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ПОВЫШЕНИЕ КАЧЕСТВА ОБРАБОТКИ ПЕРЕУВЛАЖНЕННЫХ ПОЧВ В ЛЕСНОМ ХОЗЯЙСТВЕ

IMPROVING THE QUALITY OF CULTIVATION OF WATERFILLED SOILS IN FORESTRY

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Abstract: This article analyzes existing tools for processing plastic waterlogged soils and substantiates the need to create an improved tool equipped with combined working bodies in order to increase the efficiency of forest restoration.

Keywords: felling, wetted soils, plasticity, plough, double-mouldbody plough.

Аннотация: В данной статье производится анализ существующих орудий для обработки пластичных переувлажнённых почв, а также обосновывается необходимость создания усовершенствованного орудия, оснащённого комбинированными рабочими органами, с целью повышения эффективности лесовосстановления.

Ключевые слова: вырубка, переувлажненные почвы, пластичность, плуг, двухотвальный корпус плуга

In modern forestry, soil cultivation is a critical stage of reforestation, directly

affecting the success of growing forest crops. The development of effective methods and technical means for processing waterlogged soils with high plasticity is especially relevant, since traditional technologies often do not provide the necessary quality of soil preparation.

In forestry, two main types of soil cultivation are used: basic (primary) and additional (surface). Basic cultivation includes plowing, cutting furrows, creating micro-elevations, loosening and terracing. Additional cultivation is aimed at improving the soil structure through harrowing, planning and fallow maintenance.

The choice of cultivation method depends on specific forest growing conditions. Continuous cultivation, which involves complete loosening of the area, is used on former agricultural lands and uprooted clearings. However, most often partial cultivation in strips or furrows is used, preserving untreated inter-strip coulisses.

When working with waterlogged soils, it is especially important to adapt the technology to the soil type and moisture level. Planting in inverted layers or artificially created micro-elevations proves to be effective, which improves drainage and reduces competition with weeds. Traditional planting in the bottom of a furrow on such soils often demonstrates low efficiency.

In forestry practice, ploughshare plows are widely used, among which the most common models are PKL-70, PLP-135 and PL-1. However, their use on waterlogged soils causes a number of problems. The main disadvantage of traditional plows is that they lay layers in the form of a continuous strip, which complicates subsequent planting and worsens the quality of processing. Plastic soils form dense, slightly loosened layers that do not create optimal conditions for the development of the root system of seedlings.

As an alternative, disk tools such as PLD-1,2 are considered, as well as combined units combining ploughshare and disk working bodies. Foreign analogues, such as the Polish ploughs LPŻ-30 and LPŻ-75, are equipped with additional press rollers and active loosening elements, which significantly improves the quality of the formation crumbling.

A promising direction is the development of tools with auger berm cleaners and disc batteries, which not only form a furrow, but also provide intensive loosening of the formations. Such solutions, described in patents of the Russian Federation No. 2183918 and A.s. USSR No. 940660, demonstrate increased efficiency on heavy and waterlogged soils.

Modern research in the field of soil cultivation is aimed at optimizing the design and operating parameters of tools. A significant contribution to this area was made by the works of V.P. Goryachkin, G.N. Sineokov, F.I. Kanarev and other scientists who developed the theoretical foundations of the interaction of working bodies with the soil. Experimental studies conducted at VSTU named after G.F. Morozov made it possible to simulate the process of soil cultivation with disk batteries using the discrete element method. It was found that the optimal angle of attack of the disks is 15-25°, which ensures the best soil crumbling. Research by the Kuban State Agrarian University showed that reducing the operational weight of the tool while maintaining the processing depth allows increasing the efficiency by 9-12%. Of particular interest are the works on modifying disk working bodies with a variable radius of curvature. Such designs ensure more uniform soil crumbling and reduce the energy intensity of the process by 7-10% compared to standard spherical disks.

The analysis shows the need to improve the designs of soil-cultivating tools for working on waterlogged soils. The most promising direction is the creation of combined units combining ploughshare bodies with active disk or auger rippers. Further research will need to substantiate the parameters of such implements, including the geometry of the working bodies, operating modes and methods of aggregation with tractors. An important aspect is the development of mathematical modeling methods for predicting the quality of processing and energy consumption on various types of soil.

The introduction of improved tillage implements will improve the efficiency of reforestation in difficult areas by creating optimal conditions for the growth of

forest crops. This will help solve the problems of sustainable forest management and restore disturbed lands.

Therefore, it seems advisable to develop a forest tillage implement in the form of a complex design with combined working bodies. It should include a two-moldboard plow body, as well as additional safety, loosening and crushing elements with spring mechanisms.

The basis of the design will be a welded frame made of rolled steel, equipped with lugs for attaching to a three-point mounted system tractor theme. The crusher roller must be made in the form of a metal frame structure with two posts and rolling bearings. The roller disks must be equipped with plate knives with a sharpening angle necessary for cutting small logging residues and weeds.

The plow bodies must have a moldboard-plow surface of a screw shape, which will allow for effective cutting of soil layers, turning them by 180° and laying them on the edge of the furrow. The handle knife, installed in the front part on the axis of symmetry of the double-moldboard body, is designed to cut the soil layer and small plant roots.

The loosening elements of the structure are supposed to be placed and secured on the crossbar in the rear part of the frame. Each roller is additionally equipped with a spring safety mechanism.

The developed tool is intended for preparing the soil for planting forest crops on sodded unstumped clearings with wet soils. The area being cultivated may contain up to 600 stumps per hectare. During the process, micro-elevations are formed by turning and loosening the layers on the sides of the furrow, which creates optimal conditions for subsequent planting.

In addition to its main function, the implement can be used to lay mineralized barrier strips when localizing forest ground fires, which significantly expands its functional purpose.

Thus, the developed design of the tillage implement is a modern technical solution for cultivating waterlogged soils in forestry conditions. The combination

of a two-moldboard body and disk batteries ensures comprehensive soil cultivation, including cutting furrows, turning layers and their subsequent loosening. The presence of adjustable safety mechanisms and ballast boxes allows the implement to be adapted to various working conditions and ensure stable processing quality. The introduction of this tool into forestry practice will increase the efficiency of forest restoration in difficult areas with waterlogged soils, create optimal conditions for the growth of forest crops and expand the possibilities for protecting forests from fires.

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