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**EFFICIENCY OF USING A LOOSENER-MOLE PLOW FOR
REGULATING THE SOIL WATER REGIME**

Doszhanov O.M., Ormanbekova A.A., *Doszhanov E.O., *Tuseev T.T.

Almaty Technological University, Almaty; KazNU Al-Farabi Kazakh National
University, Almaty*

During loosening–mole plowing, the soil zones above the mole drain improved in looseness and in their water–air properties. The optimal parameters of the drainer and share during loosening–mole plowing ensure structural stability.

Caring for the land, continuously increasing its fertility, protecting soils from erosion, and ensuring their rational use are the keys to stable economic growth and effective solutions to agricultural and social challenges. One of the negative factors that worsens the water–physical condition of soils is compaction caused by the running gear of agricultural machines and implements. To improve such soils, loosening, slotting, and mole plowing tools are used.

The use of these reclamation tools, aimed at accelerating the infiltration of surface water, helps accumulate moisture in the soil profile and speeds up the removal of excess water. Among them, the most widely used method for regulating the water–physical state of soils is mole drainage. This improves soil structure, removes excess moisture from farmland, and enhances soil aeration, resulting in increased crop yields.

However, due to the short service life (2–4 years) of mole drains, this method has not become widely used. The destruction of mole drains depends not only on the mechanical composition of soils but also on the structural and technological parameters of the working body of the drainage machine and its operating modes. From this point of view, a study was conducted on the operation of a loosener–mole plow, which combines the functions of both tools, altering the technological process of laying mole drains. The combination of loosening and mole plowing sufficiently loosens the soil above the drain while minimizing traction resistance and allows for an increase in the drainer diameter.

The loosener–mole plow (a loosener equipped with a debulking share) loosens the soil along its movement path using the share; at the same time, the cut soil layer, passing over the debulking share, fills the slit left by the vertical knife. The drainer, matched to the share’s parameters and connected by a flexible link to the heel of the vertical knife, forms a drain in a loosened medium with more uniform density along the perimeter of the mole channel. Therefore, loosening–mole plowing, aimed at accelerating surface water infiltration, is effective not only on heavy but also on light loamy soils, as it redistributes water in the soil profile and accumulates moisture from snow and rainfall. Excess moisture entering the drain spreads along the length of the mole channel.

Considering the high efficiency of deep loosening–mole plowing, it can be applied on sloping lands to prevent water erosion, eliminate waterlogging in low-relief areas, and, at the same time, prevent pollution of water bodies.

The study showed that with a ratio of b/d above 0.65–0.85 (where b is the width of the debulking share and d is the diameter of the drainer), resistance continues to slightly decrease, but proper mole formation is not achieved and the cavity density becomes insufficient. Table 1 presents data on the hardness of the mole drain cavity during loosening–mole plowing ($b/d = 0.7$) and mole plowing (in both cases, drain diameter $d = 100$ mm). Earlier studies examined the working process of loosening–mole plowing of mineral soils [1,2] and its effects on improving the physical–mechanical, water–air, and thermal properties of mineral soils. During this period, various parameters were studied, in particular the hardness of the surface of the mole drain cavity (Table 1)

Table 1. Hardness of the mole drain cavity surface

Surface of the cavity	Hardness (MPa) - Loosening–Mole Plowing	Hardness (MPa) - Mole Plowing
Upper part (arch)	0.5	0.3
Side walls	0.6	1.2
Bottom	0.7	0.7

These data show that the cavities formed during loosening–mole plowing with $b/d = 0.7$ are sufficiently dense at the arch, but significantly less so on the side walls compared to standard mole plowing. The obtained results indicate that mole channels formed with the loosener–mole plow are more efficient, as the density along the perimeter is more uniform. Consequently, the service life of mole drains made by loosening–mole plowing increases by more than 1.5 times compared to conventional mole plowing.

During the loosening–mole plowing process, the deviation of the drainer from the horizontal plane was within 0–2 degrees. This is explained by the fact that the share, geometrically matched to the drainer, leaves a suitable space behind it for the drainer. The drainer should be located 300–400 mm behind the heel of the vertical knife, calibrating the loosened soil along its cylindrical surface.

Thus, during loosening–mole plowing, a continuous loosened zone was formed above the mole drain, which accelerates the filtration of surface water into the drain. As a result, the physical–mechanical, water–air, and thermal properties of mineral soils improved.

References:

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