SOME ASPECTS REGARDING THE USAGE OF THE DRENVSUBIR PROGRAM TO THE PROJECTION OF THE DRAINAGE ON THE SOIL, FROM DRAINAGE FIELD SÎNMARTIN, BIHOR COUNTY

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Abstract

The objective of this paper is checking the results obtained at the dimension of horizontal drains on the heavy soils with a high content of clay, using DrenVSubIR program of determining the distance between the drains, by comparing the results of the research done in Sînmartin drainage field, Bihor.

In this experimental field, on a stgnic, albic luvosoil have been noticed in the period 1987-1993, a lot of types of drainage of rifled PVC, 6,5 cm, with filtrated prism of ballast with the height of 15 cm, having distance between the drains of 15, 30 and 45 m in association or non whit deep loosening

For the confirmation of the results of the research in the field, the distance between the drain wires have been calculated for the conditions given by the type of the soil with the Ernst-David method, using the program DrenVSubIR.

The closest results to the ones obtained in the field are obtained using the calculating module of the distance between the drains, with the relation Ernst-David of the program DrenVSubIR.

Key words: heavy soils, drain tube, filtrate prism, DrenVSubIR program.

INTRODUCTION

Under the conditions of Bihor district, from the 490 thousand ha amount of agricultural surface, 63 % (307 thousand ha) are fields degraded by different limitative factors of the fertility of the soils. Among these, the limitative factor with the greatest dispersion in the west of the country is represented by the temporary excess of humidity traceable to the formation of the suspended water table above a clayey horizon with a high clay content, characterized by a high compaction level and little hydraulic conductivity. (Colibaş I., et al, 1987)

One of the imposed measures for improving this soil is the elimination of the temporary excess of humidity by surface or underground drainage. The main problem at the projection of the underground drainage with horizontal tubes is to establish the distance between the drain wires in permanently working regime. (Man T.E., et al., 2007)

For the dimensioning of the drainage in a permanent working regime, various methods are being used: based on the values of the tangent of the angle alpha, determined on the texture of the soil using the nomogram for dimensioning the crossed drainage, based on the colloidal clay content (<0,002 mm), with the relations Donnan, Hooghoudt, Ernst, David, Toksoz-Kirkham, etc. (Wehry A., et al., 1982; Man T.E., et al., 2007; Sabău N.C., 2009)

The calculating program DrenVSubIR 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 sub-irrigation and the third for the technical economical (the cost) calculation of ha, of drained field. (Bodog Marinela, 2008; Teuşdea A., et al., 2008; Gomboş D., et al., 2009)

In the last years was checked up the working of DrenVSubIR program, in the conditions of soils with a high content of clay from drainage field Diosig and Cefa, was checked up the possibilities of using the drainage from Avram Iancu field for sub-irrigation and was calculated the costs of the arrangements. (Sabău N.C., et al., 2009; Sabău N.C.**,** 2009; Sabău N.C., 2010; Sabău N.C., et al., 2011)

MATERIAL AND METHOD

The drainage field from Sînmartin is placed in Crişurilor Plain, on the second terrace, on a stagnic, albic luvosoil.

The main proprieties of the the stagnic albic luvosil from the drainage field indicates a heavy soil with a content of colloidal clay (< 0,002) in BtW horizon, at 44 – 90 cm deepness of over 40 %. (Table 1)

Table 1

Some proprieties of the stagnic, albic luvosoil from Sînmartin, Bihor County

Horizon	**Deepness (cm)**	**Clay (%) <0,002 mm**	**Bulk Density (g/cm^3)**	**Field Capacity (%)**	**K (mm/h)**	**pH (H_2O)**	**Humus (%)**
Ap	0-22	24,7	1,36	23,0	5,5	5,1	2,80
Eaw	22-32	23,7	1,52	23,0	1,9	5,2	1,27
EBtW	32-44	30,0	1,54	23,0	1,3	5,2	1,50
BtW	44-90	43,3	1,63	24,0	0,2	5,4	-
Btw	90-110	40,2	1,65	23,0	0,2	5,9	-

The bulk density is high under the ploughed layer and the hydraulic conductivity has small values. The index of texture differentiation is of 1,76.

Soil reaction is strongly acid and the humus content indicates a medium nutritive elements supply.

The soils which are affected by periodical humidity excess, the formation of the pedological water table layer is traceable to the existence of a horizon with a colloid clay content of over 40 %, located on 40 - 60 cm deepness on the soil profile. In this case, the deep loosening works are necessary.

The experimental device from drainage field Sânmartin is of the randomized blocks type, with three repetition parcels having the damaged surface covered by one drain ware, deigned at the tested distance between the wire. (Table 2.)

Table 2

The drainage variants tested in the drainage field Sînmartin (1987 – 1993)

Nr. crt.	**Variants**	**Distance (m)**	**Filterable prism**		**Deep loosening**	
			Vegetal soil	**Sorted ballast**	**Mole drainage**	**Scarifying**
V1	Mt (control)	-	-	-	-	-
V2	D15 + Fî + Sc	15	-	Yes	-	Yes
V3	D30 + Fî + Sc	30	-	Yes	-	Yes
V4	D45 + Fî + Sc	45	-	Yes	-	Yes
V5	D30 + Fî + Dc	30	-	Yes	Yes	-
V6	D30 + Fp	30	Yes	-	-	-

The drainage variants has the distance between the absorbent drain wires of 15, 30 and 45 m, with rifled PVC, with a diameter of ϕ = 6,5 cm and filterable prism of vegetal soil or sorted ballast, having the height of 15 cm, posing deepness at 0,8 m, in association or non with deep loosening, through mole drainage or scarification.

RESULTS AND DISSCUSIONS

The module for calculating the distance between drains of the DrenVSubIR program presents the advantage of automatizing of necessary laborious calculus and especially that it takes into consideration the type and the characteristics of the drain tube, the characteristics of used material in the filter and the soil characteristics.

At first sight the DrenVSubIR program presents the disadvantage that in the case of multi layered soils it considers two layers, the layer above the plain of the drain tubes placement and the layer under this plain.

The saturated hydraulic conductivities of the horizon that create the soil profile (table 1) are determined through the cylinder method and these are pedological conductivities K_P (mm/h) and the program use the real hydraulic conductivity, determined through the borehole method (Hooghoudt) K_R (m/day).

For transforming these in real saturated hydraulic conductivities K_r, the polynomial correlation of second degree, very significant from a statistical point of view can be used, established after the data presented of Canarache A. 1990, resulting K_R corresponding to each horizon. (Table 3)

Table 3

The real saturated hydraulic conductivity of stagnic albic luvosoil from Sînmartin, Bihor County

Hori-zon	**Deep-ness (cm)**	**Pedological conductivity K_P**		**Clay <0,002 mm (%)**	**K_R (m/day)**	**The thickness (m)**	**K_{Re} (m/day)**
		(mm/h)	**(m/day)**				
Ap	0 - 22	5,5	0,1320	24,7	0,1657	0,80	0,0768
Eaw	22 - 32	1,9	0,0456	23,7	0,0902		
EBtW	32 - 44	1,3	0,0312	30,0	0,0780		
BtW	44 - 90	0,2	0,0048	43,3	0,0559		
Btw	90 - 110	0,2	0,0048	40,2	0,0559	0,30	0,0559

The value of the real equivalent filtrating coefficient K_{Re} for the layer above the plain of the drain tubes placement is of 0,0768 m/day and for the layer under the plain is 0,0559 m/day.

Using the characteristic data of the drain tube of rifled PVC ϕ = 0,065 m, the number of port rows on generators n = 6, the width of rectangular slots l = 0,001 m, the length of the slots orientated after generators b = 0,005 m and the distance between slots on generators B = 0,025 m, the distance between drains L, can be determined. (Table 4.)

Table 4

The distances between absorbent drain wires, in conditions of drainage variants from Sînmartin drainage field, calculated with DrenVSubIR program

Nr. crt.	**Variant**	**$K1_{Re}$ (m/day)**	**$K2_{Re}$ (m/day)**	**Kfc (m/day)**	**ζ_{i+f} (zita)**	**Distance L (m)**
1.	Drain tube, rifled PVC Φ=0,065 m	0,0768	0,0559	-	1,63	1,8
2.	Drain tube + filterable prism, vegetable soil	0,0970	0,0559	0,1657	-2,46	9,9
3.	Drain tube + filterable prism, sorted ballast	0,1033	0,0559	12,4	-4,52	15,2
4.	Drain tube + filterable prism, sorted ballast + mole drainage	2,50	0,0559	12,4	-4,52	19,9
5.	Drain tube + filterable prism, sorted ballast + scarifying	5,00	0,0559	12,4	-4,52	25,9

Considering that the ameliorative works associated, with a life period of 4 to 6 years, after which they have be redone, it is considered that the hydraulic conductivity is 2,5 m/day when using the mole drainage, and is 5 m/day when using the scarifying, the distances between drains (L) are 1,8 m in the case of the tube without filter, 9,9 m when we have filterable prism with vegetable soil, 15,2 m for the sorted ballast filterable prism, 19,9 m when these are associated with mole drainage and 25,9 m for the deep loosening by scarifying.

By operating the dimension between wires program, with the same filter material and the same ameliorative works we get the close results as those obtained in the experimental drainage field Sânmartin, between 1987 - 1993, L = 30 m high sorted ballast filterable prism (15 cm) associated with deep loosening by scarifying.

Taking in consideration, the soil conditions from drainage field Sînmartin, auspicious in order to use the drainage to sub-irrigation, the small deepness of impermeable layer and the absence of salinization processes was checked the reversibility drainage – sub irrigation.

In order to function in the conditions of sub-irrigation 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 humidity in the upper layer of soil is between the level of the active humidity, between the minimum easily available water content (Pmin = 17 %) and field capacity (CC = 23 %).

These values, in the conditions from drainage field Sînmartin was established to: the deepness of water table Hc = 0,7 m, for the humidity in upper layer at field capacity and respectively the deepness corresponding to the humidity in upper layer at minimum easily available water content of Hp = 0,9 m.

Because the deepness of wire drains are to 0,8 m and the hydraulic conductivity of layer above drains is very small, any more of the drainage variants studied, do not can be used for sub-irrigation.

CONCLUSIONS

By designing the distance between drain wires with DrenVSubIR program, with the same filter material and the same ameliorative works we get the close results, L = 25,9 m, as those obtained in the experimental drainage field Sînmartin, between 1987 - 1993, L = 30 m high sorted ballast filterable prism (15 cm) associated with deep loosening by scarifying.

The drainage variants studied in the drainage field Sânmartin cannot be used in the sub-irrigation function, because the deepness of posing is 0,8 m and the hydraulic conductivity of above layer is very small.

REFERENCES

1. Bodog Marinela – Interacțiunea Irigații-Drenaj și impactul acestora asupra mediului în bazinul Crişurilor – Teză de doctorat, Universitatea "Politehnica" Timişoara, Facultatea de Hidrotehnică; - 2008;
2. Canarache A. - Fizica solurilor agricole – Ed. Ceres Bucureşti – 1990;
3. Ciobanu Gh., Domuța C., Cerctări agricole în Crişana, Editura Universității din Oradea, 2003:
4. Colibaş I., şi colab., Rezultate ale unor cercetări privind ameliorarea solurilor grele şi tasate afectate succesiv de exces şi deficit de umiditate din Câmpia Crişurilor.

Lucr. Conf. Nat. de Ştiinţa Solului, 27-31 aug. 1985, Timişoara, Publ. S.N.R.S.S. nr..23A - 1987;
5. Gomboş Dan, Sabău N.C., Bodog Marinela, Domuţa Cr., *DrenVSubIR design sofwere validation for seepage drainage and subirrigation,* 20th Danube Adria Association for Automation & Manufacturing (DAAAM) World Symposium, Austria Center Viena, pp. 1073-1074, 25-28 nov. 2009;
6. Man T.E., Sabău N.C., Cîmpan Gabriela, Bodog Marinela– Hidroamelioraţii – Ed. Universităţii din Oradea – 2007;
7. Mureşan D., Pleşa I., Onu N., Savu P., Nagy Z., Jinga I., Teodorescu Al., Păltineanu I., Toma I., Vasilescu I.– Irigaţii desecări şi combaterea eroziunii solului – Ed. Didactică şi Pedagogică Bucureşti – 1992;
8. Sabău N.C., Îmbunătăţiri Funciare – IF, Editura Universităţii din Oradea, 2009;
9. Sabău N.C., Bodog Marinela, Teuşdea A.C., The projection on the drainage on the soil with a high content of clay using DrenVSubIR program, Universitatea de Ştiinţe Agricole şi Medicină Veterinară " Gh. Ionescu Şişeşti" Iaşi, Al 52 –lea Simpozion Internaţional "Ecological Agriculure – Priorities and Perspectives" 22/24 oct. 2009;
10. Sabău N.C.**,** The effects estimation of drainage and subirrigation with DrenVSubIR program in drainage experimental field from Avram Iancu, Bihor County, International Symposia "Risk Factors for Environment and Food Safety" & "Natural Resources and Sustainable Development" Oradea, Analele Universităţii din Oradea, Fascicula Protecţia Mediului, Agriculture, Vol XIV, Anul 14, Ed. Univ. din Oradea, I.S.S.N. 1224 – 6255, pp. 296-303, pg. 380, November 6 – 7 2009;
11. Sabău N.C., The experimental determination of a neded parameters for reversibility checking drainage-subirrigation, with DrenVSubIR soft, in Avram Iancu drainage field, Bihor county, International Symposium "Trend In The European Agriculture Development"**,** Banat's University of Agricultural Sciences and Veterinary Medicine Timişoara, Faculty of Agriculture and University of Novi Sad, Faculty of Agriculture, Timişoara, may 20-21, 2010;
12. Sabău N.C., Some proposal for the performances bettering of DRENVSUBIR soft, uzed at the agricultural drainage design - International Symposia "Risk Factors for Environment and Food Safety" University of Oradea, Faculty of Environmental Protection, Fascicula Protecţia Mediului, Agronomy, Vol XIV, Anul 15, Ed. Univ. din Oradea, I.S.S.N. 1583 – 4301, I.S.S.N. (Ed. română): 2065 – 3476, I.S.S.N. (Ed. maghiară): 2065 – 3484, pp. 204-213, pg. 1565, November, 5 – 6, Oradea, Romania, 2010,
13. Sabău N.C., Bodog Marinela, Teuşdea A.C., Domuţa C., Şandor Maria, Brejea R. - The new functions that can be added at the soft for horizontal drainage design DrenVSubIR - Buletinul Ştiinţific al Universităţii "POLITEHNICA" din Timişoara, Seria HIDROTEHNICĂ, TRANSACTIONS on HYDROTECHNICS, Tom 56(70), Fascicola 1, pp 15 – 18, Timişoara, 2011;
14. Teuşdea, A., David, I. Mancia Aurora, *Subsurface drainage and its reversible facilities in subirrigation*, Annals of DAAAM for 2008 & Proceedings of the 19th International DAAAM Symposium „Intelligent Manufacturing & Automation: Focus on Next Generation of Intelligent Systems and Solutions", Trnava, Slovakia, 2008.
15. Wehry A., David I., Man T.E. – Probleme actuale în tehnica drenajului – Ed. Facla Timişoara– 1982.