THE RESEARCH OF THE RAIN INTENSITY ADAPTATION TO THE CONDITIONS OF HYDROPHYSICAL CHARACTERISTICS OF THE SOIL FOR ECOLOGICAL AND ECONOMICAL IMPROVEMENT OF THE IRRIGATIVE EQUIPMENT

Iu. Melnic, A. Coronovschi, R. Ceban, A. Melnic.
State Agrarian University of Moldova, Chisinau, Republic of Moldova,
iu.melnic@uasm.md, a.coronovschi@uasm.md

***Abstract**: The article presents the result of the research on the possibility of using in the watering process the effect of swallowing and cracking of chernozem soils depending on their humidity. Watering installations where the rain intensity is variable or constant but higher than Kf = const lead to an essential reduction of working time in position, since in this case the soil soaking process also includes the infiltration phase.*

Water losses would be less because in this case the soil soaking process also includes the infiltration phase in which, depending on its initial humidity, the soil can incorporate essential water volumes. Consequently, it is possible to improve the ecological and economic efficiency of the irrigation technique by adapting the intensity of the rain to the dynamics of the process of water movement in the soil during the watering process.

***KEYWORDS**: SOIL WATER FIELD CAPACITY (CC), THE MOVEMENT OF WATER IN THE SOIL, EFECT OF SOIL SWELLING.*

1. Introduction

It is known that while choosing the irrigative equipment, one of the most important and decisive factor is that of the rain intensity produced by the installation. This intensity must definitely be smaller or equal to the speed of the water circulation of soil with the humidity of CC (field capacity).

Taking into account the fact that black earth (chernozem`s soil) has the speed of filtration about 0.3-0.5mm per minute, watering norm of 55mm can be absorbed in soil in about 3-4 hours, which makes a disadvantage the usage of the irrigative equipment.

Another problem while irrigating appears due to the small level of the homogeneity of the soil`s type or sub-type spread in the area that is irrigated. Because of this from time to time may happen some losses of water by its leak from the surface and by percolations on the soil.

In turn, these phenomena lead to the leakage of organic, mineral and chemical leaching substances, thus producing a negative impact on the fertility of the irrigated soil and the environment.

Considering these, the goal of the research is the demonstration of the possibility of the irrigation equipment`s modernization in conditions of the increasing
of rain intensity. So that the its intensity would fit in the limits:

$$Kfmax > I > KfCC. \quad (1)$$

where: Kfmax – the speed of the water circulation after the first hour of the research of the permeability of soil for water;

KfCC – the speed of water circulation when the soil`s humidity is equal to CC.

The research was made on the base of the existing and personal studies of the irrigation water circulation and distribution in soil.

2. Results and discussions

As we already mentioned, technical characteristics of the irrigation equipment are chosen depending on the speed of the water filtration on soil with the humidity equal to CC (Fig.1).

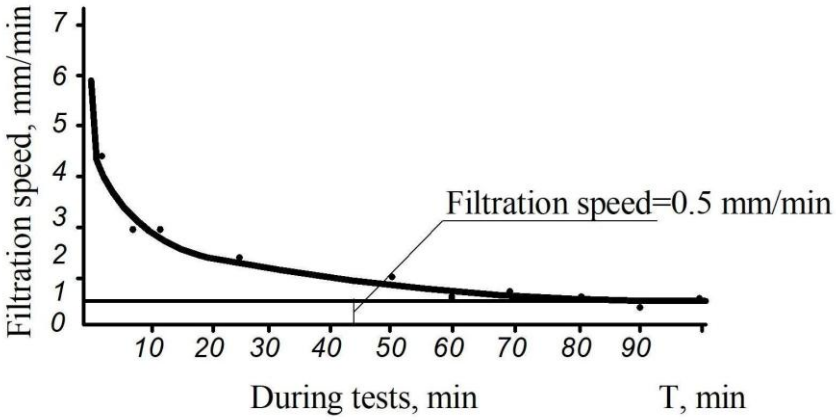

***Fig.1.** Choosing the intensity of rain*

As we see in this figure, the speed of the filtration is about 0.5mm/min. Considering this, actually, the intensity of the artificial rain made by the irrigation equipment does not have to overcome this level (0.5mm/min). This, as was already mentioned, is an accepted condition with the goal of not permiting leaking on the surface.

Coming out of this condition one can calculate the time of the functioning of any irrigation machine: the smaller is the speed of water circulation, the longer is the time of the positioning. With all this, there appear relatively big losses of the irrigation water both due to the leaking on the surface and to the percolations on the soil [1].

These phenomena happens because the pedological conditions of irrigated areas are not homogene. That means that in the area of one type or sub-type can exist even 1% of some other types of soil which have different hydrophysical characteristics. That is why if the irrigation equipment was chosen for one type of soil with one speed of the water filtration with the humidity CC, then when we meet sub-areas of other types and sub-types of soil with worse hydrophysical characteristics, only then in these conditions the negative impact can be essential (losses of about 35% absorbed water) [1, 2].

Apart from this, the actual concept of the movement and distribution of water in the unsaturated with water soil is based on the idea that the water that penetrates the soil, firstly saturates all the pores and particles of one certain layer in a hygroscopic and capillary way [2, 3].

The water that is influenced by the force of gravity enters gradually in the depth of soil, moisturizing continually the soil until the level of depth where its saturation becomes complete with this

hydroscopic and capillary water. It turns out that every layer of soil becomes similar to an accumulating container which fills itself with water, and the excessive quantity of water runs out into the container situated below.

That is why the traditional physico-chemical approach of water movement into the soil frequently leads to a negative impact on this soil.

Ecological consequences can be highly unpredictable: sodiumisation, consolidation of soil masses and cessation of transformation of organic material into humus [4, 5, 6, 7]; the raising of phreatic water level over the critical limits, the periodic apparition of anaerobic processes [7]; the losses of structure, compaction, hydrophilisation of mineral colloids, secondary gleization [8]; the leaching of carbonates and of nutrients, the increasing of Na+ and Mg2+ content of microbial restructuration [7, 9].

One of the reasons why these problems appear is the soil`s maintaining of some regimes of humidity not appropriate for hydrophysical characteristics of the chernozem.

In order to change these problems` state the accommodation of humidity regimes of soil to its hydrophysical natural properties is strongly required.

In order to remove the mentioned disadvantages we offer the modernization of the irrigation equipment by usage of hydrophysical characteristics of black earth to inflate in the contact with water. In the result of the inflation in time, the speed of the water circulation is modified from the maximum in the initial phase to the minimum in the phase when the soil is imbued wholly with water (Fig.2).

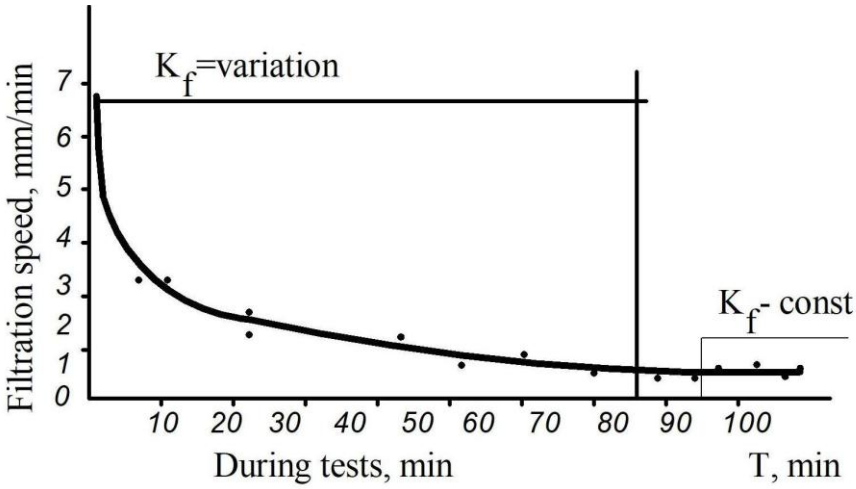

Fig.2. *Dynamic intensity of water irrigation:*

Kf = variation and Kf = const - coefficients of water infiltration into the soil (variable and constant).

From the graphic we can observe that while absorbing of the water into the soil not saturated initially with water, the process of water circulation happens in two phases:

1. Soaking of soil with water by filling the blanks (infiltration through the unsaturated soil with water in the process of the inflation).
2. Filtration. A phase when the water moves through the soil in the inflated state and completely imbued with water).

In the first phase, due to the fact that the soil is not inflated, the speed of the water circulation is relatively fast (0.5-5.8mm/min), while in the second phase the speed is relatively constant (about 0.5 mm/min) because the soil was made compact.

In order to use this characteristic of the chernozem we need to equip the irrigation technique with the possibility of changing of the produced rain intensity depending on the specific dynamics and characteristics of water circulation in the irrigated soil (Fig.2).

Example. The soil administers some norm of the humidity of 550 m3/ha, in case of usage of the specific character of water circulation in soil in the first phase, the functioning time of positioning would vary from 9.5 to the 110 min. In the second case this time would be minimum 110 minutes.

As can be seen, the average time required to administer the of 550 m3/ha with the new method would be twice as fast as when using the real method.

Conclusions:

1. Irrigation with the instalations which have the variable or constant but higher then the Kf = const intensity of rain (shower) lead to the essential reduction of working time because in this case the process of the soil wetting includes the phase of infiltration.
2. Water losses could be less essential because in this case the process of soil wetting includes the phase of infiltration, a phase when, depending on the its initial humidity, the soil can incorporate essential volumes os water (Fig.2).

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