ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 7, Issue 12 , December 2020

Justification of Parameters Tooth Harrow Copying Field Relief

Abduvahobov Dilshod, Xaydarov Kamoliddin, Imomov Muqimjon, Mamadaliyev Islomjon

PhD in Technical Sciences, PhD. Department of General Technical Sciences, Namangan Engineering and Construction Institute, Namangan, Uzbekistan
Trainee teacher, Department of General Technical Sciences, Namangan Engineering and Construction Institute, Namangan, Uzbekistan
Trainee teacher, Department of General Technical Sciences, Namangan Engineering and Construction Institute, Namangan, Uzbekistan
Research trainee, Namangan Engineering and Construction Institute, Namangan, Uzbekistan

ABSTRACT: The article presents the results of research on the substantiation of the taper angle, thickness and length of the bevel of the tooth of a tooth harrow that copies the relief of the field.

KEYWORDS: tine harrow, copying the relief of the field, tooth, tooth sharpening angle, tooth thickness, length of the bevel of the tooth.

I. INTRODUCTION

We have developed a tine harrow that follows the topography of the field. It consists of a frame with a device for mounting on a tractor, working links, rings connecting them, as well as rods connecting the working links with the frame. The working link consists of a base and teeth. The base has three holes through which the rings pass connecting the adjacent links, thereby forming a movable connection between them [1].

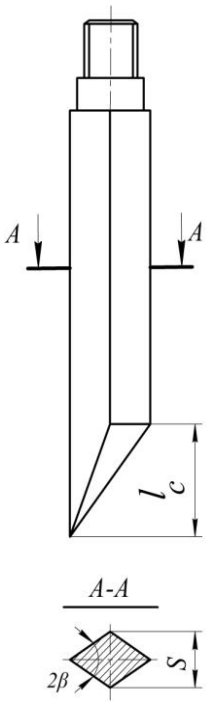

Fig. 1. Explored harrow tooth parameters

In the process of work, the teeth of this harrow copy the unevenness of the field surface and make angular and vertical oscillations in the longitudinal-vertical plane. As a result, the uniformity of the soil loosening depth and the quality of its crumbling improve, and weed seedlings are more completely destroyed.

II. LITERATURE SURVEY

In world practice, various working bodies and machines have been developed to increase the efficiency of pre-sowing tillage. They were recommended by design organizations for the development of new machines. V.P. Kondratyuk, R.I.Baymetov, A.Tukhtakuziev, I.K. Kodirov, S.Narkulov, and R.B.Safarov and others. Machines and tools created as a result of these studies are used in agriculture and certain positive results have been achieved in this direction. In these works, studies were conducted to improve technology and technical equipment, as well as their working bodies for pre-sowing tillage. However, they have not sufficiently studied the development of a tooth harrow that copies the topography of the field [3].

III. RESULTS

This article presents the results of studies carried out to substantiate the taper angle 2β, thickness S and bevel length l_c of the tooth of the developed harrow (Fig. 1).

The angle of sharpening of the tooth was determined from the condition that, all other things being equal, the time of its exposure to soil particles was minimal, because this eliminates the adhesion of the soil to the working surfaces (cheeks) of the tooth and unloading it in front of it. The result is a reliable execution of the technological process with minimal energy consumption. In this case, to determine the angle of sharpening of the tooth, the following expression was obtained

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 12 , December 2020

$$\beta = \frac{\pi}{4} - \frac{\varphi}{2}$$

or

$$2\beta = \frac{\pi}{2} - \varphi, \quad (1)$$

where β-is half of the angle of tooth sharpening;

φ-is the angle of friction between the soil and the tooth material.

Substituting into (2) the values of the angle φ (30-35°) known from literary sources [2, 3], we obtain that the angle of the tooth sharpening should be within 55-60°.

The thickness of the tooth is determined from the condition that in the process of the harrow's operation, chipping (loosening) of the soil occurs directly at its lower end, because otherwise, grooves with compacted walls are formed in the soil [2], leading to a deterioration in the physical and mechanical properties of the soil and an increase in energy consumption.

Let us find out due to what factors it is possible to ensure the chipping of the soil directly at the lower part of the tooth, i.e. at the required depth. For this purpose, we will consider the deformation of the soil under the action of a tooth when it moves at a given depth h with a speed V_n (Fig. 2).

When the tooth moves from position I to position II, the soil particle A, located opposite the tooth tip at a depth h, will move to its side edge, i.e. to point A_1. In this case, the soil is crumpled in the horizontal direction by the value $l = AA_1$.

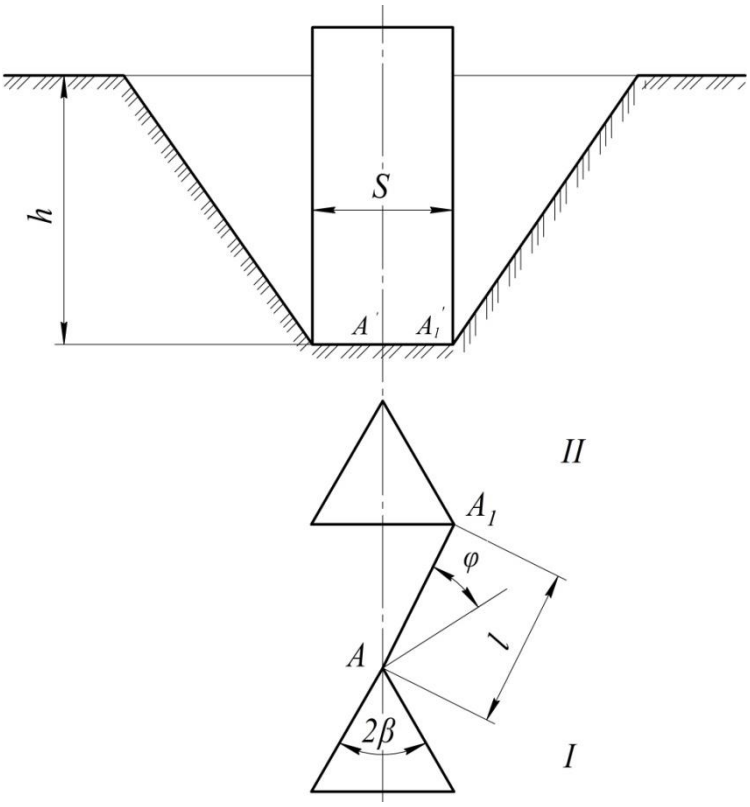

Fig. 2. Scheme to justify the thickness of the tooth

Studies have established [2, 3] that in order to ensure the chipping of the soil at a given depth h, the value of l must be greater than or equal to the ultimate deformation of the horizontal crushing of the soil l_n, which corresponds to its yield point at this depth, ie. $l \geq l_n$. In this case, a destructive stress arises in the soil with the formation of a shear surface at a depth of h.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 12 , December 2020

According to the literature [3], the value of l_n depends on the properties of the soil and the depth of cultivation. In the 0-10 cm horizon, in which the harrow tooth works, there is a linear relationship between the maximum deformation of the horizontal soil crushing and the depth

$$l_n = ch \tag{2}$$

where *c*-is a coefficient depending on soil properties.

And fig. 2

$$l = \frac{S}{2\cos(\beta+\varphi)} \tag{3}$$

It follows from this expression that for given operating conditions, i.e. with a known value of φ, the necessary deformation of the crushing of the soil *l*, ensuring its chipping at a depth h, can be achieved by changing the thickness of the tooth and the angle of its sharpening. However, as stated above, the angle of the tooth should be within 55-60°. Taking this into account, the necessary deformation of the crushing of the soil, which means its chipping at a given depth, can be provided by changing the thickness of the tooth.

Equating the right-hand side of expression (3) to ln, one can find the minimum permissible tooth thickness for chipping the soil at a depth h

$$S_{\min} = 2l_n\cos(\beta+\varphi) = 2ch\cos(\beta+\varphi). \tag{4}$$

From this expression it follows that for a given type of soil and for a known value of the tapering angle, the thickness of the tooth depends only on the depth of loosening h. The larger h, the greater the thickness of the tooth should be. It follows that the harrows for shallow depth work should have tines narrower than those of deep-loosening harrows.

Substituting into the formula (4) the above-found value of the tooth sharpening angle and taking *c = 0.25* [3] and $\varphi = 30\text{-}35^{\circ}$ and *h = 10 cm*, we obtain that the tooth thickness should be at least 25 mm.

It is recommended to determine the length of the bevel of the harrow teeth by the following empirical formula [4]

$$l_c = 0{,}25l_з,$$

where l_c - is the length of the tooth.

A more correct length of the bevel of the tooth can be set from the following considerations. For normal penetration of the harrow into the soil, the value should be such that the angle γ of the lower pointed part of the tooth in the transverse-vertical plane was less than the angle of lateral soil shearing (Fig. 3), i.e.

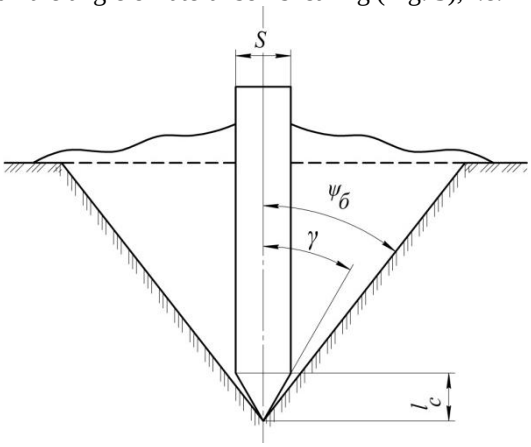

Fig. 3. Scheme for determining the length of the bevel of the tooth.

$$\beta_1 < \psi_б \tag{5}$$

When (5) the ribs and the lower pointed part of the tooth will rest on loose soil and prevent it from deepening.

Using the diagram in Fig. 3, you can determine the length of the bevel of the tooth, at which the condition (5)

$$h_o > 0{,}5Sctg\psi_б \tag{6}$$

ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 7, Issue 12 , December 2020

It follows from this expression that the length of the bevel of the tooth depends on its thickness and the angle of lateral cleavage of the soil.

It should be noted that the sharpening of the lower part of the tooth, although it contributes to its deepening, has a negative effect on the degree and completeness of loosening of the soil in terms of depth and ridging of the bottom of the loosened layer. Therefore, in the final choice of the length of the bevel of the tooth, it is impossible to overestimate its value determined by the formula (6).

Experimental studies have shown that for normal burrowing of the harrow into the soil, it is sufficient that the angle γ is 4-6 ° less than the angle, $\psi_б$ i.e.

$$\beta_1 = \psi_б - (4-6°).$$

With this in mind, the formula for determining the length of the bevel of the tooth will take the following form:

$$l_c = 0{,}5Sctg[\psi_б - (4-6°)] \quad (7)$$

IV. CONCLUSION.

Using expression (7) and taking $S = 25\ mm$ and for serozemic medium-heavy loamy soil $\psi_б$=29-30º [2], we determine the length of the bevel of the tooth. It should be in the range of 25-28 mm.

From the results of the research it follows that the angle of the tooth of the developed harrow should be within 55-60°, its thickness and bevel length should be 25 and 25-28 mm, respectively.

REFERENCES

1. Harrow: UZ Pat. No. FAP 06206 RUz., IPC 8 A01B19 / 00 / D.A Abduvahobov et al. Pub. 29/05/2020, Bul. No. 5.-p. 35.

2. Abduvahobov D.A. Development and substantiation of the parameters of a tooth harrow that copies the field relief. author. dis. … Dr. Philosophers tech. sciences / D.A. Abduvahobov, IMESH. - Tashkent, 2018.

3. Abuvahobov D.A., Ismatullayev Q., Madrahimova M. Results of experimental research on the substantiation of the parameters of the tooth harrow copying the field - International Journal of Advanced Research in Science, Engineering and Technology: - India. 2020.-№7, Issue 6, 14049-14053 pp.

4. Abduvahobov D.A. Determination of the completeness of loosening the soil with the teeth of the articulated-oscillating harrow / Mechanization and electrification of agriculture: - Russia, Moscow, 2016. -№6. - S. 16-17