The design and results of the study of the comb-forming fertilizer

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Abstract. The article presents the results of research into the physical and mechanical properties of soils and fertilizers, the effectiveness of the method of applying mineral fertilizers layer by layer on the formed dams, the development of the design of machines for the formation and fertilization of furrows, as well as the justification of the technological processes of their operation**.** Key words: research, ridge former fertilizer, fertilizer line, traditional method, application of fertilizer, ridge, soil properties, ripper, working body, sown area, source, dispenser, fertilizer line, support wheel, ridge make

1 Introduction

The carried out research have proven that the normative density of the soil of the cultivated regions is 0,9–1,2 g/cm3, the humidity throughout processing is 16-18% and its tensile hardness is 5-6 kPa, for shear – 10-12 kPa and for compression - 65-108 kPa. For the manner of fertilization and the introduction of technical way for its implementation, the observe of the bodily and mechanical houses of the soil is the primary task.

The outcomes of the carried out research at the effectiveness of techniques of layered fertilization at the ridge have proven that, in comparison with conventional techniques, the approach of making use of fertilizers in layers at the ridge fashioned in autumn, moreover, fertilizers are implemented to the decrease layer alongside the width of the ridge, permits to boom the yield of cotton.

Based at the evaluation of literature reassets and research, in addition to at the outcomes of initial research, a era for layer–by-layer software alongside the width of the fashioned ridge and the layout of the system for its implementation - a comb-forming fertilizer (Fig.1) has been developed. Dispensers and pipelines are hooked up below the hopper of the system, fertilizers with a pointed arc-formed foot and a sharp-angled ripper are constant to the decrease a part of the racks hooked up at the frame.

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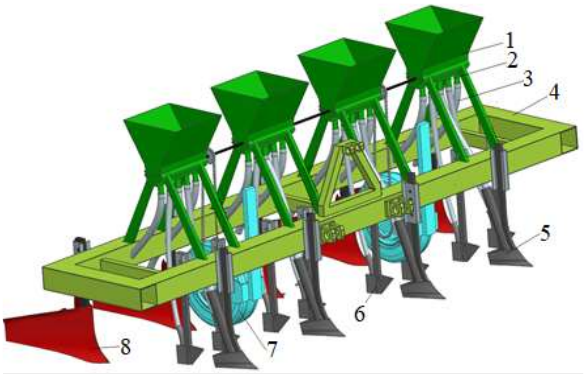

Fig. 1. Machine for combing and simultaneous layered application of fertilizers.
Note: 1-hopper; 2-dispenser; 3-current line; 4-frame; 5-fertilizer with a pointed arc-shaped foot; 6-fertilizer with a pointed ripper; 7-support wheel; 8-comb maker.

2 Experimental

2.1. Materials

The working bodies are individually connected to the dispenser through the pipeline, which allows the adjustment of the supply of fertilizer to each working body. Layered fertilization of fertilizer to the formed dam is carried out by applying fertilizer to the lower layer through the pipeline of three working bodies forming a wide band equal to the width of the lower base of the dam. The fertilizer passes through the pipeline in two wide strips applied to the top layer. The comb former, which is installed after the working body of the wide-band two-layer fertilization, seals the fertilizer in the soil and forms a dam of a certain shape. In this way, the formation of the comb and simultaneous fertilization are carried out. In this way, the fertilizer in the upper layer nourishes the plants immediately after sowing, and the fertilizer in the lower layer of the dam gradually nourishes the plants as they grow.
Fertilizer is spread in five strips along the width of the embankment using the band method. h. There are three ribbon strips in the central part of the lower base of the dam, and two ribbon strips symmetrical to the central vertical axis of the dam in the upper layer of the dam. At the same time, three loose fertilizers and two fertilizers are introduced through pipelines to the bottom (lower layer) of the dam. Thus, fertilizers are disbursed to the bottom of the ridge (decrease layer) through dispensers 1, 2 and three and to the top layer of the ridge (top layer) through dispensers four and 5.

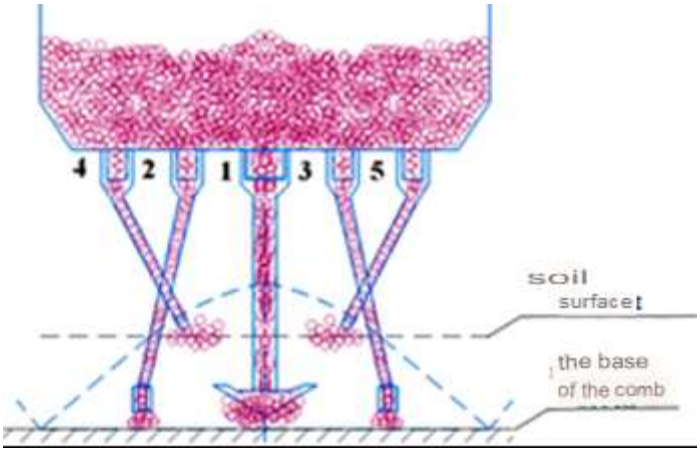

Fig. 2. The technology of applying fertilizers in two layers along the width of the ridge

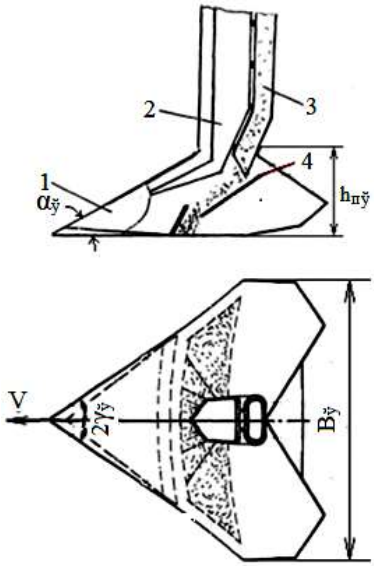

Fig. 3. The main parameters of the pointed arched paw

Note: 1-a pointed arc lamp; 2-a stand; 3-a current line; 4-a plate for spreading fertilizer

Fig. 4. The scheme of the sharp-angled ripper of the fertilizer and its main parameters

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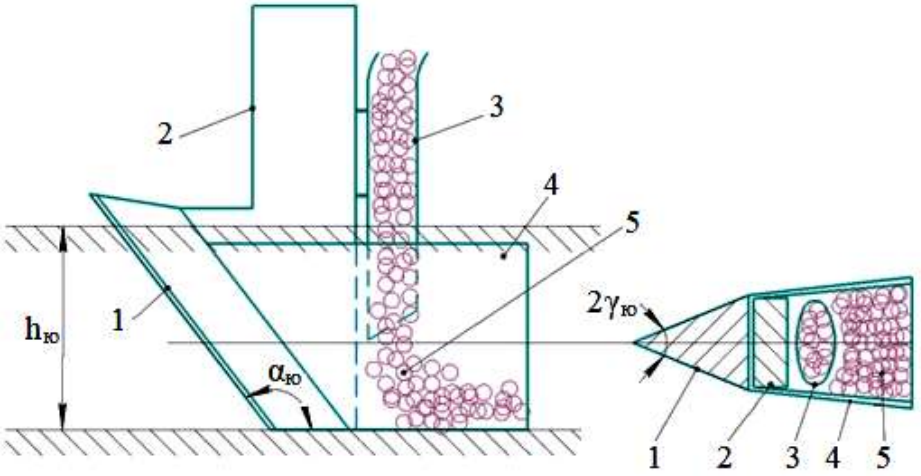

Fig. 4. The scheme of the sharp-angled ripper of the fertilizer and its main parameters
Note: $h_{ю}$- processing depth; $\alpha_{ю}$- the angle of entry into the soil of the sharp-angled ripper of the fertilizer; $2\gamma_{ю}$ – sharpening angle of the sharp-angled ripper; 1- ripper; 2- Desk; 3- the current line; 4- protective film; 5- fertilizer.

2.2 Method of Research

The consequences of studies at the substantiation of the parameters of the comb-forming gadget, the fertilizer with sharp-angled and pointed arc-formed rippers, in addition to the dispenser of the comb-forming gadget and fertilizer also are presented.

The most important parameters of the followed comb-forming gadget for combing and fertilization are substantiated, at the same time as the subsequent dependence is used to decide its frontal height, deliberating a sure fee of the intensity of access into the soil h:

$$H_{к} > (1+\kappa)\cdot h \quad (1)$$

Substituting a positive cost of h and taking the cost k = 0.5, it's far hooked up that the frontal peak of the comb-forming tool must be extra than 22.eight sm. Considering this, we anticipate Hк=30 sm.

The perspective of establishing of the ridge-forming wings is decided via way of means of the subsequent dependence:

$$\gamma_{к} = \frac{\pi}{4} - \frac{\varphi}{2}. \quad (2)$$

Substituting a positive cost of h and taking the cost k = 0.5, it's far hooked up that the frontal peak of the comb-forming tool must be extra than 22.eight sm. Considering this, we anticipate Hк=30 sm.

The perspective of establishing of the ridge-forming wings is decided via way of means of the subsequent dependence:

The angle of opening of the wings of the pointed arc-shaped fertilizer was determined by the following dependence:

$$\gamma = \frac{[\frac{\pi}{2} - \varphi]}{2}. \quad (3)$$

Taking under consideration the above values of the friction angles, the common price of the sliding attitude of the paw turned into decided, which varies inside γ= 29–31° . Thus - 2y could be withinside the variety of 58–62°.

The attitude of access into the soil of the pointed arc-fashioned fertilizer is decided primarily based totally on the subsequent condition:

$$Ntg(\frac{\pi}{2} - \alpha) > Ntg\varphi \quad \text{or} \quad \alpha < \frac{\pi}{2} - \varphi, \quad (4)$$

Substituting φ1 =30° into the inequality, we get α from <60°. Thus, determining the value of the angle of entry into the soil of a pointed arc-shaped fertilizer through its structural dimensions, we obtain α = 36°.

$$R_{uзю} = K \cdot B_{uз}(t_{cm} + L \cdot \sin\alpha_{uз})\{[1 + \tau(H + h_o)] \cdot (1 + tg\varphi_2 \cdot \sin\alpha_{uз})[1 + \varepsilon(V_p \cdot V_o)]\} + \\ + (B_{uз} \cdot L \cdot \sin\alpha_{uз} + t_{cm} \cdot 0{,}01 \cdot H) \cdot \rho \cdot \left(\frac{V_{up}}{3{,}6}\right)^2 \quad (5)$$

3 Result and Discussion

Substituting into this expression the values of the parameters mounted in preceding research and accepted, we decide the traction resistance of the pointed arcuate paw at a processing intensity of h = 0.thirteen m, processing width Виз=0,2 m and the rate of movement, which amounted to Rиз=516–656 N.

For broadband fertilization withinside the decrease layer of the ridge, sharp-angled fertilizer rippers are set up on each aspects from the middle of the fertilizer with a pointed arc-formed foot. With their help, the soil layer is loosened and on the equal time the sharp-angled a part of the ripper creates an opening for making use of fertilizer to a strip 6-7 sm wide (Fig. 4).

Formatting the title, auth With the correct choice of the angle of entry into the soil of the fertilizer ripper, its sharp-angled part cuts through or shifts the remnants of weeds and large clods of soil. To do this, the angle of entry into the soil of the sharp-angled part of the fertilizer ripper should be non-acute (Fig. 4) and is determined as follows:

$$\alpha_{ю} > \frac{\pi}{2} + \varphi. \quad (6)$$

This dependence is a condition for cutting through the remnants of weeds and large clods of soil. Calculations based on expression (6) it is established that $\alpha_{ю}$=140°.

If we take the value of the sharpening angle of the sharp-angled ripper to be equal β^{l}=28°then the cutting or clearing of the strip from the remnants of weeds will be ensured, and the soil will not collect and stick to the working organ.

4 Conclusion

The traction resistance of a sharp-angled fertilizer ripper is determined by the following expression:

$$R_{ю} = \frac{2q_{м} \cdot \delta \cdot h \cdot L_{mu} \left(ctg\beta \cdot tg\varphi + 1\right)}{\cos\varphi} \cdot \cos(\beta - \varphi) +$$

$$+ 0{,}5q_{м} \cdot S \cdot \ell_{n} \frac{h}{\sin\alpha} \cdot \frac{\cos(\beta + \varphi)}{\cos\varphi} + f \cdot G_{c} \cdot l_{n} \cdot h \qquad (7)$$

Substituting the found and accepted values into this expression, i.e. $q_м$=4,5·10^5 H/m^3, δ=0,001 m, h=0,120,13 m, φ=30^o, β=28^o, $\ell_п$=0,13 m, $L_{mиг}$=0,187 m, α=140^o, S=0,03 m the traction resistance of the sharp-angled ripper of the fertilizer is determined - $R_{ю}$=213 N.

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