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THE EXPERIMENTAL DETERMINATION OF A NEDED PARAMETERS FOR REVERIBILITY CHECKING DRAINAGE-SUBIRRIGATION, WITH DRENVSUBIR SOFT, IN AVRAM IANCU DRAINAGE FIELD, BIHOR COUNTY

Nicu-Cornel SABĂU

University of Oraadea, Faculty of Environmental Protection; Oradea, Gen Magheru Str. no 24.
Corresponding author: nsabau@uoradea.ro

Abstract: *The objective of this work is to experimental establish of characteristic ground water depth, required for checking reversibility between drainage and subirrigation, with DrenVsubIR software in the experimental drainage field Avram Iancu, Bihor county. The experimental drainage field from Avram Iancu was set up in 1983, on a gleical, cambical phaeosiom with a high content of colloidal clay, higher with 50 % on the entire profile. The DrenVSubIR soft, is a calculating program implemented by Faculty of Environmental Protection from Oradea and consists of three modules, the first one is of calculating the distance between drain wires with the relation Ernst – David, the second for checking the possibility of using the drainage at subirrigation and the third for the technical economical (the cost) calculus of ha, of drained field. In the observation period from Avram Iancu, between 1984 and 1990 was measured in hydro geological drills in the field, the depth of ground water and soil humidity in the upper horizon. The correlation between the inverse of soil humidity in the upper horizon and the depth of ground water, measured in hydro geological drill in the field is linear and very significant, the correlation coefficient is R = 0,9907. With the help of this correlation was establish the depth of ground water corresponding at the field capacity is H_0 = 0,69 m and the depth of the ground water corresponding at the minimum easily available water content is H_m = 0,98 m. Using the "Checking SUBIRIIRIGATION - David Equation" module of the DrenVsubIR program, for drainage variants that have been conventionally designed results the possibility of reversibility between drainage and subirrigation when distances between drains are bigger than 20 m, with filter prism out of rubble of 10 cm (Fm) or 20 cm (Fî), no matter if they are associated or not with soil reclamation works. Considering that the cost of this extra investment is not linked to the distance between drains the most indicated variant for subirrigation from Avram Iancu drainage field is the one with the biggest distance between drains L = 30,4 m, associated with ruble filter prism of 0,2 m (Fî) and deep loosening through scarification (Sc).*

Key words: *drainage, subirrigation, DrenVsubIR soft;*

INTRODUCTION

Subirrigation or underground irrigation is the irrigation method where water is brought at the base of the root area, with the help of some pipes buried underground, thus watering the plants through capillarity. This method has the advantage of cutting out all losses the level of the soil [5.].

The surfaces set up with drainage systems, conceived for eliminating excess water (conventional drain) can be used for adjusting the level of the soil water (controlled drainage) or for administrating water through subirrigation (reversible irrigation drain) [1.].

This method has the advantage that in wet periods the system works in conventional drain, thus eliminating the excess water in the soil profile, the controlled drain allows the humidity control in the root area by controlling the level of the ground water and the quantity of water coming from conventional drain and in the drought periods the system is used for subirrigation, the water needed is brought through a network of drainage channels.

For verifying the reversibility of the conventional drain in subirrigation, we can use DrenVsubIR design software. [2, 7.]

The objective of this work is to experimental establish of characteristic ground water depth, required for checking reversibility between drainage and subirrigation, with DrenVsubIR software in the drainage field Avram Iancu, Bihor county.

MATERIAL AND METHODS

The experimental drainage field from Avram Iancu was set up in 1983, on a gleical, cambical phaeosiom with a high content of colloidal clay, higher with 50 % on the entire profile and with hydraulic conductivity determined using the cylinder methods (pedological method) between 7,9 mm/h and 1,2 mm/h. [3.]. (Table 1.)

Table1.

Some hidro-phisical proprieties of the Cambical, Gleical Phaeozion, from Avram Iancu, Bihor County

Horizon	**Deepness (cm)**	**Clay (%) < 0,002 mm**	**Textural class**	**DA (g/cm^3)**	**CC (%)**	**CO (%)**	**K (mm/h)**
Ap	0-29	67,0	AL	1,36	38,5	16,8	7,9
AmGo	29-43	64,0	LA	1,47	36,3	13,9	5,0
BvGo	43-81	59,1	LA	1,54	34,5	13,0	1,6
BCG	81-120	56,8	LA	1,56	32,8	11,6	1,2

The depth of the ground water is at 0,5 – 1,5 m from the surface of the soil.

In order to carry out underground drainage, 14 variants of drainage were studied, with distances between tubes varying from (L) of 15, 30 and 45 m, no filter or prism filter from soil (Fa), or rubble with the height of 5 - 10 cm (Fm) and from rubble with the height 15 - 20 cm (Fî) associated or not with mole drain or deep loosening through scarification.

In the observation period from Avram Iancu, between 1984 and 1990 was measured in hydro geological drills in the field, the depth of ground water and soil humidity in the upper horizon.

The DrenVSubIR soft, is a calculating program implemented by Faculty of Environmental Protection from Oradea and consists of three modules, the first one is of calculating the distance between drain wires with the relation Ernst – David, the second for checking the possibility of using the drainage at subirrigation and the third for the technical economical (the cost) calculus of ha, of drained field.

Using the DrenVSubIR software for designing the drain spacing with similar parameters to the ones from the field of Avram Iancu led to the same results indicating around L = 30 m drain spacing. [4, 6.]

RESULTS AND DISCUSSIONS

The goal of the subirrigation verification is to determine the subirrigation height $h_{sub} = H_0 - H_m$, where H_0 is the width of saturated soil zone at drain and H_m is the width of saturated soil zone midway between the drains. This level difference represents the total load loss, which secures the water reserve at the root end depth (Figure 1.).

The module for checking reversibility of the designed drain in subirrigation of the DrenVSubIR program can be accessed from the Drain design – The Ernst David equation, after calculating the distance between drains by activating the “Check Subirrigation” command.

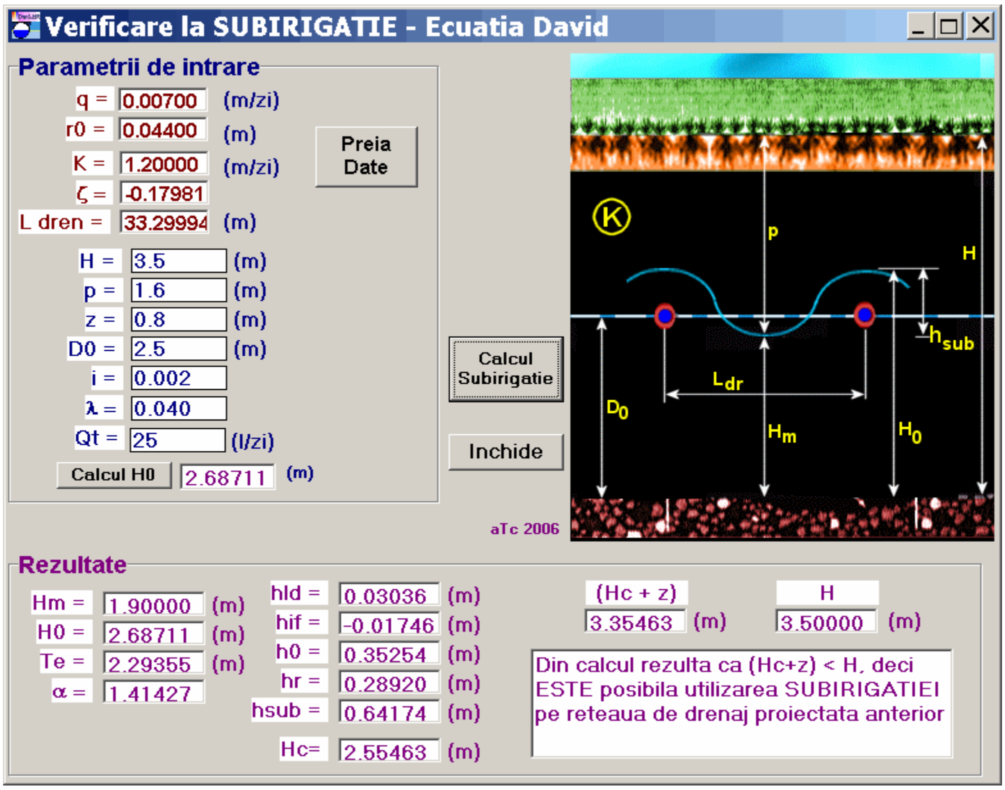

Figure 1. DrenVBsubIR module for subirrigatin validation

The required elements are: H – the depth of the waterproof layer, p – drain norm at the easily available level, z – drain norm for the field capacity, D_0 – the position of the drain plain compared to the separation plain of the two layers, i – the average slope of the drains, λ – coefficient of the drain tube and Q_t – the water flow of the tube in sub irrigation (l/s).

In order to determine the values of z and p, that represent the drain norm at minimum easily available water content we use the correlation between soil humidity in the upper horizon and the depth of ground water, measured in hydro geological drills in the field.

Man T.E. and all., 2007 presents for this correlation the form:

$$W(\%) = \frac{1}{a + b \cdot H(m)}; \qquad [1.]$$

when W (%) is soil humidity in the upper horizon in percents, and H (m) is the depth of ground water, in meter, measured in hydro geological drills in the drainage field.

If in relation [1.] we express the inverse of humidity 1/W(%) result:

$$\frac{1}{W(\%)} = a + b \cdot H(m); \qquad [2.]$$

The relation [2.] is a line, and for the values of the inverse humidity in the upper horizon and the depth of ground water H (m) measured in Avram Iancu drainage field result an very significant equation, the correlation coefficient is R = 0,9907. (Figure 2.)

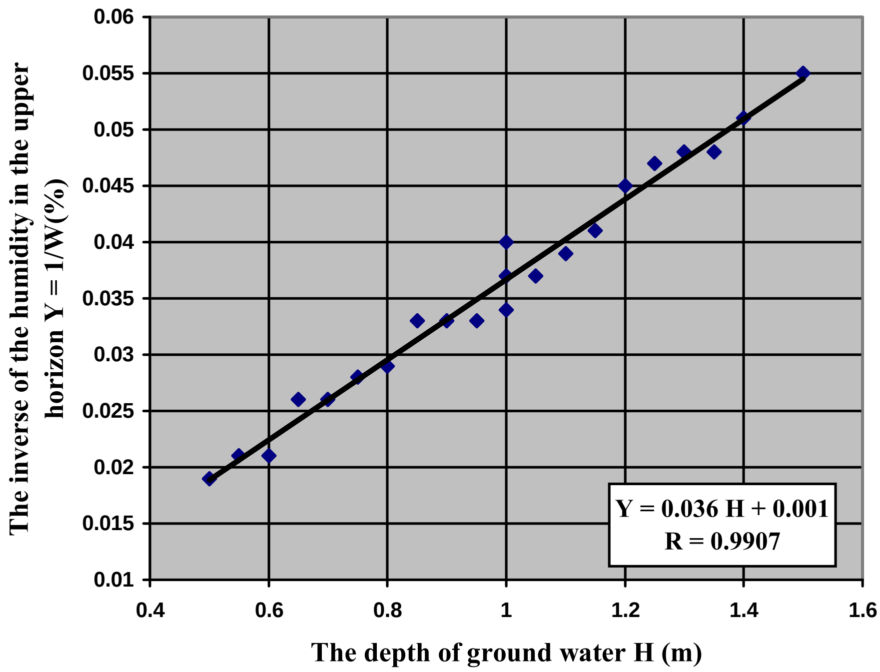

Figure 2. Correlation between the depth of ground water H and the inverse of soil humidity in the upper horizon Y = 1 / W, measured in Avram Iancu drainage field

We have values of the coefficients a and b, from the relation [1.] in the above graphic representation. With this values a = 0,001 and b = 0,036 we can obtain the graphic representation of the relation [1.] (Figure 3.)

In order to function in the conditions of controlled drain and subirrigation we need to adjust the level of ground water by maintain the level of the water in the drain channel at a level in which the soil humidity in the upper layer is between the interval of the active humidity. The interval of active humidity is defined between the minimum easily available water content (P_{min}) and field capacity (CC).

From the table 1, the field capacity is CC = 38,5 % and the minimum easily available water content can be calculated:

$$P_{\min} = CC - \frac{CC - CO}{2} = 38{,}5 - \frac{38{,}5 - 16{,}8}{2} = 38{,}5 - \frac{21{,}7}{2} = 38{,}5 - 10{,}9 = 27{,}6;$$

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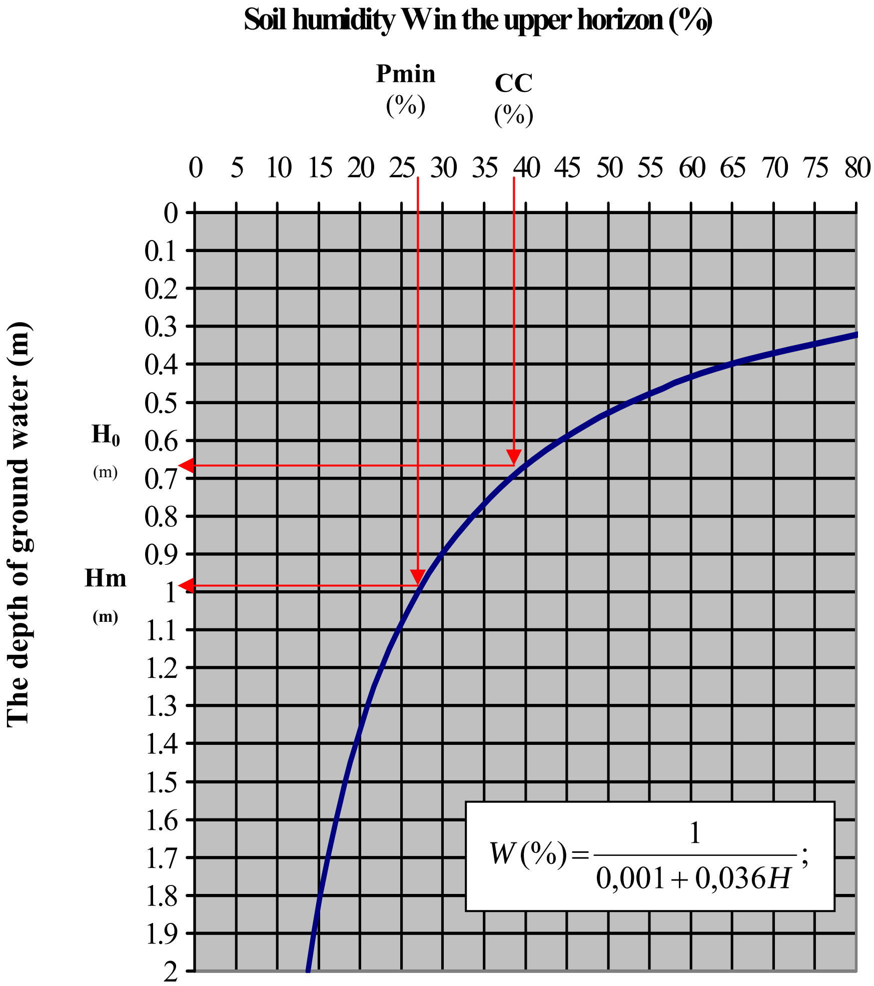

Figure 3. The link between depth of ground water and soil humidity in the upper horizon

From the figure 3, the depth of the ground water corresponding at the field capacity is H_0 = 0,7 m and the depth of the ground water corresponding at the minimum easily available water content is H_m = 1 m.

A precise determination of these depths can be made analytically, using the following equation:

$$H = \frac{1 - 0{,}001 \cdot W}{0{,}036 \cdot W}; \qquad [3.]$$

thus obtaining H_0 = 0,69 m and H_m = 0,98 m.

For the conditions from the drainage field of Avram Iancu, the depth of the waterproof layer is of H = 2,9 m and the values of the drain norm at minimum easily available water content p = 0,69 m and the drain norm at field capacity z = 0,98 m.

After determining the height of the water in the channel the program calculates $H_C + z$ and compares this values to the depth of the waterproof layer H. If $H_C + z < H$, the message that ”subirrigation is possible” appears in a window on the right side. For when $H_C + z > H$, the message displayed is ”subirrigation is not possible” on the drain network entered previously.

The results of using the “Verificare la SUBIRIGAȚIE - Ecuația David” module of the DrenVsubIR program, for drains that have been conventionally designed shows the possibility of reversibility between drain and subirrigation when distances between drains are bigger than 20 m, with filter prism out of rubble of 10 cm (Fm) or 20 cm (Fî), no matter if they are associated or not with soil reclamation works. (Table 2.)

Table 2.

Verifying through sub irrigation the drain variants designed with the DrenVSubIR program

Nr. crt.	Variants	L (m)	Hc (m)	Hc + z (m)	H (m)	Reversibility drain/ subirrigation
1.	Ff	3,6	2,36	3,05	2,90	NO
2.	Fa	17,4	2,97	3,66	2,90	NO
3.	Fm	22,2	2,03	2,72	2,90	YES
4.	Fî	29,9	1,95	2,64	2,90	YES
5.	Ff + Cr	5,4	2,33	3,02	2,90	NO
6.	Fa + Cr	16,6	2,68	3,37	2,90	NO
7.	Fm + Cr	22,5	2,02	2,71	2,90	YES
8.	Fî + Cr	30,1	1,95	2,64	2,90	YES
9.	Ff + Sc	7,5	2,27	2,96	2,90	NO
10.	Fa + Sc	15,8	2,32	3,01	2,90	NO
11.	Fm + Sc	23,0	2,02	2,71	2,90	YES
12.	Fî + Sc	30,4	1,95	2,64	2,90	YES

Ff – No filter prism; Fa – filter prism out of soil for acidity correction with a 0,1 m height; Fm – filter prism out of rubble with a height of 0,1 m; Fî – rubble filter prism of 0,2 m; Cr – mole drain perpendicular on the drain direction; Sc – deep loosening through scarification, on the perpendicular direction of the drains;

For maintaining the soil moisture between minimum easily available water content and field capacity the level of the water in the collector channel has to be maintained at measurable depths for the surface of the terrain about 0,18 m, and respectively 0,56 m.

In order to retain the water coming from conventional drain or the volume of water brought by the channel network, in the case of subirrigation we need to place some dams, that will regulate the level of the water at the depths from above.

Considering that the cost of this extra investment is not linked to the distance between drains the most indicated variant for subirrigation from Avram Iancu drainage field is the one with the biggest distance between drains L = 30,4 m, associated with ruble filter prism of 0,2 m (Fî) and deep loosening through scarification (Sc).

CONCLUSIONS

The objective of this work was to experimental establish of characteristic ground water depth, required for checking reversibility between drainage and subirrigation, with DrenVsubIR software in the experimental drainage field Avram Iancu, Bihor county.

In the observation period from Avram Iancu, between 1984 and 1990 was measured in hydro geological drills in the field, the depth of ground water and soil humidity in the upper horizon.

In order to determine the values of z and p, that represent the drain norm at minimum easily available water content we use the correlation between the inverse of soil humidity in the upper horizon and the depth of ground water, measured in hydro geological drills in the field. This is linear and very significant, the correlation coefficient is R = 0,9907.

With the help of this correlation was establish the depth of ground water corresponding at the field capacity is H_0 = 0,69 m and the depth of the ground water corresponding at the minimum easily available water content is H_m = 0,98 m.

The results of using the "Verificare la SUBIRIGAȚIE - Ecuația David" module of the DrenVsubIR program, for drains that have been conventionally designed shows the possibility of reversibility between drain and subirrigation when distances between drains are bigger than 20 m, with filter prism out of rubble of 10 cm (Fm) or 20 cm (Fî), no matter if they are associated or not with soil reclamation works.

Considering that the cost of this extra investment is not linked to the distance between drains the most indicated variant for subirrigation from Avram Iancu drainage field is the one with the biggest distance between drains V_{12}, L = 30,4 m Fî +Sc.

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