Buletinul Ştiinţific al Universităţii "POLITEHNICA" din Timişoara

Seria HIDROTEHNICA

TRANSACTIONS on HYDROTECHNICS

Tom 55(69), Fascicola 1, 2010

Expanding possibilities for using the software DrenVSubIR, to design associated drainage with deep loosening works through scarifying

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Abstract: The objective of this paper is to extend the possibilities for using the program DrenVSubIR [1.10] to cross drainage sizing, specific to heavy and compress soils.

The experimental drainage fields of Bihor County (Avram Iancu, Cefa, Sanmartin and Diosig) were verified over the years, different variations of drainage, with or without prism ballast filter associated with deep-loosening work through scarifying. [8]

DrenVSubIR is a software consists of three modules, specializing in determining the distance between horizontal drains, checking for possible use in subirrigaţionand and technical-economic calculation (cost of arrangement of one hectare of land) of the designed variants.

Simulating the conditions from the experimental drainage fields from Diosig and Avram Iancu, Bihor county led to the same distance between drains without a filter or prism ballast filter and drains proposed for expansion in production.

Starting from the observation that in all the experimental fields the most effective option was that with the distance between the drains of 30 m, with prism ballast filter and associated with deep-loosening work scarifying, transverse direction drains, simulating with software DrenVSubIR these situations, it was established the effect of deep-loosening through scarifying on hydraulic conductivity lines of horizon higher drain wire.

Keywords: heavy soil, drain tube, filtering prism, deep loosening through scarifying, DrenVSubIR program

1. INTRODUCTION

The main limiting factor of agricultural production in the western is represented by the temporarily excess humidity suspended due to phreatic resource training over a horizon with high clay content, is characterized by high degree of compaction and low hydraulic conductivity.

For land reclamation one of the imposed measures is temporarily remove of the excess moisture by surface or underground drainage.

When designing underground drainage with horizontal pipes, determining the distance between drain lines, in the operating permanent system can be made with DrenVSubIR program, which is based on the relationship between loss of vertical, horizontal, radial hydraulic load and the entry into drain and respectively the distance between drains, established by Ernst and completed by David. [10]

For heavy and compress soil conditions, characterized by low hydraulic conductivity, the distances between drains are small resulting huge investments, which is why using different types of filters and associated works for deep loosening of soils. [5.6]

Studies in previous years were determined using the program features DrenVSubIR for sizing drainage prism ballast filter, based on results of experimental field research in the Diosig, [7] how to use the module to verify the reversibility of drainage in subirrigation and determine data necessary to verify the reversibility of experimental field drainage variants of Avram Iancu. [8]

The objective of this paper is to determine how to use the program DrenVSubIR for sizing drainage with prism ballast filter associated with deep-loosening through scarifying, from research in experimental fields of drainage in Bihor county, Sanmartin (1986), Diosig (1987) , Cefa (1982) and Avram Iancu (1983), thus highlighting the effect of deep-loosening through scarifying on the actual hydraulic conductivity of the layer above the drains.

2. MATERIALS AND METHOD

The main hydro-physical properties of soil from experimental fields of drainage from Bihor county reveal the existence of factors favors the appearance of excess moisture. (Table 1).

Alkaline gleyic faeoziom (alkaline humic gley soil) of the experimental field Cefa is characterized by a colloidal clay content (<0.002 mm) more than 40% throughout the profile analysis, with increasing values towards the surface profile.

High content of clay, soil prints a compact settlement, indicated by higher values of apparent

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density (1.4 to 1.6 g/cm3) and low total porosity (41-46%) except processed surface horizon.

Characterization of soil compaction through the degree of compaction indicates that the soil profile is strongly settled on base, below 45 cm depth, moderate settled between 26 and 45 cm respectively weak settled on surface.

The influence of these unfavorable physical characteristics of soil is quantified by hydraulic conductivity, determined on undisturbed soil samples collected in cylinders, which are values consistent with the degree of compaction, higher at profile surface (6.1 mm/h) and low values at the base of analyzed profile (0.6 mm/h).

Cambic gleyic faeoziom of Avram Iancu, present the greatest content of colloidal clay, over 55%, remarking the high surface content of 67%. High apparent density and low total porosity make the soil profile to be moderate and respectively strong settled, with higher values of hydraulic conductivity in horizon A processed, of 7.9 mm/h which is reduced towards the profile base down to 1.2 m /h.

Table 1. Some hydro-physical properties of soils in experimental fields of drainage (Cefa, Avram Iancu, Sînmartin and Diorig) of Bihor county. [3]

Experimental field	Soil type	Horizon	Deep (cm)	Clay (%) <0,002 mm	DA (g/cm^3)	PT (%)	GT (%)	Rating compaction	K (mm/h)
Cefa	Alkaline gleyic faeoziom	Ap	0-26	40,3	1,35	50	3.04	Poor settled	6,1
		Amac	26-45	41,1	1,46	46	11.02	Moderate settled	4,5
		AGsc	45-58	43,1	1,57	42	19.27	Powered settled	1,7
		Gac	58-81	44,4	1,60	41	21.51	Powered settled	0,6
		GCac	81-103	41,0	1,57	42	18.74	Powered settled	0,7
Avram Iancu	Cambic gleyic faeoziom	Ap	0-29	67,0	1,36	50	10.59	Moderate settled	7,9
		AmGo	29-43	64,0	1,47	46	17.02	Moderate settled	5,0
		BvGo	43-81	59,1	1,54	43	21.29	Powered settled	1,6
		BCG	81-120	56,8	1,56	42	22.59	Powered settled	1,2
Sânmartin	Luvosol albic stagnic	Ap	0-22	24,7	1,24	53	-8.11	Slab afânat	5,5
		Eaw	22-32	23,7	1,52	43	12.00	Moderate settled	1,9
		EBtW	32-44	30,0	1,54	43	13.81	Moderate settled	1,3
		BtW	44-90	43,3	1,63	40	23.16	Powered settled	0,2
		Cw	90-110	40,2	1,65	39	24.35	Powered settled	0,2
Diosig	Alkaline gleyic faeoziom	Apac	0-21	31,6	1,37	49	2.29	Poor settled	4,4
		Amac	21-31	38,9	1,46	46	10.40	Moderate settled	2,0
		AGna	31-78	44,6	1,50	44	15.82	Moderate settled	0,07
		Gna	78-101	41,5	1,55	42	18.86	Powered settled	0,07
		GCna	101-130	40,0	1,61	40	22.36	Powered settled	0,07

Albic luvosol stalled at Sanmartin, despite having a colloidal clay content from 23.7 to 43.3% lower than in other sections analyzed, show high values of apparent density and lower total porosity, which prints moderate and strong soil settlings, except processed horizon which is slightly loose. Saturated hydraulic conductivity of horizon of clay accumulation Bt argic is very small, of 0.2 mm/h.

Diosig, alkaline gleyic faeoziom profile in terms of a colloidal clay content of 32.6 to 44.6% higher at the profile base, where horizons are strongly settled, saturated hydraulic conductivity values have almost zero. (0.07 mm / h)

Drainage variants tested in experimental fields in Bihor county used corrugated PVC tubes, Ø = 6.5 cm in diameter, laid at an average depth of 0.9 m, at different distances between absorbing drains (L) without filter or filtering prismed graded ballast, with low height of 10 cm (Fm) or 20 cm high prism (Fi) without associated works or in combination with deep loosening through scarifying, (Sc) in the direction transverse drains. (Table 2).

Table 2. Drainage variants studied experimental drainage fields of Bihor County

Current issue	Variant			Avram Iancu (1984-1990)	Cefa (1983-1990)	Diosig (1988-1994)	Sânmartin (1987-1993)
	Distance L (m)	Filtering prism	Scarifying				
1.	15	-	-	*	-	-	-
2.	30	-	-	*	*	-	*
3.	45	-	-	*	-	-	-
4.	30	Fm	-	*	*	-	*
5.	20	Fî	-	-	-	*	-
6.	30	Fî	-	*	*	-	-
7.	35	Fî	-	-	-	*	-
8.	50	Fî	-	-	-	*	-
9.	30	Fm	Sc	*	*	-	-
10.	15	Fî	Sc	-	-	-	*
11.	20	Fî	Sc	-	-	*	-
12.	***30***	***Fî***	***Sc***	*	*	*	*
13.	40	Fî	Sc	-	-	*	-
14.	45	Fî	Sc	*	-	-	*
15.	50	Fî	Sc	-	-	*	-

Note: L - distance between drains; Fm - filter prism ballast low height of 10 cm, Fî - prism ballast filter high, 20 cm, Sc - deep loosening through scarifying, transverse to the direction of drainage;

Among the variants tested in experimental fields was noted by hydraulic efficiency and economic efficiency determined by production increases from the period of observations, variant drainage at the distance L=30 m, with high-graded ballast filtering prism (Fî) associated with deep loosening through scarifying transverse to the direction of absorbing drainage (Sc), which was recommended for expansion in production.

DrenVSubIR computer program consists of three modules, the first calculation of the distance between the drain wires with Ernst-David relationship, the second for checking the possibility to use drainage at subirrigation and the third for technical and economic calculation (cost) of a hectare of land drained. [1,9]

For calibration software DrenVSubIR was used the data obtained in the four experimental drainage fields, establishing particular module used for sizing the distance between absorbing drains, in the permanent regime.

3. RESULTS AND DISCUSSIONS

DrenVSubIR computer program consists of three modules, the first module is used to determine the distance between absorbing drains in permanent regime, the second for checking the reversibility of conventional drainage in subirrigation and the last for technical and economical calculation of a hectare of land arrange with drainage works.

Teh module for the distance sizing between absorbing drains use the Ernst relationship subsequently completed by David relationship.

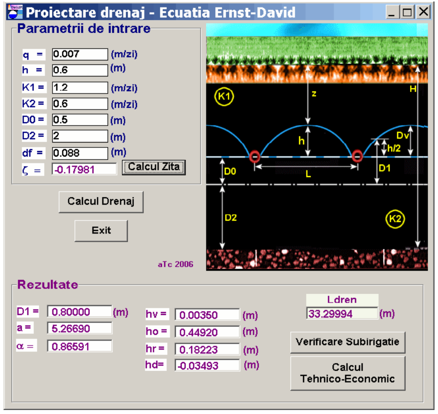
Ernst relationship breaks total loss of hydraulic load h in loss of vertical load h_v, horizontal h_o, radial h_r and input h_i, and by summing them to obtain:

$$h = \frac{qD_V}{K} + \frac{KL^2}{8KD} + \frac{qL}{\pi K}\ln\frac{D_O}{U}; \qquad [1,4,10]$$

David I., 1982 completed Ernst relationship by considering the of loss of hydraulic load at water entry to drain-filter complex, suggesting its determination using coefficients determined experimentally, respectively the resistance coefficient of water entry into the drain-filter complex ζ_{if}.

Required input data for the design module of the distance between absorbing drains are: q (m/day) - specifically flow of drainage, h (m) - total loss of hydraulic load, K_1 (m/day) - saturated hydraulic conductivity of higher layer; K_2 (m/day) - saturated hydraulic conductivity of the lower layer, D_0 (m) vertical distance between siting plan of drainage and and plane separating the two layers; D_2 (m) - the lower layer thickness, d_f (m) - diameter of drain-filter complex. (Figure 1).

To calculate the distance between absorbing drains L (m), pass before the calculation of the total hydraulic resistance coefficient zita (ζ) by operating the button "calculation zita". In this window are required geometric characteristics of corrugated PVC drain tube: n - number of kerfs on the drain circumference; do (m) - drain tube diameter; df (m) - diameter of used filter; l (m) - length of one kerf; b (m) - kerf width; B (m) generating distance between kerfs; Kfc (m/day) - saturated hydraulic conductivityof clogged filter; K (m/day) - saturated hydraulic conductivity of topsoil that drain tube is posed;



q = 0.007 (m/zi)
h = 0.6 (m)
K1 = 1.2 (m/zi)
K2 = 0.6 (m/zi)
D0 = 0.5 (m)
D2 = 2 (m)
df = 0.088 (m)
ζ = -0.17981

D1 = 0.80000 (m)
a = 5.26690
α = 0.86591
hv = 0.00350 (m)
ho = 0.44920 (m)
hr = 0.18223 (m)
hd= -0.03493 (m)
Ldren 33.29994 (m)

Figure 1. Input of module Drainage Design , Ernst-David equation [1]

Processor to calculate the total hydraulic resistance coefficient can display and its value required by the user, to determine the distance between the ideal drains in which situation zita is zero.

Total hydraulic resistance coefficient values (ζ) are calculated after the action button "Calculation" and taken by the processor to calculate the distance between drains through the action button "Close".

For all experimental fields in Bihor county, technical characteristics of corrugated PVC drain tube without filtering prism were: n = 6, do = 0.065 m, df = 0.065 m, l = 0.001 m, b = 0.005 m and B = 0.025 m.

To determine the distance between absorbing drains using the calculation of DrenVSubIR program, in similar conditions to that from the experimental fields of Bihor county starts from hydro-physical characteristics of soil profiles of the respective fields.

In all cases, specific drainage flow and hydraulic load loss were estimated at 0.007 m/day and respectively 0.4 m.

Since the computer program considers soil bilayer, horizontal plane of the drains is located above the surface layer and soil profile is composed of several horizons, it is necessary to determine, in advance, the effective saturated hydraulic conductivity equivalent for the layer above drainage plan.

Saturated hydraulic conductivity, the K horizons (mm/h) forming the soil profile (Table 1) are determined by the method of cylinders are soil conductivity, K_P point. To convert them into real saturated hydraulic conductivity K_R, characterizing overall soil horizons can be used polynomial correlation of degree two, very significant statistically, $K_R = 0,2489\ K_P^2 + 0,8289\ K_P + 0,0519$ ($R^2 = 0,9996$) determined by data submitted by Canarache A., 1990. [2.]

Using this relationship filtrate coefficients corresponding to each horizon, shown in table 1 can be converted to real K_R filtrate factors, expressed in m/day.

Since the pedological mapping, soil profile is digging up the rock or parent material, the delimitation of the two layers is made having regard to the average depth of laying of drains which is 0.90 m. (Table 3).

Table 3. Calculation of real equivalent hydraulic conductivity K_{Re} (m / day) for soil profile layers.

Experimental field	Soil type	Horizon	Deep (cm)	K (mm/h)	K_P (m/zi)	K_R (m/zi)	Layer name	Layer thickness (m)	K_{Rei} (m/zi)
Cefa	Alkaline gleyic faeoziom	Ap	0-26	6,1	0,146	0,178	1	0,90	0,117
		Amac	26-45	4,5	0,108	0,144			
		AGsc	45-58	1,7	0,041	0,086			
		Gac	58-81	0,6	0,014	0,064			
		GCac	81-103	0,7	0,017	0,066	2	0,13	0,066
Avram Iancu	Cambic gleyic faeoziom	Ap	0-29	7,9	0,190	0,218	1	0,90	0,137
		AmGo	29-43	5,0	0,120	0,155			
		BvGo	43-81	1,6	0,038	0,084			
		BCG	81-120	1,2	0,029	0,076	2	0,30	0,076
Sânmartin	Luvosol albice stagnice	Ap	0-22	5,5	0,132	0,166	1	0,90	0,090
		Eaw	22-32	1,9	0,046	0,091			
		EBtW	32-44	1,3	0,031	0,078			
		BtW	44-90	0,2	0,005	0,056			
		Cw	90-110	0,2	0,005	0,056	2	0,20	0,056
Diosig	Alkaline gleyic faeoziom	Apac	0-21	4,4	0,106	0,140	1	0,90	0,078
		Amac	21-31	2,0	0,048	0,092			
		AGna	31-78	0,07	0,002	0,054			
		Gna	78-101	0,07	0,002	0,054			
		GCna	101-130	0,07	0,002	0,054	2	0,40	0,054

Actual hydraulic conductivity equivalent of layer i, considered homogeneous was calculated from the actual hydraulic conductivity of soil horizons and their thickness using the relationship:

$$K_{\mathrm{Re}} = \frac{\sum H_i}{\sum \frac{H_i}{K_{Ri}}}; \qquad [2.]$$

where: K_{Re} – actual hydraulic conductivity equivalent of layer considered homogeneous (m/day);

H_i – component horizon thickness i (m);

K_{Ri} – actual hydraulic conductivity of soil i horizon (m/zi);

Whereas the separation plan between the two layers was considered to be similar to plan laying of drains and calculation module Ernst-David believes that drainage plan is the first layer, the distance D_0, represent the difference between the two plans is will set at 0,001 m.

Case of drain with filter, the calculation of hydraulic resistance coefficient ζ are necessary filter diameter df (m) and hydraulic conductivity of the clogged filter Kfc (m/day).

Drainage variants studied in experimental fields in Bihor county were provided with filter prism with graded ballast of low height (F_m), of 0.1 m, and height of 0.2 m (F_i).

To estimate the filter df diameter was considered that width of trench for laying drains width was 0.15 m. Considering that the perimeter of a circular filter is

U=2πr, equivalent diameter of the filter of graded ballast was obtained with the relationship:

$$df = 2r = U/\pi; \qquad [3.]$$

For low filter prism Fm, the perimeter is U = 2 x 0.15 +2 x 0.10 = 0.50 m and equivalent diameter of the filter is df = 0.159 m. For high filter prism Fî, the perimeter is U = 2 x 0.15 + 2 x 0.2 = 0.70 m, resulting equivalent diameter of the filter df = 0.223 m.

For hydraulic conductivity of clogged filter was considered that the value closest to reality is that experimentally determined by Wehry A., David I. and Man T.E., 1982 [10] respectively Kfc = 12.4 m/day.

At distances between drain wires without filter sizing simulation, in experimental fields of drainage in Bihor county was considered hydraulic conductivity of the clogged filter equal to the first layer. (Table 4).

The distances between drain wires, in the version of drain without filter, calculated in terms of soils from experimental drainage fields above are between 1.8 m at Diosig and 2.9 m at Avram Iancu.

Comparing values obtained for distances between drains, in conditions of drainage without filterable filter to those tested in experimental fields is observed that they are much smaller.

In one experimental field, only at the Avram Iancu were tested variants with distances of 15, 30 and 45 m and in the experimental fields from Cefa and Sanmartin were used only variants at a distance of 30 m.

In the first case the best behavior of all variants without filter tested had the variant L = 15 m, with the smallest distance between absorbing drain.

Table 4. Calculating the distance between drains L (m) with module „Design drainage Equation Ernst-David” of DrenVSubIR program.

Variant	Experimental field	K_{H1e}	K_{H2}	D_2 (m)	df	K_{fc}	L (m)	h_v	h_o	h_r	h_i
Without filter (Ff)	Diosig	0,078	0,054	0,4	0,065	0,078	1,8	0,036	0,080	0,014	0,270
	Sânmartin	0,090	0,056	0,2	0,065	0,090	2,1	0,031	0,128	-0,021	0,262
	Cefa	0,117	0,066	0,13	0,065	0,117	2,5	0,024	0,171	-0,038	0,243
	Avram Iancu	0,137	0,076	0,3	0,065	0,137	2,9	0,020	0,142	-0,001	0,238
Small filter 10 cm (Fm)	Diosig	1,447	0.054	0,4	0.159	12.4	15,4	0,002	0,666	-0,015	-0,253
	Sânmartin	1,458	0,056	0,2	0,159	12,4	15,4	0,002	0,679	-0,030	-0,251
	Cefa	1,482	0,066	0,13	0,159	12,4	15,5	0,002	0,686	-0,039	-0,248
	Avram Iancu	1,500	0,076	0,3	0,159	12,4	15,7	0,002	0,668	-0,021	-0,249
High filter 20 cm (Fî)	Diosig	2,816	0,054	0,4	0,223	12,4	22,1	0,001	0,725	-0,017	-0,309
	Sânmartin	2,826	0,056	0,2	0,223	12,4	22,1	0,001	0,735	-0,028	-0,307
	Cefa	2,847	0,066	0,13	0,223	12,4	22,2	0,001	0,741	-0,035	-0,306
	Avram Iancu	2,862	0,076	0,3	0,223	12,4	22,3	0,001	0,727	-0,022	-0,306

If we look at the size of the loss of hydraulic load, proper drainage without filter variants, stands high rate of pregnancy loss in drain water entry h_i, followed by loss of horizontal hydraulic load h_o.

Given that these distances between small drains investment is very high, it must reduce the loss of load at water entry into the drain tube using prisms filter of different heights.

For drainage variants provided with small filter (Fm) represented by filtering prism of graded ballast with 10 cm height, distances between absorbing drains grow to over 15 m for the conditions of all experimental fields.

Hydraulic load losses became negative as both the radial and the entry of water into complex filter drain, showing improving the conditions of drainage toward the drain tube.

Among the variants tested in experimental fields only version stands at a distance L = 30 m with small filter, from Avram Iancu and Cefa, but the results of field is not recommended to be expanded in production.

If drainage variants fitted with high filter Fî, represented by filtering prism of graded ballast with height of 20 cm, simulating the conditions from experimental fields with DrenVsubIR software, also shows close resultsl. Distances obtained in these conditions are L = 22.1 to 22.3 m.

The simulation results are confirmed by research conducted in experimental fields, drainage variant L 20 m + Fî in the experimental field from Diosig having the best hydraulic efficiency and economic efficiency of variants without association with deep loosening. Also variants of distance drainage L = 30 m + Fî from the drainage fields Avram Iancu and Cefa had good behavior.

Analyzing the structure of hydraulic load losses made by high filtering prism variants prism stands to further improve the conditions of water entry into the complex drain-filter, loss of radial load h_r and of input h_i having negative values and reduced almost to cancel vertical hydraulic load losses, h_v = 0.001 m. There remain very high load losses at the flow of water to drains on horizontally direction h_o = 0.725 - 0.741.

Horizontal hydraulic load losses size justifies the need for deep loosening through scarifying, perpendicular to drains.

Research conducted in Bihor county drainage fields have confirmed that in terms of settled soils with very low coefficient of filtrate, best behaved drain with high filter variants associated with deep-loosening through scarifying in transverse direction drains, at a depth of 0.7 to 0.8 m, providing better conditions of drainage to drain tubes.

For all four experimental drainage fields, field observations have shown good behavior in terms of hydraulic, technical and economical of drainage variant L = 30 m, with filtering prism of graded ballast 20 cm high Fî associated with deep-loosening through scarifying Sc at 0.7 to -0.8 m depth.

Field observations were not intended to determine hydraulic conductivity of soil layer above the drainage plan. For this reason it can not be simulated, using software DrenVSubIR, drainage variant with high filtering prism of ballast Fî, associated with deep-loosening through scarifying Sc, transverse direction drains.

Module to calculate the distance between the drains of the DrenVSubIR program present the advantage that once established drain tube type, its characteristics and filtering material, the total hydraulic load losses remain unchanged, which allows testing by testing several types of drainage.

Using the known characteristics of the soils of drainage fields, for the same drain tubes anf filtering prisms have tried several values of equivalent hydraulic conductivity K_{Re1} above the drain lines aiming to obtain the distance between drains L = 30 m. (Table 5).

Equivalent actual hydraulic conductivity K_{Re} of upper layer of horizontal siting plane of drain tubes are very close, being between 6.447 m/day at Cefa and 6529 m/day at Diosig.

Given that these values cumulative the effect of hydraulic conductivity of high prism of graded ballast, Kfc = 12.4 m/day and knowing the scarifying depth and filter height can estimate the effect of deep-loosening through scarifying.

Table 5. Actual hydraulic conductivity of the first soil layer, the drainage variant L = 30 m + Fî + Sc, from the experimental drainage fields of Bihor county

Variant	Experimental field	K_2 (m/zi)	df (m)	K_{fc} (m/zi)	K_{Re1} (m/zi)	K_{Rsc} (m/zi)
L = 30 m, Fî + Sc	Diosig	0,054	0,223	12,4	6,529	4,852
	Sânmartin	0,056	0,223	12,4	6,495	4,808
	Cefa	0,066	0,223	12,4	6,447	4,746
	Avram Iancu	0,076	0,223	12,4	6,478	4,786
Media						4,798 ± 0,044

Actual hydraulic conductivity values of deep loose layer by scarifying are also very close, between 4.746 m/day at Cefa and 4.852 m/day at Diosig, with an average standard deviation of ± 0.044 m/day.

Knowing these values may propose extending the use of software DrenVSubIR and in sizing drainage associated with works of loosening the scarificare deep,at the drainage sizing associated with works of deep loosing through scarifying, drains transverse direction, recommanding that at the module "Drainage Design - David Ernst-equation" to be used for actual hydraulic conductivity of scarifier layer value of 4.8 m/day.

To maintain of this hydraulic conductivity during the operating period is recommended the deep loosening through ripping/scarifing, transverse direction drains every 4-5 years.

CONCLUSIONS

Research conducted in experimental fields of drainage in Bihor county, from Cefa (1983-1990), Avram Iancu (1984-1990), Sanmartin (1987-1993) and Diosig (1988-1994) have tested different types of drainage of corrugated PVC tube, with a diameter of 0.065 m at different distances, without filter or with filtering prism with sorted ballast, with high or low height without ameliorative works or associated with deep loosening through scarifying perpendicular drains direction.

The soils in these locations are characterized as moderately and strong settled, all analysis profile, except plowing horizon, with very low hydraulic conductivity.

Simulating the conditions from experimental drainage fields, with DrenVSubIR program, module „Design drainage, Ernst-David relationship" leads to absorption values of the distance between absorbing drains, in case of drainage without filter (Ff) and without associated land improvement works, between L = 1.8 m at Diosig and L = 2.9 m at Avram Iancu, confirming the difficult conditions due to settled soils.

To simulate variations in drainage provided with filtering prism of ballast with low height (Fm) of 10 cm, for all field locations it obtains distances between drains close to L = 15 m, its effect is emphasized by the negative values of radial hydraulic load losses and entry into the drain- filter complex.

In case of drainage with filtering prism of graded ballast 20 cm high (Fî), loss of hydraulic radial load and input in drain-filter complex is reduced further, the distances between drains increase to values exceeding 20 m, beeing very close for all analyzed sites.

Given that in all experimental fields, research has shown the best behavior in terms of hydraulic effectiveness and economic efficiency version with distance L = 30 m, with filtering prism of high ballast Fî associated with deep loosening through scarifying on drainage direction been proposed determination through tests, using "Drainage Design - Ernst-David relationship", DrenVSubIR program of actual hydraulic conductivity equivalent of the loose soil layer.

Values obtained, very close, allowing extended use DrenVSubIR program to dimensioning the distance between drains in case of variants associated with scarifying, urging for real hydraulic conductivity of loose layer K_R = 4.8 m/day.

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