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THE ESTABLISHMENT OF THE CORRELATION BETWEEN THE DEEPNESS OF THE PHREATIC LEVEL AND THE HUMIDITY AT THE SOIL SURFACE, IN THE EXPERIMENTAL FIELD FROM THE WATERWORKS IN ORADEA, BIHOR COUNTY

STABILIREA CORELAȚIEI ÎNTRE ADÂNCIMEA NIVELULUI FREATIC ŞI SUPRAFAȚA SOLULUI, ÎNTR-UN CÂMP EXPERIMENTAL SITUAT ÎN INCINTA UZINEI DE APĂ, ORADEA

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Abstract: *The objective of this paper is the establishment of the correlation between the deepness of the phreatic level and the humidity at the soil surface because the rational usage of the water in the drainage, irrigation or the ones with reversible functioning drainage-irrigation systems is wanted. The reversible usage of the drainage systems and irrigations leads to: a rational usage of these, ensuring a judicious husbandry of the waterworks; reduction of the arrangement investments and saving electric energy.*

Rezumat: *Scopul acestei lucrări este de a stabili corelația dintre adâncimea nivelului freatic şi suprafața solului, într-un câmp experimental situat în incinta Uzinei de Apă din Oradea, deoarece se doreşte utilizarea rațională a apei în sistemelor de desecare-drenaj, irigație sau a celor cu funcționare reversibilă drenaj-subirigație. De aceea, folosirea în mod reversibil a sistemelor de irigație drenaj duce la o folosire rațională a apei reducând investițiile de amenajare şi la economisirea de energie electrică.*

***Key words*:** *correlation, deepness, phreatic, humidity, soil*
***Cuvinte cheie*:** *corelație, adâncime, freatic, umiditate, sol*

INTRODUCTION

The reversible usage of the drainage systems and irrigations leads to:

- a rational usage of these, ensuring a judicious husbandry of the waterworks;
- reduction of the arrangement investments and
- saving electric energy.

This way, in our country, three more important possibilities of using the drainage systems for irrigations are known: the irrigation by aspersion, surface leak or dripping and sub-irrigation. In the first case, the water detained in the drainage canal by closing the existent dams on this canal network, will be pumped for her usage at irrigations when the requirements of the agrarian culture will impose it. In the second case, the water will leak or will drip directly to the root of the plant and in the third case, the sub-irrigation will be realized by raising the water level from the canal of drainage with the help of the dams (flat, flexible, auto-adjustable, RHN, etc.) [4]. In this way, the stocked water from the system or brought from another source with the help of drains will infiltrate itself in the soil (contrarily from the drainage) and will rise trough capillary, ensuring a humidity at the soil surface in the boundaries imposed by the requirements of the agrarian culture: the minimal ceiling and the capacity of field for the soil water.

On the field where the capillary ascension does not cause the secondary salting of the soils, the drainage system which have had the role of evacuating the exceeding waters from the soil surface and the descent of the phreatic level, can be reversibility used by raising the water level in the channel, reducing or even stopping the leak with the help of dims and alimenting this way underground the field, which leads to the phreatic level and ensuring the sub-irrigation of the agrarian cultures this way [2].

This way, for the reversible functioning of the arrangements of drainage- sub-irrigation is necessary to know the variation law of the humidity of the soil above the level of the phreatic water. Through this law can be established, based on the hydrographics constant of the soil type, the necessary deepness of the phreatic water, so that at the soil surface the humidity at the field capacity or the humidity at the minimal ceiling would be obtained. This way, the soil profile from above the phreatic level will be alimented through capillarity and the soil humidity, situated at saturation at the phreatic level, will decrease towards the soil surface.

At the underground drainage, the descent of phreatic level is imposed to ensure a humidity at the soil surface smaller or equal with the capacity of the field, called drainage norm and noted with z. from the effectuated studies has been proved that, on the fields where there is no danger of secondary salting, maintaining of the phreatic level between limits which should ensure at the soil surface a humidity between Cc and P_{min} leads to very good agrarian productions [2].

MATERIAL AND METHODS

Processing the primary measures taken from the field from the Water Works from Oradea a number of 18 borings has been executed and from 2 of them we have taken samples: the borings 5 and 7. In this borings there is aluviosol which, according to the vectorized map of Bihor County corresponds with the one to which subirrigation lends itself. Above this soil type the variation of the humidity above the phreatic the beginning of April in a dry period.[7]

For this type of soil have been obtained, in Bihor County after the method of regarding the variation of the soil humidity W (%) at the soil surface (in the active layer) based on the deepness of the phreatic water H (m), the determinations and graphics presented this way:

- in table 1 are given and primary processed the measures effectuated in the field at the boring 5 and 7 at the Waterworks Oradea, gate 5;
- in a figure 5 is graphically represented the calculating relation of the variation of the soil humidity W at the field surface based on the deepness of the phreatic water.

The soil humidity is influenced by climate, the mineralogical composition, the structure and texture of the soil, the nature and slope of the filed, vegetation, etc.

The humidity or the water content of the soil represents the water quality which is graphically connected to the soil, in the moment when the crop is made and which evaporates at 105°C.

Next to the temperature, the humidity of the soil influences largely the biological activity and the self-purification possibility

The humidity of the soil determined by direct observation can be classified this way:

- 1st degree – dry soil which does not cool the hands, the sand leaks, the clay is dry, in big grains kept in the sun it almost does not decolorized by drying;
- 2nd degree – soil with fresh aspect, cools easily the hands and decolorizes very little by drying;
- 3rd degree – wet soil, produces a visible cooling of the hands and decolorizes by drying;
- 4th degree – wet soil which does not glimmers but strongly decolorizes at sunshine. At touch is cold and wet;

Figure 1 – Piezometrul F7

- 5^{th} degree – wet soil, glimmers because of it is covering with a water film. It is characterized by fluidity it does not bind it stretches.

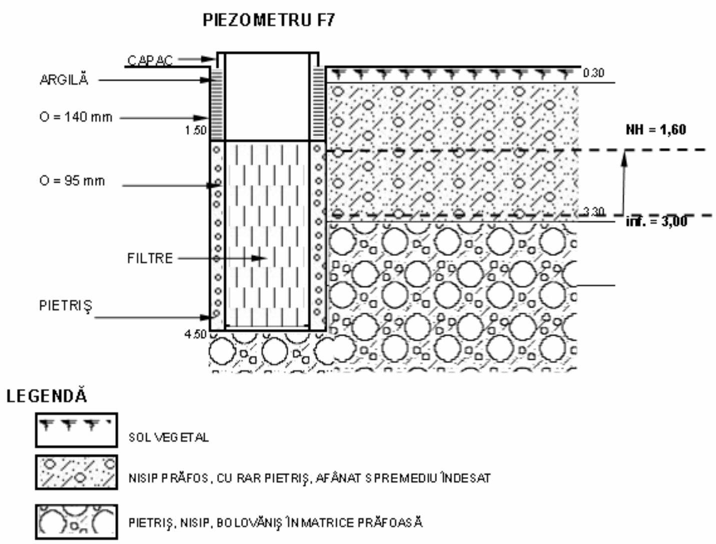

Figure 2 - Transverse profile for boring 7

RESULTS AND DISCUSSIONS

For determining the humidity in situ (without taking samples) it is used:

- radioactive methods of measuring which use neutron bore which is put directly in the soil;

- conduct metrical methods who is electrodes are put in the soil the electric conductivity being influenced by humidity.

Because of the difficulty of obtaining the necessary machines, in praxis the gravimetrical method from harvested soil is used.

The soil humidity has been determined from harvested soil in through direct observation, based on the existing water. The determination of the soil humidity has been made according to the gravimetrical method after the relation:

$$\text{Humidity W \%} = \left(\frac{b-c}{c-a}\right)\cdot 100[\%]$$

where: b – the weight of the vial with wet soil, in g;
c – the weight of the vial with dry soil, in g;
a – the weight of the vial, in g;
100 – percent.

In the lower table 1 are given and processed the necessary values to determine the humidity. The relation of calculating the humidity is: $W = \frac{1}{a+b\cdot H}$ and noting $y = \frac{1}{W}$, resulting $\frac{1}{y} = \frac{1}{a+b\cdot H}$ or y = a + b · H (a line)

Table 1

Table containing the primary data of calculus determined in the laboratory

No.crt.	M vial with wet soil	M vial with dry soil (after 4 hours)	M vial with dry soil (after 8 hours)	M vial with dry soil (after 12 hours)	M vial	M *dry soil* – M *vial*	*M wet soil – M dry soil*	*M wet soil*
	(g)	(g)	(g)	(g)	(g)	(g)	(g)	(g)
1	19.7368	16.155	16.1546	16.1542	9.5629	6.5913	3.5826	10.1739
2	22.8038	19.7276	19.7269	19.7264	13.6233	6.1031	3.0774	9.1805
3	17.7816	15.0183	15.0179	15.0176	9.4012	5.6164	2.7640	8.3804
4	17.6144	14.5878	14.5873	14.5873	9.5177	5.0696	3.0271	8.0967
5	22.415	19.3112	19.3106	19.3104	9.4214	9.8890	3.1046	12.9936
6	20.3738	17.7652	17.7645	17.7641	9.1556	8.6085	2.6097	11.2182
7	33.7438	29.4251	29.4245	29.4244	13.4856	15.9388	4.3194	20.2582
8	27.8637	24.0326	24.0322	24.032	13.9844	10.0476	3.8317	13.8793

For exploitation, is necessary to know z, p and respectively q (the water flow that can be infiltrated through the soil from drain). For the west zone of our country there is: z = 0,4 – 0,9 m and q = 7 mm/day. The medium humidity for the boring 5 is $\overline{W} = 53{,}24$ and $Y = 0{,}018$, for boring 7 $\overline{W} = 31{,}76$ and Y = 0,031 and the coefficients a and b determined from calculus is in figure 3.

From the regression line is determined r which must have a value as close to 1 as possible to avoid a too bog dispersion of the experimental points towards the resulting line. The relations who express the variation of soil humidity W%, at the soil surface, based on the deepness of the phreatic water H (m), determined through tests for our example is:

$$W = \frac{1}{0{,}13 - 0{,}177\cdot H}$$

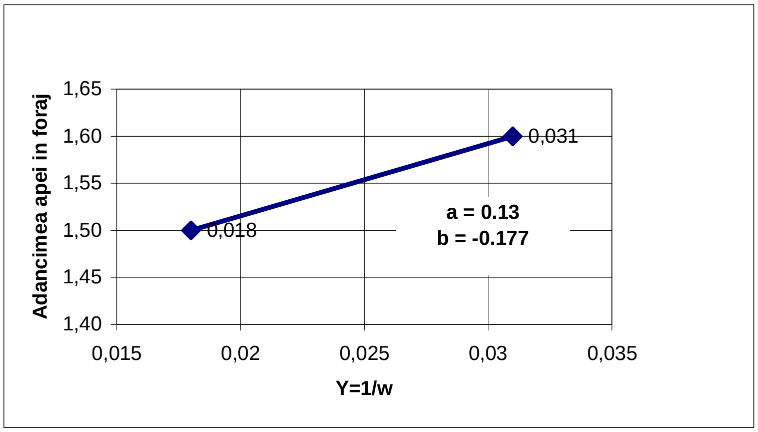

Figure 3. The linear regression line

Table 2

Correlation between W and H

H (m)	W (%)	1/W
1.5	55.6	0.017986
1.6	32.3	0.03096
1.7	22.7	0.044053
1.8	17.5	0.057143
1.9	14.3	0.06993
2	12	0.083333
2.1	10.4	0.096154
2.2	9.2	0.108696
2.3	8.2	0.121951
2.4	7.4	0.135135
2.5	6.8	0.147059
2.6	6.2	0.16129
2.7	5.7	0.175439
2.8	5.3	0.188679
2.9	5	0.2
3	4.7	0.212766

CONCLUSIONS

This way, in figure 4 for p = 3,5 m and z = 0,6 on a soil type, aluviosol, representing the correlation between the phreatic level H(m) and the medium humidity at the field surface, W(%) are obtained for the known hidrophisics characteristics of the soil in the respective point:

- the field capacity at the soil capacity C_c = 22%
- the droop capacity C_o = 8 %
- minimal ceiling at the surface of the soil P_{min} = 15%.
- the following characteristic deepness :
- the value of the drainage norm Z = 1,5 m, meaning the necessary deepness of the phreatic level so that at the field surface there would be no humidity excess, the soil would have the humidity of the field capacity;
- the value of the sub-irrigation norm p = 3,5 m meaning the necessary deepness of the phreatic level so that at the field surface the humidity of the soil would be ensured at the minimum sealing.

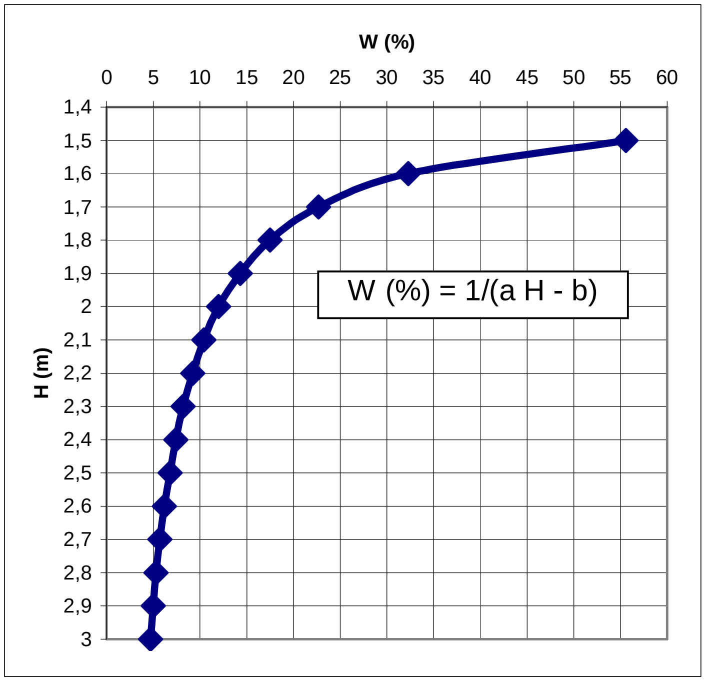

Figure 5. The correlation between the phreatic level (H) and the medium humidity, in the first 30 cm of the active profile (W), for borings 5 and 7 with a type of aluviosol, in Bihor County.

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