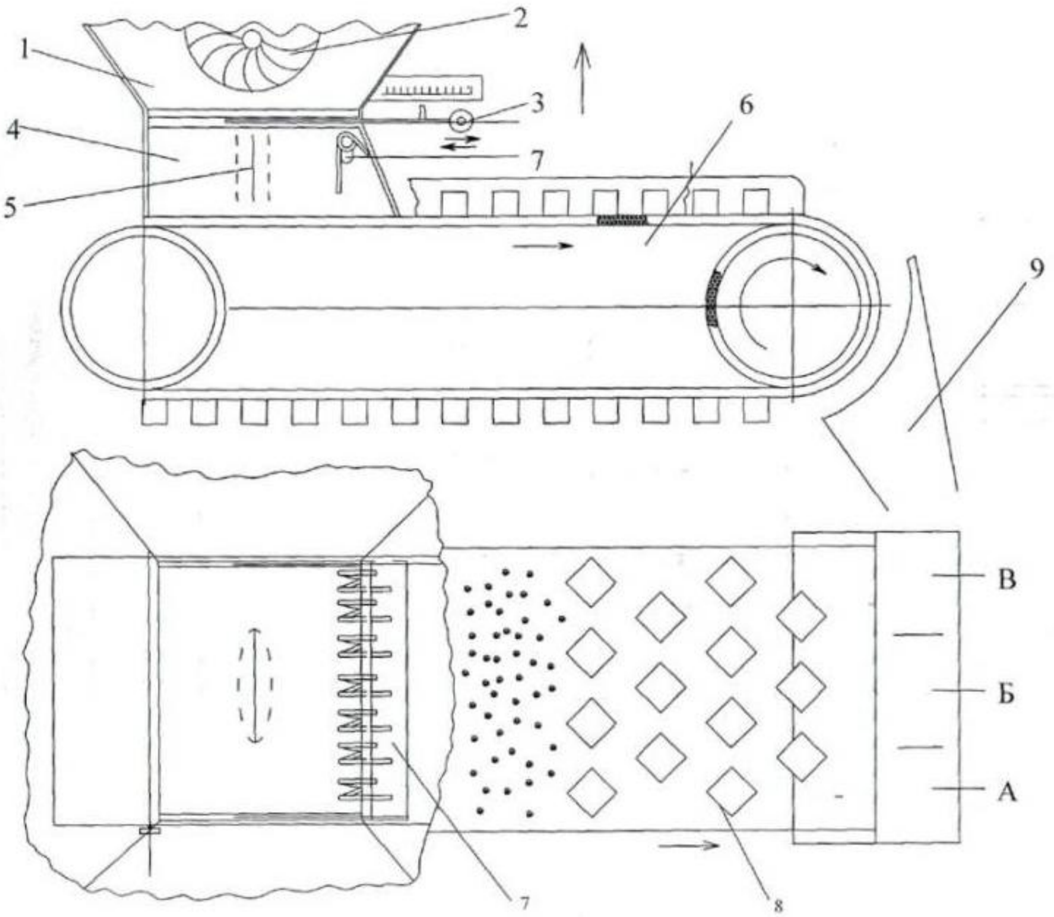

Fig. 1. *Belt transporter sowing apparatus for mineral fertilizers*

$$AB = l.$$

If the helix cross lateral line N, equally spaced, you can get the number of pins N, located at the same distance between them:

$$N = l: в, \quad (1)$$

where *в* - the distance between the pins to sweep a helical line.

Helix angle to the cylinder: (2)

To determine the number of entries in the multiple-step screw helix must be divided by the distance between the taps:

$$n = t: a. \quad (3)$$

By adopting a ratio can determine the distance to the pin traces width of one step t. What is known, if the number of taps n = 1, number of tracks on the width of one step equal to N. In this manner, if n = 2, the number of traces equal to 2N, and if n = n, then the number of traces equal to nN. Where in:

$$c = t: n\,N. \quad (4)$$

Given the preceding relation (3) we find:

$$c = a: N; \; a = cN. \quad (5)$$

Consequently, the number of traces of the transverse lines on the distances between the taps is N.

If the location of the points of the pins to hold the line BC with a backslash, you can get a scan line of screw reverse direction with the number of entries n_1 and step t_1. To determine the meaning of unknown n_1 and t_1 consider on the surface of a triangle pin, such as the triangle EFD. Drop a perpendicular from the point F on the base can be found:

$$в = EL : \cos \alpha.$$

Considering (1), (2) and (4) we obtain:

в

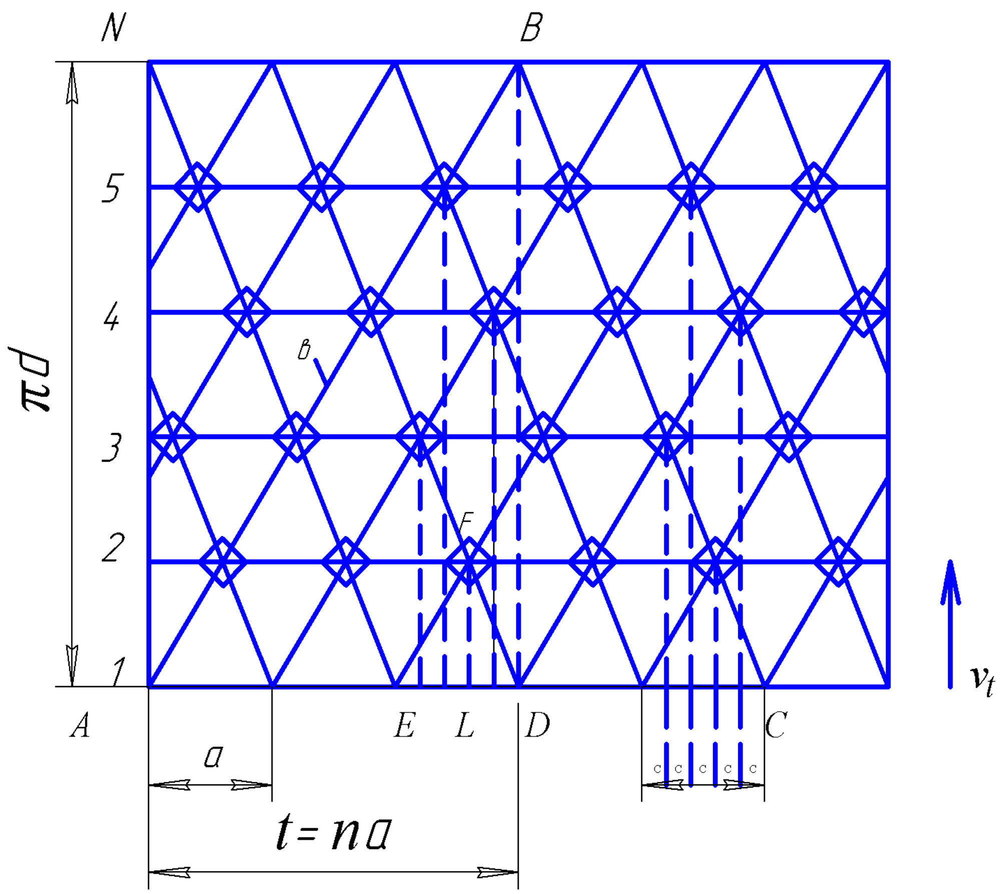

Fig. 2. *Location of the pins on the conveyor surface*

The last equation can be seen in the triangle EFL and it comes from the equation (4).

In this order:

$$DL = \frac{t_1}{n} = n_1 c$$
$$EL + DL = a$$

Based on the equation (5), you can get the latest relationship:

a

Then:

$$N = (n + n_1).\ (6)$$

Consequently, the number of visits right and reverse helical line equal to the number of transverse lines.

If the number of pins, as shown in Figure 1, the bottom will continue repeating, repeated pins can follow the first. For example, we will assume that one next pass η pins. In this case, a distance ED = number of tracks must not be N, but

$$k = N : \eta.$$

If so, taking into account (6), the previous equation to be rewritten differently:

$$DL = n_1 c = (N - n)c = (k\eta - n)c;$$
$$DL = \left(k - \frac{n}{\eta}\right)\eta c. \quad (7)$$

In the last equality ηc shows the distance between the tracks, and $\left(\mathbf{k} - \frac{\mathbf{n}}{\boldsymbol{\eta}}\right)$ - the number of tracks.Hence, the ratio k and η n is an integer. To each pin went on his trail, from the parameters N and n should not be a common factor. 5 and example 3 and 7, and 5, etc.

As shown above, the pins are located at the intersections of helix right and left direction. The pins disposed consecutively on helix right directions shift occurring fertilizer granules, right, and pegs

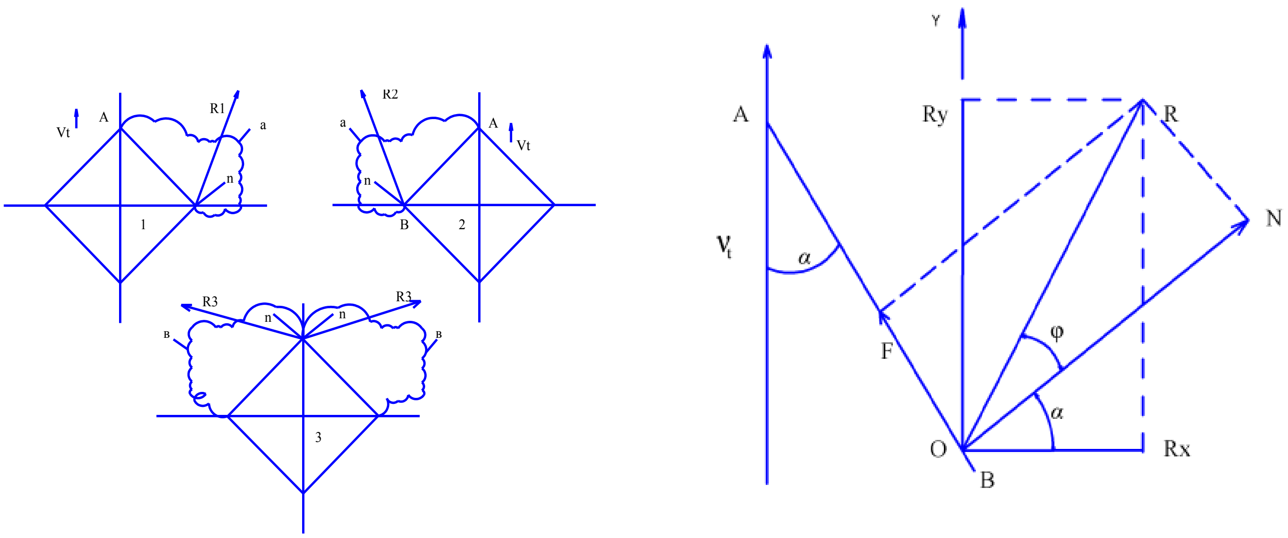

Fig. 3. *Scheme of transporting pins*

disposed sequentially on the direction of the helix of the left shift to the left of these granules. As a result of this alternating shear fertilizer is uniformly distributed on the surface of the conveyor. To ensure alternating shear granules necessary to determine the inclination angle of helical lines.

Assuming that the conveyor moves in the direction v_t, consider a few pins positioned on the surface of the conveyor, Figure 2 and. As noted in previous work, the form of pins may be different - rectangular, square, diamond-shaped, cylindrical, etc. For theoretical considerations, advance, take the form of a square pin.

As can be seen from the figure, the first and second pins have an impact on fertilizer in the directions R1 and R2, and move them to the center, a cluster. The third pin acts in the direction R3, shifts toward fertilizer last between 1 and 2 pins with no impact to the cluster. As a result of such movement, to the center and to the sides, fertilizer should be distributed evenly on the surface of the conveyor.

When the fertilizer out of the window of the hopper is supplied to the surface of the tape, the direction of the velocity turns 90° and its value has changed significantly. Therefore, the relative movement of fertilizer at this point can be very intense. However, the activity of this movement depends on the angle α, the rib positioned between the pin and the direction of movement of the tape. If the angle α is very large, the pin operates as scraper and without relative motion drags fertilizer. And if the angle α is very small, the fertilizer will wrap around the sides of pins and lateral movement will be insignificant. That means we need to find the optimal value of the angle α.

Figure 3 b shows the edge of the pin AB. On the point about the pellets, which met with the edge of the pin, the following powers:

N - the normal reaction of the surface of the pin;

F - the force of friction between the surface of the pin and granules;

R - resultant force, which affects the pellet O;

v_t - direction of belt speed;

α - the angle between the surface of the pin and the tape direction.

The resulting effect can be decomposed into the x and y:

$$\overline{R_x} = \overline{N_x} + \overline{F_x}; \quad R_y = N_y + F_y. \tag{8}$$

We define a scalar value of the components of the system (8):

$$N_x = N\cos\alpha; \quad F_x = F\sin\alpha; \quad N_y = N\sin\alpha. \quad F_y = F\cos\alpha \tag{9}$$

Taking into account (9) (8) we get:

$$R_x = N\cos\alpha - F\sin\alpha; \quad R_y = N\sin\alpha + F\cos\alpha \tag{10}$$

From Figure 3, you can find:

$$tg(\alpha+\varphi)=\frac{R_y}{R_x};$$

Taking into account (10):

$$tg(\alpha+\varphi)=\frac{N\sin\alpha+F\cos\alpha}{N\cos\alpha-F\sin\alpha}.$$

Substituting the value of the friction force F = fN get:

$$tg(\alpha+\varphi)=\frac{\sin\alpha+f\cos\alpha}{\cos\alpha-f\sin\alpha}. \quad (11)$$

As seen from (11), with the angle α, the angle increases (α + φ) and tends to $\frac{\pi}{2}$. In this case granules stop sliding on the surface of the pin. The pin functions as a scraper. This occurs under the condition:

$$\cos\alpha_m - f\sin\alpha_m = 0; \quad f=\mathrm{ctg}\alpha_m.$$

From the last equation can be determined:

$$\mathrm{tg}\varphi=\mathrm{tg}\left(\frac{\pi}{2}-\alpha_m\right); \quad \varphi=\frac{\pi}{2}-\alpha_m, \quad \alpha_m\le\frac{\pi}{2}-\varphi \quad (12)$$

As seen from (12) to provide relative motion of the granules, the angle between the surface of the pin and the direction of the belt must be less than $\frac{\pi}{2}-\varphi$.

In order to test the working hypotheses and theoretical assumptions were made laboratory apparatus. It consists of a frame on which the fragment bunker CZC-2,0 with sowing device running tape. Fertilizer distributing machine receives a drive from the stand STEU-10M-1000-GOSNITI that allows infinitely variable speed. For a traveling endless belt mounted separate drive. The experiments were conducted at sowing granular fertilizer superphosphate.

In laboratory tests, the speed of the shaft measured by tachometer SK, and the stopwatch time. Weight fertilizer measured weights FeLV-500.

To confirm the results of experimental studies, obtained in the laboratory, field tests were carried out on the field the sowing of «Akmola Phoenix» Akmola region Tselinograd area Akmol village. Experiments were carried out on the basis of drills ESS 2,0, conveyor seeding apparatus during laboratory and field tests run continuously, and there were no stops for technical reasons. The experimental unit is shown in Fig 6. Data taken on field trials is currently being processed.

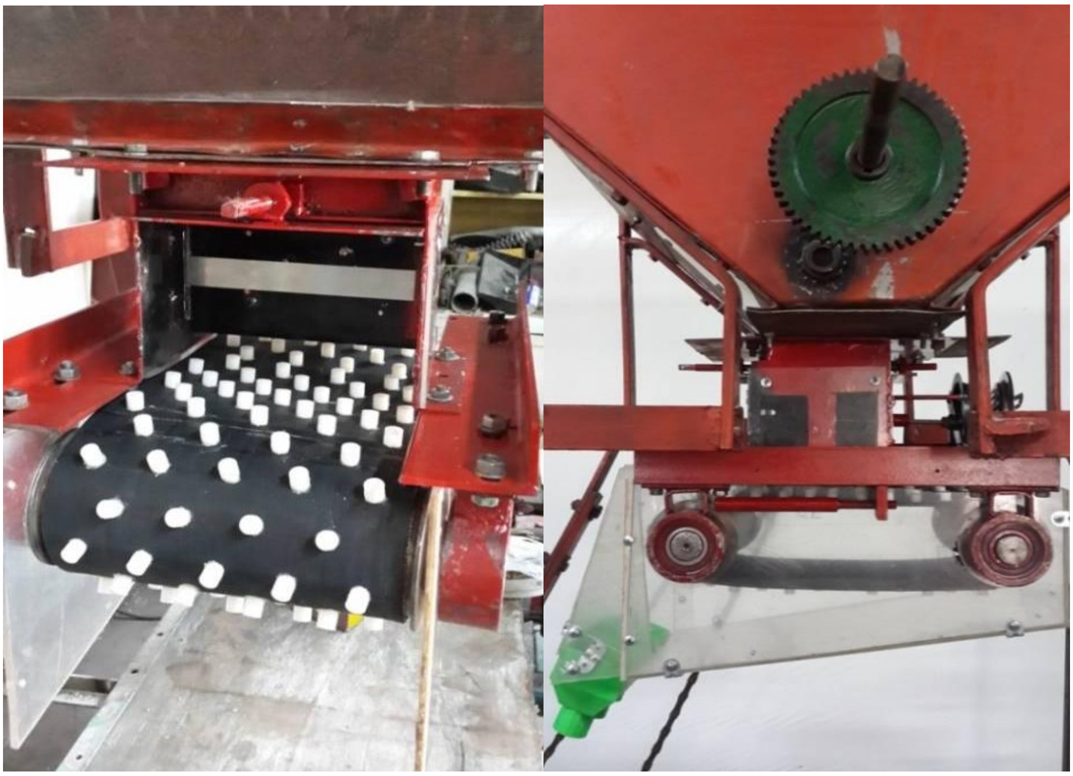

Fig. 4. *Experimental laboratory apparatus*

Fig. 5. *Experimental sowing machine during field work*

CONCLUSIONS

1. In laboratory studies, the angle of helical lines α was set at 30°, 35°, 40°, 45° and 50°. One running meter at a width of 21 cm ribbon, installed 150 pcs pins. Pin shape: square, diamond-shaped, cylindrical, semi-cylindrical and hemispherical.

2. During the experiments, the pins rhomboid formed with an angle of 40° provided the best mix fertilizer granules and their uniform distribution on the surface of the conveyor belt.

3. The laboratory study showed that the instability of mineral fertilizers with the device does not increase 8-11%.

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