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ANALYSIS OF TECHNOLOGIES AND TECHNICAL MEANS FOR PROCESSING SLOPING FIELDS

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Abstract. This article presents an analysis of technologies and technical means for tillage of sloping fields. According to it, technologies and technical means for soil erosion control are presented.

Keywords: machine, soil, softener, combination, pawl, working body, traction resistance, coverage width.

Introduction. Soil erosion prevention is an urgent problem for many countries of the world, including Uzbekistan. According to researchers, agrotechnical methods such as furrowing, ridge formation, and step and layered tillage are important for preventing and effectively combating erosion in lowland areas [1-2].

Research method. Scientists have conducted scientific research on the development of technologies for soil erosion control on sloping fields and technical means for their implementation.

Research results and discussion. V.I.Taranin and V.B.Rykov developed a method of anti-erosion treatment and a device for its implementation. The proposed method (Fig. 1) involves the construction of wet storage tanks with depths h_1, h_2 and h_3 between the ridges left by the untouched soil. In turn, the line of location of the bottom of each tank, which ensures the formation of a stepped appearance at the bottom of the plow layer, is located at an angle α to the horizon. Open water-retaining tanks are built on these steps [3].

Cross-slope plowing is considered one of the main measures against water erosion. With such plowing and cross-slope cultivation, erosion is sharply reduced and productivity increases. For example, when plowing cross-slopes at 8 and 100, the wheat yield was 15.7 and 15.8 t/ha, respectively, while when plowing these slopes longitudinally - 12.9 and 7.1 t/ha [4-5].

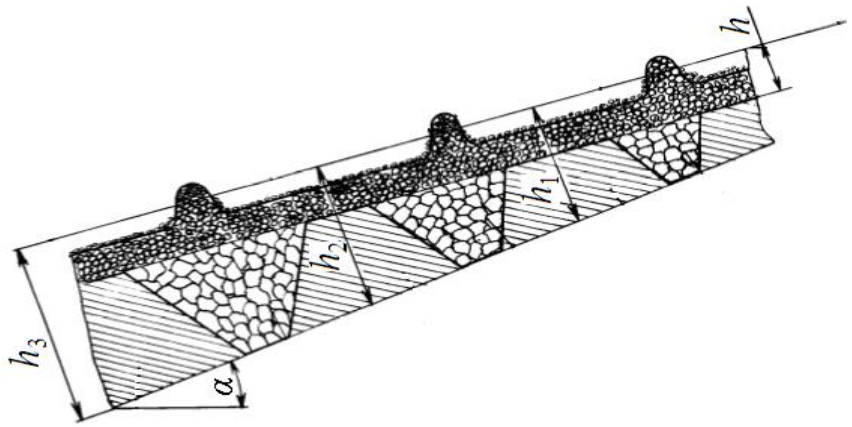

Figure 1. Anti-erosion treatment method

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On sloping fields, furrowing during autumn crops, perennial grasses, and autumn plowing provides high soil protection efficiency. As a result of research by L.S. Orsik and G.N. Sineokov, it was found that furrowing during autumn plowing on sloping lands, in fields sown with perennial crops, and autumn crops allows to capture up to 50% of the water flow. Such a soil tillage system significantly eliminates soil erosion on slopes and allows for maximum use of autumn precipitation [6-8].

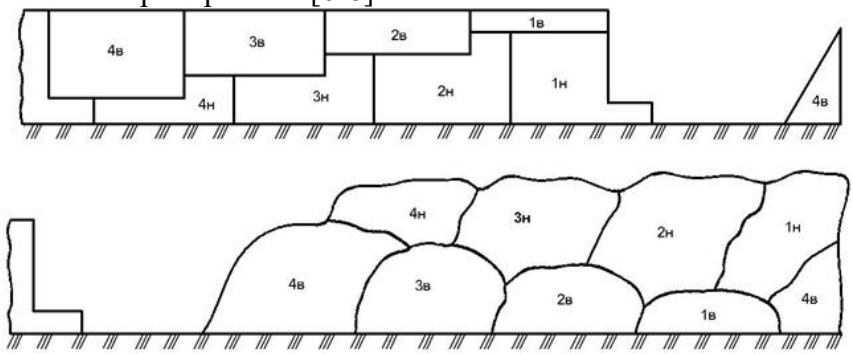


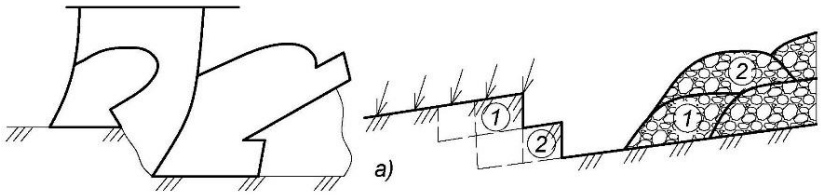
Figure 2. Method of plowing slopes

The soil protection technology for growing agricultural crops recommended by the Ukrainian Research Institute for Soil Protection from Erosion on Slopes provides for the main soil tillage for autumn crops, which includes loosening the surface to a depth of 8-10 cm and making furrows to a depth of 50-60 cm every 8-10 m (Figure 2) [9-11].

To protect soils with slopes of 7-80 in the mountainous regions of Uzbekistan from water erosion, maintain humus balance and basic nutrients, S.S. Rustamov recommends alternating tillage with flat cutters and heavy harrows (BDT-3) with traditional tillage with a depth of 20-22 cm [12-14].

To reduce moisture loss in the plowed layer, Ukrainian scientists have proposed a two-layer tillage of slopes by turning over the upper and lower layers of the soil (Fig. 3, a). The upper layer is turned over at different depths, i.e. in a stepped manner, with the depth of tillage of the upper layer increasing as the slope rises. The lower layer is also turned over, with the lower and upper layers of the soil alternating [15-18].

To reduce moisture loss in the overturned layer, a two-layer plowing method of slopes has been proposed [19-21]. In this case, the upper and lower layers of the soil are overturned (Fig. 3, b). The upper layer is cultivated at different depths, that is, in a stepped form. According to this method, the depth of cultivation of the upper layer increases as the slope rises. This creates a stepped plow in the soil, which allows moisture to accumulate and accumulate on the slopes [22-23].



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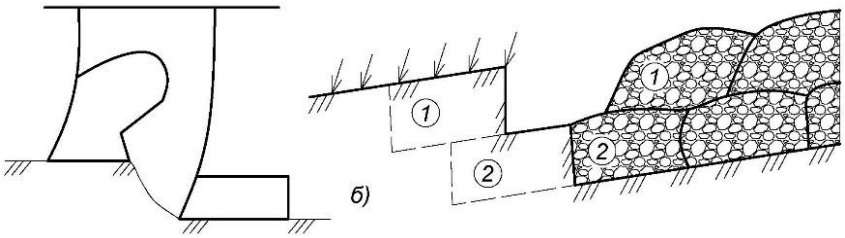

a–two-row plowing; b–with a flat-cutter

Figure 3. Scheme of working bodies and technological processes of layered soil cultivation

The thickness of the adjacent layers of the lower layer increases towards the lower side of the slope, while the total depth of cultivation remains the same, the upper layers are laid on the lower layers. This allows for internal step-like plowing of the soil. Such plowing allows for the capture and storage of soil water, and prevents water erosion [24].

Ukrainian scientists have developed two-tier plows with interchangeable working bodies and combined tools based on them for cultivating sloping lands (Figure 1.4) [25].

The following tillage techniques are recognized as promising in the crop rotation system for the development of ecological farming: two-layer plowing; inversion-flat-cutter; inversion-chisel; flat-cutter-chisel [26].

Two-layer plowing involves layered cutting, loosening and turning the upper blade into the furrow bottom, and moving the lower blade to the field surface. The depth of cultivation is 25-35 cm. Periodic two-layer cultivation reduces field contamination by 1.3-2 times [27].

V. Aleksandryan found that plowing with deep loosening on slopes greater than 20 reduces water flow by 40% compared to conventional plowing. It was observed that with deep loosening to 30-35 cm, water flow was reduced by 0.8 to 4.5 mm per cm of deepening [28].

The analysis of the literature shows that agrotechnical methods are of great importance in the integrated fight against erosion. The main requirement for combating erosion is to form the field surface and the bottom of the trench in such a way that it is resistant to wind and water erosion and creates conditions for plant development and crop formation.

It is known that the main cause of water erosion is rainwater, which leads to the washing away of the topsoil and the deterioration of soil fertility [29]. The main tasks of primary treatment of soils affected by water erosion include: bringing the soil to a state of fine-grained, softened structure to improve its water permeability and aeration capabilities; creating a microrelief on the surface of the slope that traps water; reducing soil washing under the influence of surface water flows; deepening the topsoil; breaking the plowshare [30].

Conclusion. The main disadvantage of the above technologies is that they only involve soil cultivation. Additional operations are required to plant crops. This, in turn, leads to additional fuel and labor costs and increases operating costs.

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