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PARAMETERS OF COTTON SEED DRILL COMB FORMER OPENER

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Abstract. The aim of the study is to substantiate the parameters of the ripper of the ridge former to the cotton seeder. The authors have proposed a comb shaper for a cotton seeder for the implementation of sowing technology with simultaneous formation of ridges. The design of the developed ridge shaper with rippers and the principle of its operation are presented. The constructive scheme of the shaper includes rippers with soil-shifting plates that cut weeds, crumbles the soil of the upper part of the ridge, moving the soil towards the middle part of the ridge, sprinkles the walls of the ridge with loosened soil. The type of the ripper, the parameters of the loosening share and the soil-shifting blade have been theoretically and experimentally substantiated. It was found that for processing ridges with a row spacing of 900 mm and 600 mm, respectively: the width of the ripper should be 190 and 180 mm, the opening angle - 30°, the crumbling angle - 16°; the coverage width of the soil-shifting plate is 60 and 28 mm, the angle of installation of the plate is 30°, the height of the plate is 100 mm, the angle of inclination of the wing of the plate is 360.

Keywords: cotton plant, sowing, seeder, soil, technology, shaper, ridge, ridge formation, ripper, paw.

Introduction. Currently, in the world to obtain a high yield of agricultural crops, the leading place is taken by the use of advanced innovative technologies and modern technical means. In world practice, the bed technology of cultivating row crops has become widespread, which has a number of advantages over traditional technologies. With this technology, favorable temperature, water and air conditions are created for rapid and friendly germination of plants [1-5]. Therefore, all over the world, the area of cultivation of crops using ridge technology is increasing annually. At the same time, special attention is paid to the development of energy-saving machines and tools for the formation of ridges with a high quality of work and efficiency [6-12].

In the Republic of Uzbekistan, large-scale research is being carried out to reduce labor and energy costs, save resources, cultivate crops using innovative technologies and develop resource and energy-saving agricultural machines. In this regard, in particular, special attention is paid to the development of technical means that ensure high-quality and timely sowing of cotton, first of all, the elimination of the harmful effect of weather conditions on cotton crops. Proceeding from this, the development of technology and device for the formation of ridges simultaneously with sowing is relevant. The aim of the study is to substantiate the type and parameters of the ripper of the ridge former for the cotton seeder.

Literature survey. Research on the creation of tools for the formation of ridges, substantiation of the structures and parameters of their working bodies were carried out by G.M.Rudakov [1], E.Ponamarev [2], V.I.Kurdyumov and E.S.Zykin [3, 4], F.M.Mamatov, U.Kh.Kadirov [5], Kh.G.Abdulkhaev and others. G.M.Rudakov and A.G.Ponamarev [11] substantiated the parameters of the ridge for sowing cotton. V.I.Kurdyumov, E.S.Zykin [12] substantiated the technology and means of mechanization of ridge cultivation of row crops for the conditions of the Russian Federation. F.M.Mamatov and U.Kh.Kadirov [5] developed the technology of soil preparation for sowing potatoes on the ridges. F.Mamatov, B.Mirzaev [8, 9] considered the issues of anti-erosion tillage before sowing industrial crops. The studies of Kh.G.Abdulkhaev [10, 11] are aimed at developing a tool for loosening ridges and destroying weeds, as well as forming a mulch layer on their surface. All these studies are aimed at improving traditional technologies and technical means for preparing the soil for sowing industrial crops, including cotton, which does not meet the modern requirements of agricultural production. These studies did not address the issues of loosening and formation of ridges with the simultaneous sowing of cotton. The above disadvantages can be eliminated by developing a ridge shaper with rippers for a cotton seeder, which loosens, ridge formation and sowing cotton in one pass of the unit.

Materials and methods. The basic principles and methods of classical mechanics, athematical analysis and statistics were used in this study.

To eliminate the negative effect of heavy rainfall on seed germination by eliminating rain flow into the seedbed, we have developed a comb shaper for a cotton seeder to implement sowing technology with simultaneous formation of ridges [5, 7, 8]. When forming ridges simultaneously with sowing, the prepared soil should be fine crumbly with a loosened layer. On this basis, rippers are provided in the ridge shaper design. The ridge shaper carries out the formation of ridges as follows (Fig.1): the cutting part of the ripper 1 trims the weeds, crumbles the soil of the upper part of the ridge, the soil-shifting plate of the ripper, moving the soil towards the middle part of the

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ridge, sprinkles the ridge walls with loosened soil, then the shaper 2 forms and compacts the ridge , after which the runner-shaped opener 3 following it opens the groove in the middle of the ridge, the compactor 4 compresses its bottom, and the roller 5, after placing the seeds, will press them into the bottom of the groove, partially cover it and compact the soil. The harvesters 6 cover the seeds to the set depth, and the roller with the conical rim 6 compacts the soil [7].

Depending on the working conditions, the rippers can be made in the form of a one-sided flattening share, a duck foot share or a furrow cutter - a dumper.

Rippers 1 with wings are fixed, and the molder is attached to the seeder frame using a parallelogram mechanism.

The loosening working body is intended for loosening the upper part of the ridge formed in autumn and destroying weeds. At the same time, its soil-shifting plate moves the loosened soil towards the middle of the ridge and prevents the backward displacement of the soil into the furrow.

On the one hand, the working width of the working bodies should be greater than or equal to the width of the inlet part of the shaper runner, and on the other hand, it should provide loosening of the upper part of the ridge.

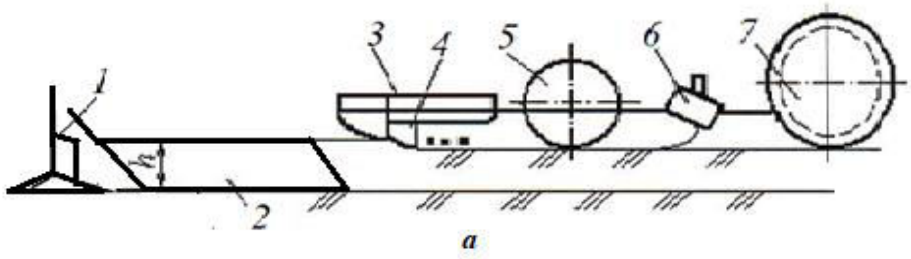

Fig.1. Sowing technology with simultaneous formation of ridges (side view): 1 - semi-plow with soil-shifting plate; 2 - molder; 3 - seed drill opener; 4 - sealant; 5 - roller; 6 - scraper; 7 - skating rink

Results and discussion. As a ripper, we take half of the duck foot paw of the chisel-cultivator, since it loosens the soil well enough and destroys weeds to a depth of 12 cm.The main parameters of the ripper are the working width b_n, the crumbling angle α and the opening angle γ (Fig.2).

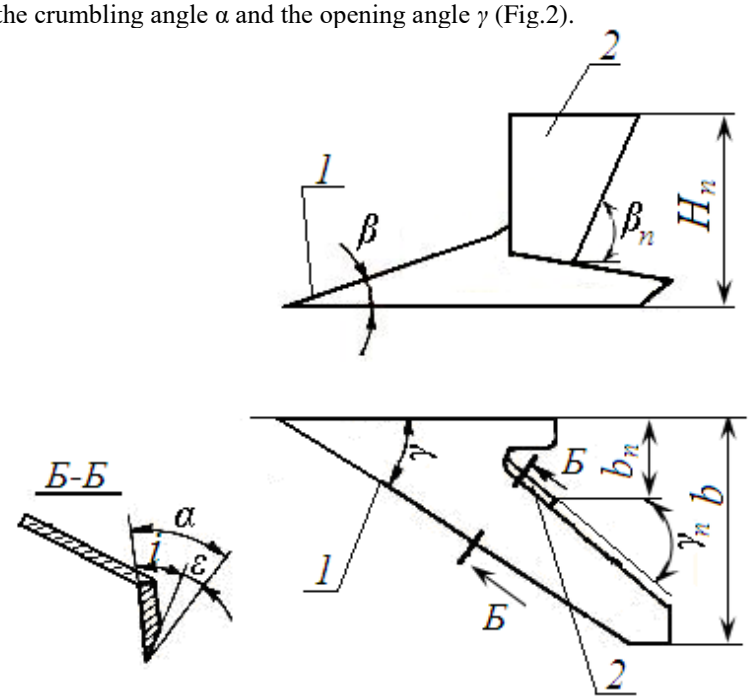

Fig.2. The main parameters of the lancet loosening half-paw of the soil-shifting plate: 1 - the loosening half-paw; 2 - soil-shifting plate

The working depth of the ripper share must be equal to or greater than the minimum ridge height, i.e. $h_1 \geq H_1$.

The soil-shifting plate should ensure movement towards the roots of plants cut by the paw and loosened soil without unloading them in front of the working body. She sprinkles the walls of the ridge with soil, loosened

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with paws. For this, it is necessary to ensure free sliding of soil and plants on the working surface of the soil-shifting plate.

The main parameters of the soil-shifting plate are the height of the plate H_n, the capture width b_n, the angle of installation γ_n to the direction of movement, and the angle of inclination of the wing β_n (Fig.2).

The rational values of the angle γ_n, at which the sliding time of weeds along the soil-shifting plate will be minimal, are determined by the following formula [7]

$$\gamma_n \le \frac{\pi}{4} - \frac{\varphi_к}{2}, \quad (1)$$

where $\varphi_к$ – is the angle of friction of plant roots on the working surface of the soil-shifting plate.

Substituting the known values $\varphi_к$=30-34^0, into this expression, we obtain γ_n=28-30^0.

When determining the height of the soil-shifting plate, we proceed from the fact that its size should be sufficient to exclude the spilling of soil, moved in front of the plate through its upper edge. Based on this

$$H_n \ge H_1. \quad (2)$$

We accept H_n=100 mm.

The swath width of the soil-shifting plate should be sufficient to move the soil by an amount (B_p–b_{or}), then

$$b_n = \frac{B_p - b_{oг}}{2}, \quad (3)$$

where B_p – is the width of the lower base of the loosened ridge formation.

The height of the cut ridges in autumn is: with a row spacing of 900 mm 24-26 cm, and with a row spacing of 600 mm - 21-23 cm. In the period from cutting to sowing, the ridges settle and their height is: with a row spacing of 900 mm 20-21 cm , and with a row spacing of 600 mm - 16-19 cm.

Numerous studies [1, 2, 11, 12] have established that by the spring sowing the shape of the ridges becomes similar to a sinusoid (Fig.3). To simplify calculations, we take the shape of the ridges in the form of an isosceles triangle. From Fig. 3 we determine the width of the lower base of the loosened ridge

$$B_p = \frac{h_1 B_M}{h_г} + \Delta, \quad (4)$$

where $h_г$ – is the average height of the existing ridge before sowing, we take at B=900 mm 21 cm, at B=600 mm 16 cm; h_1 – is the depth of the ripper stroke, taking into account the roughness of the surface fields are taken 12 cm; Δ – is the width of the ridge irregularities at the height h- h_1, Δ = 30-40 mm. We accept 40 mm.

Taking into account (4) expression (3) has the following form

$$b_n = \frac{1}{2}\left(\frac{h_1 B_M}{h_г} + \Delta - b_{oг}\right). \quad (5)$$

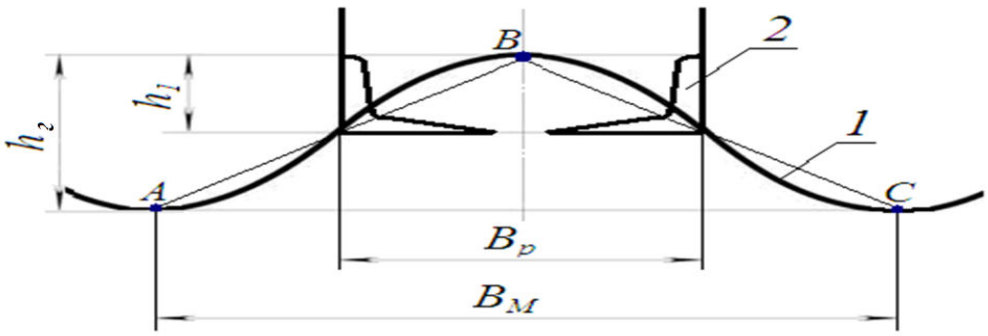

Fig. 3. To substantiate the scheme of arrangement and parameters of loosening semi-arrow paws: 1 - ridge; 2 - half-foot

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Substituting in (5) the values of h_c and h_1 at B_M = 900 mm and B_M = 600 mm, we obtain the grip width of the soil-shifting plate, respectively, 60 mm and 28 mm.

The angle of inclination of the wing of the soil-shifting plate β_n is taken to be equal to the angle of inclination of the ridge wall to the horizon, then $\beta_n=\beta=36^0$.

The lateral distance between adjacent loosening duck foots is equal to the width of the lower base of the loosening ridge, i.e. $B_l = B_p$. From (4) with B_M = 900 mm and B_M = 600 mm, we obtain the values of B_l, respectively, 554 mm and 490 mm.

When forming ridges on an even field prepared for sowing, the transverse distance between adjacent loosening lancet paws should be equal to the row spacing.

In order to verify the results of theoretical studies, the following options for working bodies were selected and tested (Fig.4): 1. A holler of a cotton cultivator (Fig.4,*a*); 2. One-sided flat-cutting share with a soil-shifting plate (Fig.4,*b*). Basic parameters of the paw: grip width b = 182 mm, opening angle $\gamma = 30^0$. The main parameters of the plate: grip width $b_п$ = 28 mm, installation angle $\gamma_п = 30^o$; height H_1=100 mm, wing tilt angle $\beta_п=36^0$. 3. One-sided loosening duck foot share of a chisel cultivator with a soil-shifting plate (Fig.4,*c*). The main parameters of the paw: width of capture b = 190 mm, opening angle $\gamma=30^o$, crumbling angle $\alpha=16^0$. The main parameters of the soil-shifting plate: width of capture $b_п$=28 mm, installation angle $\gamma_п=30^0$, height H_1=100, wing tilt angle $\beta_п=36^0$.

Fig.4. Variants of working bodies: *a* - half-pup; *b* - flat-cutting share with soil-shifting plate; *c* - semi-articulated share with soil-shifting plate

All working bodies were set to a depth of 10 cm. The tests were carried out at the test site of the Tashkent State Agrarian University. To test these options for working bodies, a unit was prepared, consisting of an MTZ-80 tractor and a SCHX-4A seeder.

The experimental working bodies were fixed on the front bar of the seeder frame in front of the molder. The experiments were carried out at a speed of 5.6 km / h. The tillage depth was 10 cm. Before the experiments, the soil moisture and hardness were determined in the horizons of 0-10, 10-20 and 20-30 cm.

The evaluation criteria for choosing the type of working body were: the quality of soil crumbling; the degree of weed control; clogging of the former with soil.

The quality of soil cultivation was determined according to RD 10. 4. 2-89 “Machines and tools for surface soil cultivation. Program and test methods ".

According to this technique, the quality of soil crumbling for each variant of the experiment was determined at four points (two in the direction of movement of the unit, two back) from areas of 0,25 m^2 to the processing depth one hour after the passage of the unit. Soil samples were taken using a box with a detachable bottom. the selected samples were divided into fractions directly in the field using a special set of sieves with a diameter of 50 and 25 mm. The sieves were arranged in decreasing order of holes. The depth of cultivation of the loosened layer was determined by immersing a ruler with a cross-sectional area of 1 cm2 into the soil. The repeatability of measurements is at least 50. In the first variant, only soil hilling was carried out, i.e. loosening and displacement of the lateral parts of the ridge. At the same time, the middle part of the ridge remained untreated, which does not meet the requirements of agricultural technology. In the second variant, insufficient crumbling of the soil was also carried out, however, good cutting of weeds was ensured. The content of lumpy fractions (fractions larger than mm) was 17,8 %, and the content of agronomically valuable fractions (fractions smaller than 25 mm) was 72,6 %. Flat-cutting shares are designed for loosening the soil and cutting weeds, mainly to a depth of 6-8 cm. When used at a processing depth of more than 8 cm, their processing quality deteriorates sharply.

In the third variant, a good quality of loosening of the soil and cutting of weeds was ensured. The content of lumpy fractions was no more than 7.8%, and the content of agronomically valuable fractions was 81.4%. In this version, conditions were created for the normal operation of the molder.

Thus, with a combination of loosening working bodies and a shaper, loosening lancet shares with a soil-shifting plate are the most acceptable, providing the required quality of soil preparation for high-quality ridge formation.

Conclusions. It has been found that when combining loosening working bodies and a shaper, loosening duck foots with a soil-shifting plate are the most acceptable. The following parameters of a loosening paw and a soil-shifting plate for processing ridges with a row spacing of 900 mm and 600 mm, respectively, have been determined: the width of the ripper is 190 and 180 mm, the opening angle is 30°, the crumbling angle is 16^0; the coverage width of the soil-shifting plate is 60 and 28 mm, the angle of installation of the plate is 30^0, the height of the plate is 100 mm, the angle of inclination of the wing of the plate is 36^0.

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