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PLANTER WITH ELASTIC ADJUSTER

A.G. Botirov

Docent Namangan Engineering-Construction Institute, The Republic of Uzbekistan

Abstract: *Connection with the development of the market economy and the reduction of cotton cultivation areas, it is possible to grow a quality product only by introducing advanced methods of cotton cultivation, using measures of technical development, increasing productivity and increasing the level of mechanization of cotton cultivation. It can be achieved by reducing manual labor in all processes.*

Keywords: High-quality planting, yields of cotton, natural and climatic conditions.

INTRODUCTION

High-quality planting of small-scale seeds is one of the important measures that affect the production of high yields of cotton with low labor costs, and provides an opportunity to save planting materials.

The main methods of sowing seeds are row, nest, dot-nest and dotted sowing. The application of each of them depends on the natural and climatic conditions of the area where cotton is grown, and the characteristics of the soil.

When sowing by the method of row sowing, the seeds move freely and fall from the seeder into the furrow without any exchange, and the seeds are sown individually and in groups (2 ... 3 pieces). The disadvantage of this method is excessive consumption of seeds (instead of 33...35 kg/ha, sometimes up to 100 kg/ha and more can be consumed).

When the seed is planted in nests, the seeds lie in a certain sequence in the furrow, and the distance between them is chosen depending on the field conditions, and the distance between the seeds is up to 10, 15, 20 or 25 cm, each nest can contain 2 ... 7 seeds.

When planting with this planting method, 30 ... 40 kg of seeds are saved per hectare compared to conventional planting, and the cost of manual seeding is also reduced by 20 ... 30%.

Due to sudden changes in summer temperature, nesting method with hairy seeds is used in the early sowing period, while the seeds provide better germination than non-hairy seeds, as a result of which the germination of seeds from the ground increases, early harvest and timely agrotechnical work for the next year's crop is used. a transfer opportunity is created.

MATERIALS AND METHODS

Currently, up to 50% of the area under cotton cultivation is planted with hairy seed, its main disadvantage is the high consumption of seed. 3 times less seed is used when planting with hairless seed. However, poor quality of seed preparation, which affects the quality of planting, is preventing the widespread introduction of cotton with hairless seed. In addition, in rainy and cold days and in soils prone to salinity, the planting of glabrous seeds does not provide the desired plant germination compared to glabrous seeds.

But in small planting standards, the existing seeding apparatus of cotton seeds does not ensure adequate seeding uniformity due to the length, abundance, and overlapping of hairs, the

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formation of gaps in the bunkers, and the high placement of the seeding apparatus in the ram, the length of the seed drop channel.

Because of this, the seeds are very unevenly distributed in the furrows, and high manual costs (at least 23 persons/ha) are required to unify the seedlings after germination.

Nevertheless, in the cotton-growing farms of our Republic, seeding with hairy seeds is mainly used, because they are more fertile than hairless seeds in areas with soil salinity and soil fertility during the early planting period.

Currently, STTs-50 mechanical seed drills are used more often for sowing cotton seeds, in which the selection of hairy seeds is carried out with the help of a reel. The advantage of these devices is the ease of maintenance and adjustment, while they also have a number of disadvantages.

First, the size of the hopper is small, and it takes a lot of time to fill it with seeds, the seeds stick to the hopper, there are gaps, and for many years, the small-scale planting machine of hairy seeds cannot be planted reliably.

Certain devices must meet three mutually exclusive conditions to hopper seeds and make them slippery. The operation of the device is to direct the seeds to the reel, maintaining the integrity of the seeds and eliminating the resulting gap, with a minimum torque. Therefore, the length of the trimmer fingers in the device of the existing seed drills is in the range of 60 ... 70 mm.

The driller performs manual or various tools to trim the gaps in the hoppers and eliminate them.

In order to eliminate voids in the hopper in the seeding units of the SXU-4 seeder, a spring - pressure board is installed in the hopper.

MAIN PART

The results of tests of roller seeding devices show that the uniformity of planting varies significantly along the length of the row when planting with hairy seeds, and the standard deviation of planting uniformity (ϭo=± 1.23) significantly exceeds the corresponding indicator when planting with hairless seeds (ϭo=±0, 63) is obtained. The reason for this is the passivity of the fingers of the rotating stern, the change of their shape during operation, insufficient power, and we can see that the height of the fingers is insufficient during the formation of a gap in the bunker (Fig. 1).

Rotating stern - stabilizers differ in shape and number of active elements (Fig. 1).

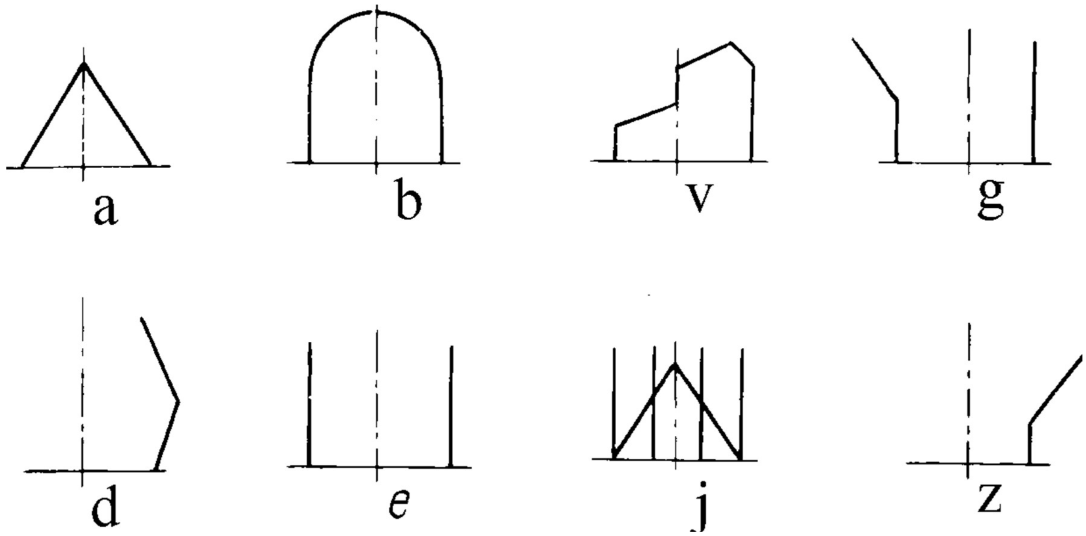

Figure 1. Types of Stergen-type straighteners:
α-conical; b-semi-round; v-stepped; g-external and vertical bent; d-bent inwards; vertical along the perimeter of the e-disk; j-joined; z-bit outer skew.

They are mainly made of bent metal bars and mounted on a rotating feeder.

The number of arc-shaped, vertical sturgeons and their number significantly affects the degree of seed treatment. During intensive rotation, the seeds are in a loose state and their mobility is improved

Feeder fingers move the seed into the feed chamber to help deliver the seed evenly to the seeding reels. But intense rotation causes high damage to the seeds and excess of the necessary torque in handling. In the stand tests of the roller seeding device of the researchers, the performance indicators of the "a", "j" and "z" type trimmers were studied.

The results of the crushing of seeds in the test of these feeders are shown in Table 1.

Table 1

Effect of Sturgeon-tositkik species on crushing of seeds.

Type of stern adjuster (according to Fig. 1)	Transfer of seeds to 1 revolution of the reel, g/rev.		Crushing of seeds, %
	In reverse transmission	On the road transmission	
a	5,65	4,10	4,5
j	5,70	4,40	5,2
z	5,47	3,70	2,9

In these experiments, the seed reels were rotated at a frequency of 8.37 and the finger feeder at 4.19s-1. Hairy seed variety 108F was obtained from 1000 seeds in a wet state, weighing 172.3 g.

As can be seen from Figure 1 and Table 1, the crushing of seeds increased by more than one and a half times when the shape of the strainers became more complex.

With an increase in the number of fingers, their influence on the seeds increases, but the space between the fingers, through which the seeds pass into the feeding chamber, decreases. In feeders, the space between the fingers is 2.7 times larger than the area occupied by the fingers These shortcomings can be eliminated by using elastic adjusters in the seed planting apparatus and they ensure the stable operation of the apparatus. They interact with a very small number of seeds without causing damage.

It can be seen from this that conducting research aimed at solving the problem of uniform planting of hairy seeds with small standards is considered urgent and of great importance.

For the feather seed drill, it consists of an elastic-adjustment design that ensures high sowing uniformity, the integrity of the planted seed and minimum moment of movement of the drill.

This innovation allows to save seeds, form sprouts with a certain density and get early sprouts with minimum manual labor, increases planting productivity due to the installation of large bunkers and significantly improves working conditions.

We have carried out scientific and research work to solve the above problems. For this purpose, we adopted the classic design of the planting apparatus for planting soaked cotton seeds. This construction is shown in Figure 2.

The planting device is equipped with an elastic adjuster, that is, an axle is installed on the flange of the feeder, a spring is placed on it, one end rests on the body of the feeder, and the other end moves freely inside the seeds in the hopper and forms a unique flexible elastic adjuster.

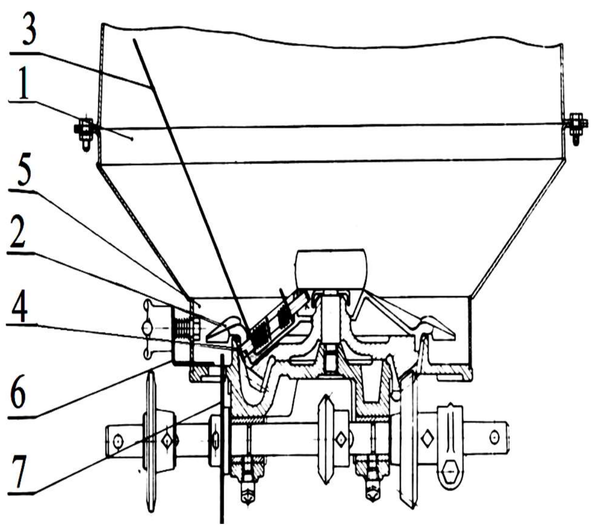

Figure 2. Experimental planting apparatus:
1 - bunker; 2 - feeder; 3 – elastic-stretcher; 4 - axis; 5 - base; 6- adjuster- trap; 7 – reel.

The length of the place where the adjuster is installed (the length of the axis) is determined in relation to the structural dimensions of the feeder. Feeder diameter ($d_п$ = 220 мм) according to the length of the spring $l_{пр} \leq 50$ мм is accepted.

When calculating the spring, first of all, it is necessary to choose the length of the rod, the length of the spring, the number of turns, the diameter of the spring and the diameter of the rod.

During operation, the elastic rod-feeder creates a certain pressure on the seed in the hopper during the rotation of the feeder, in which the lower end of the spring-loaded rod is fixed, and the rod itself is from the seeds. is met with resistance.

The height of the loose layer must be greater when the seed fluff and moisture are large, and therefore the torque is required more, which will cause the support wheels to slip and disturb the planting pattern.

Let's consider the movement of the upper end of a long and relatively low-slung stern (Fig. 3). When the groomer-feeder rotates and *0* point (the lower point of the boom fixed with a gear ring) α leans forward to the corner, stern *0′* from the point tangentially from the initial position β turns into a corner. Sufficient length of the stern has a small stiffness and $A0_1$ from the axis *0* in deviation to, sturgeon (*B*) tip 0_1 takes a stable position near the vertical axis passing through the point and forms a conical cavity on the feeder.

Steering wheel B_0 the trajectory of the tip is shown in the picture with a broken line.

The formation of a conical cavity is the most stable, and in this case the strainer is immobile.

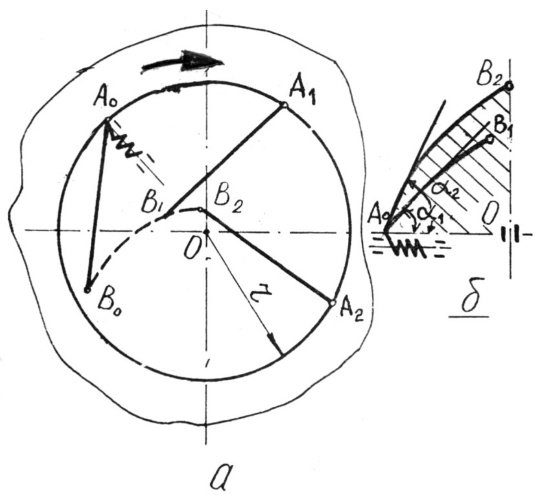

Figure 3. The trajectory of the tip of the "V" rod is in the seed mass (top view), B_0, B_1, B_2 - states of the stern tip.

From the analysis of Figure 3, it follows that in order to prevent the formation of such a conical cavity, the following is necessary:

A) To eliminate the gap in the hopper, it is necessary to increase the thickness of the elastic feeder, but this, in turn, may exceed the required torque and cause damage to the seeds;

B) It is necessary to reduce the length of the stern to a certain size without changing the elasticity of the elastic-stretcher.

To calculate the length of the tensioner, we choose the way to reduce the length of the spring at a constant length.

In order to eliminate the formation of a conical gap, the length of the straightener must be within this limit.

$r \leq l \leq Z_{kp}$ or $100\text{мм} \leq l \leq 200$ мм , (1) Here $Z_{кр}$- the minimum height of the cylinder formed by the stern lifter, m:

$Z_{kp} = \frac{r}{\cos\alpha}$, (2)

here α- angle at the bottom of the gear feeder, α= 35°…60°;

r- feeder radius, r=100 мм.

He is alone

$$Z_{kp1} = \frac{r}{cos\alpha_1} = \frac{100}{cos35°} = 120 \text{ мм}$$

$Z_{kp2} = \frac{r}{cos\alpha_2} = \frac{100}{cos60°} = 200$ мм.

Thus, for experimental tests, the length of the conveyor is taken up to 120...200 mm.

As the hopper moves, it is subjected to pressure from both very dense seeds and loose seeds, depending on the filling methods and the method of preparing the seeds for planting (soaking, soaking). Therefore, its vibrations will have a variational character.

Bending of the cantilevered elastic rod with the seed mass in the planter hopper to determine other parameters of the elastic rod-lifter during operation $U(t, Z)$ Let's look at the function.

We formulate the differential equation for the bending of an elastic rod:

$\frac{\pi d^2\gamma_c}{4g} \cdot \frac{d^2U}{dt^2} + EJ\frac{d^4U}{dZ^4} = \left(q_1 sin\frac{\pi Z}{2I_o} + q_2 sin\frac{\pi Z}{I_o}\right)\left(1 - cos\ \frac{2\pi t}{\tau_B}\right)$ (3)

Here d- rod diameter, м; γ_c- the density of the stern material, кг/м^3; g– free fall acceleration, м/с^2; E- the modulus of elasticity of the rod material, кг/м^2; J- moment of inertia of the cross-sectional area of the stern, м^4; q_1, q_2 amplitudes of changes in external forces,м; l_0- cterjen length, м; z- distance from the axis to the point in view, m; t is the current time,c; $t_в$ – the stability of the regulator in one cycle, $t_в = 2\pi/\ \omega_в$,c

We introduce some notations to make the equation easier to solve

$\mu = \frac{\pi d^2\gamma_c}{4g}$ (кг· сек^2/м^2), $C_2 = \frac{EJ}{\mu}$, $q_м = \frac{q_1}{\mu}$.

Then the equation for the first form of oscillations will have this form

$\frac{d^2U_1}{dt^2} + C^2\frac{d^4U_1}{dZ^4} = q_m \sin\frac{\pi Z}{2I_o}\ (1 - \cos\frac{2\pi t}{\tau_B})$ (4)

We get the solution of the function in the following way

$U_1(t, Z) = U_1(t) sin\frac{\pi Z}{2I_o}$ (5)

We find two partial derivatives of the function

$\frac{d^2U_1}{dt^2} = \frac{d^2U_1(t)}{dt^2} \cdot sin\frac{\pi Z}{2I_o}$ (6)

$\frac{d^4U_1}{dz^4} = \frac{\pi^4}{16I^4o} \cdot sin\frac{\pi Z}{2I_o}U_1(t)$ (7)

Substituting equations (6) and (7) into equation (4), we obtain the following.

$\frac{d^2U_1}{dt^2} \cdot sin\frac{\pi Z}{2I_o} + C_2U_1\frac{\pi^4}{16I^4o} \cdot sin\frac{\pi Z}{2I_o} = q_m(1 - cos\frac{2\pi t}{\tau_B})sin\frac{\pi Z}{2I_o}$ (8)

Expressions $\sin(\pi Z/2l_0)$ reducing to, $a^2 = c^2(\pi^4/16l_0^4)$ and we derive a second-order linear differential equation with constant coefficients.

$\frac{d^2U_1}{dt^2} + a^2U_1 = q_m\left(1 - cos\frac{2\pi t}{\tau_B}\right)$ (9)

We get the following equation by solving the differential equation using the operational calculation method according to image functions

$U_{max} = \frac{2q_m \sin(\pi Z/2I_o)}{a^2}$ (10)

Given some constructive values of the quantities and the values of the predefined function l_0 = 150; 200 and 250 мм and from there we first determine the diameter of the trimmer.

Stergen - the work of the straightener can occur under various conditions, under the influence of concentrated, evenly distributed and constant load. From the point of view of the long-term operation of the lifter, it is carried out from the position under the influence of a concentrated load at the hollow end of the stern-lifter (Fig. 4).

Concentrated load P_q is calculated according to the following equation

$P_q = q_1 h_1 = 337{,}5 \cdot 0{,}016 = 5{,}4$ Н,

Here $q_1 = H_b \cdot l_0 \cdot \gamma_{urug} = 0{,}5 \cdot 0{,}15 \cdot 10 \cdot 450 = 337{,}5$ Н/м;

H_b – height of the seed container, m;

l_0 - length of the stern, m;

h_1 - the height of the empty layer, $h_1 = 0{,}016$ *м*.

The torque of the torque is as follows

$M_p = h_p \cdot Pq$ =0,15·5,4 = 0,81 Н· м,

Here h_p - the distance from the axis of rotation to the point of application of force (A), h_p = 0,15 м.

The ratio between the dimensions of the spring is as follows (11).

$$\frac{D}{d} = \frac{12}{2{,}5} = 4{,}8$$

Stergen - the diameter of the riser is determined according to the formula /66/:

$d = \sqrt[3]{\frac{M_p \cdot K}{0{,}1/[\tau]}}$ (12)

He is alone

$$К = \frac{4D/d - 1}{4D/d - 4} = \frac{4 \cdot 4{,}8 - 1}{4 \cdot 4{,}8 - 1} = 1{,}28$$

$[\tau]$ - permissible bending stress, $[\tau]$= 0,45 МПа.

The length of the stem l_{01} = 150 мм when, D_1 = 2,8 мм

Accordingly l_{02} =200 мм and l_{03} = 250 мм when D_2= 3,1мм and D_3 = 3,38 мм.

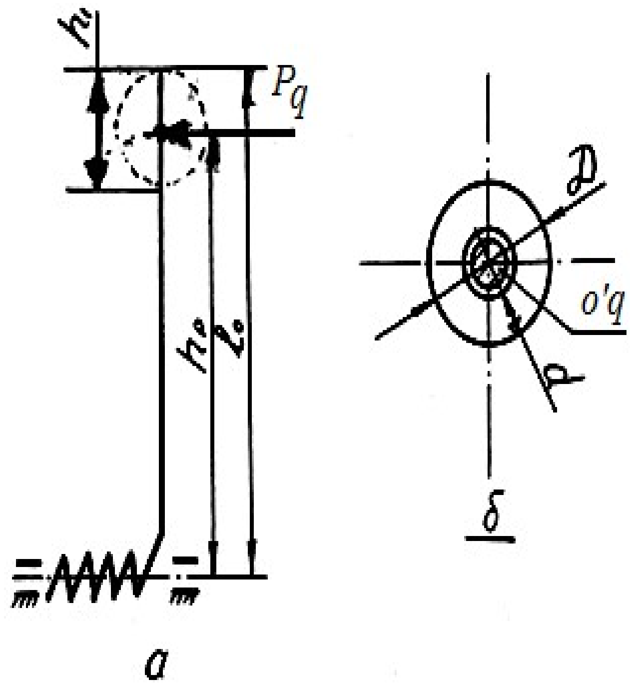

Figure 4. Scheme for calculating the diameter of the tensioner and tensioner spring a) side view; b) according to the spring profile.

After that, we determine the calculation of the stern from the condition of the maximum amplitude of the vibration of the tip of the stern using the following expression.

$U_{\text{мах}} = \frac{2q_m}{a^2} sin \frac{\pi Z}{2I_o}$м, (13)

Here

$2q_m = \frac{2q_m}{\mu}, \frac{M}{C^2};$

$a^2 = c^2 \frac{\pi^4}{16l_0^4} = \frac{EJ\pi^4}{\mu 16l_0^4}, \frac{1}{C^2}.$

He is alone

$U_{\text{мах}} = \frac{2048 \cdot q_1 \cdot l_0^4}{\pi^5 E \cdot l_0^4}.$ (14)

Here l_0^4 – the approximate length of the spring involved in the vibrations of the last part of the adjuster, $l_{\text{н}} = l_0 + 3l_{\text{В}} = 0{,}31$м,

Here $l_{\text{в}}$ - the length of one piece of spring, $l_{\text{в}}$ = 0,05 м, l_0 = 150 мм, will be equal to

$$U\text{мах} = l_o = \frac{2048 \cdot q_1 \cdot l_0^4}{\pi^5 E \cdot d_0^4} = \frac{5{,}391}{10^n d^4}$$

Here d=d_0.

He is alone

$$d_o = \sqrt[4]{\frac{5{,}39}{10^2 \cdot l_o}}$$

Here
$d = \sqrt[4]{5{,}39/(0{,}150 \cdot 10^{12})}$ = 0,00245 м.
or 2.45 mm.
According to the conducted theoretical studies, we accept the diameter of the stern-supporter with d = 2.8 ... 3.0 mm as critical values to ensure sufficient stiffness of the stern.
Determining the value of the stiffness of the spring of the steering wheel.
according to Hooke's law /24/
$\beta = \frac{М_р}{Ср}$, (15)
here β - twist angle, we $\beta = 90°$ we get:
$М_р$ – maximum torque, $М_р$ = 810 Н·мм;
$С_р$ - spring stiffness, $С_р = \frac{М_р}{\beta}$, Н· мм$/degree$
We accept the minimum torque as follows
$М_{min} = 0{,}16 \cdot 810 = 130$Н · мм,
$\beta = 90°Ср = 130/90 = 1{,}45$ Н·мм / level.
Thus, the main parameters of the steering rod were determined, its diameter is dc = 2.8 ... 3.0 mm and the spring rate is 1.45 mm/degree. Predetermined values are determined and compared experimentally in the process of experimental research.

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