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# Improvement Of Drainage – Mole Implement And Its Application Technology In The Irrigated Lands

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***Abstract*—** *This article, deals with improved drainage and mole implements and the technology of their application in highly saline irrigated lands. Existing drainage and mole implement has some drawbacks, as it has one working body, lower productivity, during operation the stability of the course is lost in the depth of the gun and the weakness of its frame. The proposed new improved drainage – mole implements, has high productivity, high machine utilization factor (MUF) and the extreme working bodies which made with inclined racks to save from collapsing from above the shells of mole drainage. It has a working width of up to 4 m, the frame consists of three parts, the middle frame is hung on a tractor with three point connections, U-shaped frames with a wide grip of up to 1 m are put on the middle frames on both sides, and between the working body there is a side and average of 2 m, and you can reduce their distance to 2 m. The depth of mole drainage formation is selected depending on the dependence of the mechanical compositions and the degree of soil salinity. The working bodies for the formation of mole drainages, the cone cylinder has a diameter of 0.105-0.110 m, the height of the stand is 1.0-1.2 m, the length of the steel cable is 0.30-0.35 m connecting the posts with the cone of the cylinder, the working width is wave-shaped bit 0,055-0,080 m, the angle of installation of the working body 27-300 and the speed of the unit 1.24-1.36 m / s with this parameter provides high-quality process execution. When using a drainage mole gun in highly saline soil, harmful salts from the soil are reduced by 5-6 times, the desalinization coefficient is 7.4 and this tool can be used after 2-3 years.*

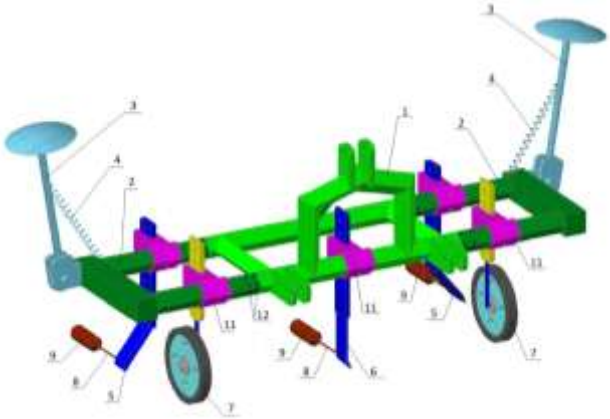
**Keywords**— mole drainage tools, saline soil, working body, cone cylinder, steel cable, frame, marker.

## 1. INTRODUCTION

It is clear, in many countries of the world, including Iran, Pakistan, Turkey, 50%, India, the Arab Republic of Egypt, 25-30%, Russia 12 million hectares, Pakistan 6 million hectares, in Uzbekistan - 2 million hectares of land have saline soils and is considered a global problem for their improvement. In the world, highly saline lands lead to a decrease in agricultural products by 44-46% [1]. To improve the reclamation state of highly saline land, various methods and technologies are used, including the use of collector drainage, tillage using various technologies and technical means and other methods. To these degrees, by these methods, it is possible to reduce harmful salts from the soil. And the use of a drainage mole with which with the lowest energy consumption can achieve high results.

## 2. MAIN PART

In the course of the study, modern methods and devices were used to measure traction resistance of the working bodies, study of soil salinity and methods for their determination.



The improved mole drainage gun differs with existing guns in that, the new gun has three working bodies which are staggered on a two-row gun frame with a working width of up to 4 m. And it consists of the following units, parts and elements (Fig. 1).

**Fig. 1. Improvement of the drainage and mole guns.**

1-hitch frame; 2-U-shaped side frames; 3-marker; 4-marker springs; 5-side inclined racks; 6-average straight stand; 7-apron ring; 8-steel cables; 9-cone cylinder; 10-clamps for securing the support ring and working racks; 11-bolts for securing the side U-shaped frames.

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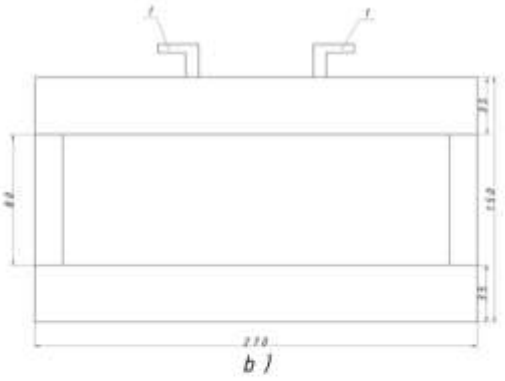
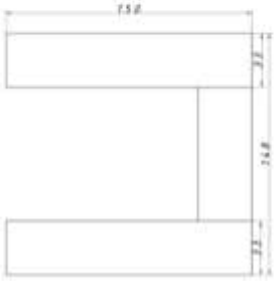


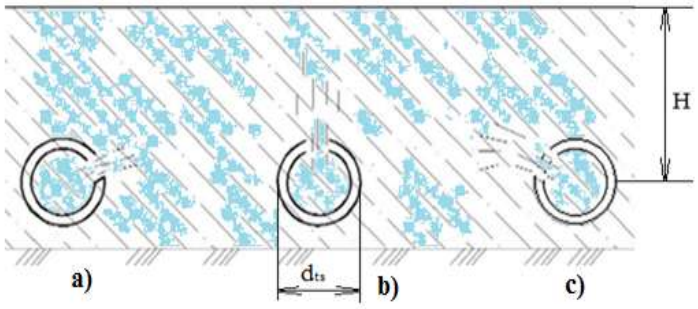
The scheme of central and side frame is given in the picture 2: a) middle frame; b) P-shaped side frames

Pic. 2. Collapsible views of draining and mole implement's frame

The improvement of the drainage and mole implements works as following: with the help of a linkage 1, the middle frame is hung on the rear linkages of the tractor, while the lateral U-shaped frames 2 are fixed to the middle frames 1, going inside 0.5 m and fastened with bolts 12, and you can reduce or increase the distance between the racks lateral 5 and middle 6. During the operation of the gun using the support ring 7, you can adjust the depth of formation of mole drainages and is set depending on the mechanical composition and salinity of the soil from 0.6 to 1.0 m.



**RESULTS & DISCUSSION** First in Uzbekistan, under irrigated conditions in saline soils, with the justified parameters of the working bodies of the tool, the tools we developed were used. The tools were tested in laboratory and field conditions to justify the parameters of the tools and obtained positive results to reduce harmful salts from the soil in irrigated agriculture, and developed by improving tools with optimal parameters [3-5].In the areas of cotton production, they are designed to form artificial mole drains in a row spacing of 22-25 cm for irrigation to water . The proposed tools were tested in laboratory and field conditions and received positive results.




**a) and c) mole drainage from side inclined racks;**
**b) mole drainage from a straight line in the middle of the racks.**
**Fig. 2. The process of groundwater flow in mole drainage.**

The experiments were carried out with drainage worm tools in the soil channel in a laboratory conditions and field conditions studied the formation of worm drainages, and the study of the general traction resistance of the working bodies of the tool.

We determine the general traction resistance of the advanced working bodies of the drainage mole gun in the following formulas [7].

$$\sum F_{tc} = 3(R_{rez} + F_{sd} + F_{kts} + F_{pkts} + F_{tro} + F_{ktsy} + F_{ioy}) + 2(F_{opk} + F_{mar}) \quad (1)$$

Here: $\sum F_{tc}$ - general traction resistance of the drainage mole gun, kN;

$R_{rez}$ - soil resistance for cutting with a wedge-shaped rack, kN;

$F_{sd}$ - resistance wave-like bits, kN;

$F_{kts}$ - cylinder cone resistance, kN;

$F_{pkts}$ - resistance to soil sticking on the surface of the cylinder cone, kN;

$F_{tro}$ - cable resistance, kN;

$F_{ktsy}$ - the resistance of the workers from sticking soil in the side, kN;

$F_{ioy}$ - resistance of a rack of workers, kN;

$F_{opk}$ - resistance of the support ring, kN;

$F_{mar}$ - marker resistance, kN.

During operation, the mole drainage machine requires $\sum F_{tc} = 27 \div 33$ kN.

After that, we determine the general dressed state during the formation of mole drainage in a certain depth (60, 70, 80 cm) of soil.

$$\sigma_{ов} = \frac{3B_s \cdot \gamma}{2k_r tg\varphi} \cdot \left[ e^{(k_r tg\varphi(\frac{2H}{B_S})-1)} \right] + q \cdot e^{(k_r tg\varphi(\frac{2H}{B_s}))}$$

Here: $\sigma_{ов}$ - the general stress state during the operation of the working bodies of the cylinder cone, MPa;

$B_s$ - the shell width of the molded mole drainage in a certain depth (N) of soil cultivation, m;

$k_r = 1 + 2tg^2\varphi$ - Kistenosen coefficient;

q - pressure from soil load, MPa.

Using equation (2), the general stress state was calculated during the work of the proposed tools in the range of $\sigma_{ов} = 3{,}9 - 4{,}2$ kN / m$^2$.

Moisture drainage guns require power during operation:

$$N_{kd} = \frac{\Sigma F_{tc} \cdot V_{kd}}{\eta_{kd}} = \frac{(27 \div 33) \cdot (1{,}34 \div 2{,}24)}{(0{,}80 \div 0{,}85)} = 79 \div 52 \text{ кН} \quad (3)$$

Here: $N_{kd}$ - Power of a drainage machine, kW;

$V_{kd}$ - the speed of the mole drainage machine, m / s;

$\eta_{kd}$ = 0.80-0.85 - machine efficiency.

The annual operational productivity of the mole-mounted drainage machine (km / h) is determined by the following formula:

$$P_{ek} = P_{ek.ch.sr.chas} \cdot T_{f.chas}$$

Here: $P_{ek}$ - Annual machine output, km/h;

$P_{ek.ch.sr.chas.}$ - Operating average capacity of the machine, km/h;

$T_{fchas}$ -Hourly operating hours of the machine in the year set by the annual operating mode, km/hour;

The working, process the proposed tool before spring washing with washing norms and washing options are shown in table 1, as well as the norms and terms are given in the column below. The experiments were carried out in 3 variants. 1-option conventional plowing to a depth of 0.35 m; 2-option plowing in depth 0.35 m and optionally loosening with a chisel cultivator and a 3-plowing option to a depth of 0.35 m and additionally the formation of mole drainage to a depth of 0.6 m with a mole drainage implement (table 1). The salt content was determined before washing on 18 ha. The experimental field was averaging 0.978% and the washing field was a decrease in salt and an increase in desalination coefficient.

During experimental study when is soil,for the first time 2300 m$^3$/ha (12/15/13) and for the second time - 2200 m$^3$/ha (01/09/13), the results were studied in all three versions, and the amount of water in the second field was 5500 m$^3$/ha. those. three times, 1 time to 2200 m$^3$/ha (12/15/13), 2 time to 1700 m$^3$/ha (01/09/14) and 3 times to 1600 m$^3$/ha (02/22/14); three times i.e. 1 time 2300 m$^3$/ha (12/15/13), 2 times 2200 m$^3$/ha (02/01/14) and 3 times 2000 m$^3$/ha (02/22/14), and the experimental work was performed in the above procedure and system.

**The results of a study of 18 ha of experimental poly**

**Table 1.**

| Indicators | Flushing rate, m$^3$/ha | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 4500 | | | 5500 | | | 6500 | | |
| Options | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| The salt content,% | 0,704 | 0,578 | 0,467 | 0,596 | 0,464 | 0,389 | 0,432 | 0,198 | 0,132 |
| Desalination coefficient | 1,4 | 1,7 | 2,1 | 1,6 | 2,1 | 2,5 | 2,2 | 4,9 | 7,4 |

According to the table 1 it can be seen that the most optimal option for reducing salt and increasing the stratification coefficient was obtained in the third option, recommended by a drainage mole gun. Salinity is 0.978%.

## 3. CONCLUSION

1. The results of the study concluded that in many countries of the world, as in Iran, in Pakistan, in Turkey-50%, in India, in the Arab Republic of Egypt 25-30%, in Russia -12 million hectares, in Pakistan -6 million hectares in Uzbekistan- 2 million hectares of land is considered highly saline land and is considered a global problem for their improvement.
2. Under the conditions of irrigated agriculture, to improve the reclamation state of the soil, improvements have been made to drainage-mole tools and applications for autumn soil leaching.
3. Substantiated the parameters of the drainage mole gun as: the width of the gun to 4 m; cylinder cone diameter 0.105-0.110 m; stand heights 1,0-1,2 m; steel cable length 0.30-0.35 m; the working width is a wave-like bit of 0.055-0.080 m, the angle of installation of the working body is 27-300 and the speed of the unit is 1.24-1.36 m/s, with this parameter, high-quality technological process is ensured.
4. The developed tools compared with traditional processing, the formation of mole drainage, and the washing of salts allowed a reduction of its time by 15 days and a decrease in salts compared to the initial 0.978% to 0.467-0.132%, the stratification coefficient was 2.1-7.4.
5. Treatment to a depth of 0.60 m with mole drainage, during the years with sufficient water, allows flushing with a norm of 6500 $m^3$/ha and, in case of water shortage, with a norm of 4500 or 5500 $m^3$/ha.
6. The use of developed by drainage mole gun on saline soils allows energy consumption of 8-12.5%, labor costs of 9.51-12.62%, operating costs of 8.07-10.05%, increase in labor productivity by 18, 5-22.0% and makes it possible to obtain 14.5 million soums of annual economic efficiency.

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