A COMPARISON OF THE HEAD LOSSES VALUES FOR TIMIS COUNTY'S DRAINAGE SYSTEMS USING THE RESULTS OBTAINED WITH DRENVSUBIR AND ESPADREN PROGRAMS

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Abstract
Romania's territory disposes of numerous areas with humidity excess from different sources and which are supposing the adoption of a suitable water management in order to facilitate a sustainable development of these fields for a durable agriculture. Surface drainage and drainage systems are representing indispensable measures in the process of obtaining crops in large quantities and of high quality. The existence of a significant number of different situations with humidity excess imposed the adoption of specialized programs in the designing process. Each of these programs analyze the humidity excess but from different points of view and by using different parameters. The authors selected for this paper the newest Romanian application in drainage design domain, DrenVSubIr, and one program from Costa Rica which has the necessary features in order to be able to compare the results. The paper will present comparisons between the results obtained with DrenVSubIr and Espadren in computing the head losses (horizontal, vertical, radial and at entrance in drain) for some areas characterized by humidity excess from Timis County.

Keywords: soil humidity excess, drainage, head losses, DrenVSubIr, EnDrain

1. INTRODUCTION

An efficient agriculture, taking in consideration the climatic conditions existent in Romania, can be practiced only with the support of efficient land reclamation and improvement systems. The land drainage systems are playing an important role in achieving the desired targets.
The multitude and variability of situations with humidity excess which can appear resulted in the use of numerous computation methods and programs which offer solutions with different levels of efficiency. Manual, classical, methods were replaced by specialized software. These software's are presenting a small risk regarding the potential errors and there are able to present detailed prognosis of the studied phenomenon.
The calculations were realized for Timis County (Margina and Faget areas) which is situated in the western part of Romania. This county is representative for studying humidity excess in Romania because more the 65% of its territory disposes of surface drainage and drainage arrangements. For studying the variation of head pressure losses I used the Ernst formula in the frame of each program. I considered in the calculations a soil with two layers, the separation line between layers being under the drain lines.

2. MATERIALS AND METHODS

DrenVSubIr represents the newest Romanian application used in drainage systems design and it was realized by a group of researchers from "Politehnica" University of Timisoara, Romania and the University from Oradea, Romania. This application was developed in Borland Delphi Pascal 7.0 and is intended to compute indicators characteristic for drainage systems as it is the distance between drains including the verification for sub-irrigation. The procedure designated for computing the distances between drains is based on Ernst formula and on the experimental drainage studies realized in the "Politehnica" University laboratory, studies which were carried according to the "Politehnica" University methodology for the main soils with humidity excess from western Romania (Bodog Pasca M., 2008).
Espadren is an application developed in Costa Rica for simplifying the computation of

distances between drains using steady-state equations (Donnan, Hooghoudt, Dagan, Ernst) but also non steady-state equations (Glover-Dumm and Jenab) for open channels and buried drains. Espadren was realized using Visual Basic environment (Villón, 1985).
The results are presented in the following table.

Table 1 Results of drainage studies for Timis County

Location and type of soil	Drain type	Drain diameter	Hydraulic conductivity (m day^{-1})	Coefficient of resistance to flow at water entrance in drain	Flow mm/ day	Drain depth (m)	Distance between drains using Ernst formula computed by UPT (m)
Margina	plastic	5 cm	0.1635	0,507	7	1,4	9
		6.5 cm	0.1635	0,532	7	1,4	9
		8 cm	0.1635	0,607	7	1,4	9
Faget	plastic	5 cm	0.355	0,507	7	1,4	15
		6.5 cm	0.355	0,532	7	1,4	15
		8 cm	0.355	0,607	7	1,4	16

The new researches were focused on the different head losses values and on comparisons between values obtained with different programs.

3. RESULTS AND DISCUSSION

The results obtained with Espadren and DrenVSubIr are presented in tables while the ratios between DrenVSubIr values and Espadren values are presented in tables and graphs. The calculations were realized for Margina area (3 types of drain diameters: 5, 6,5 and 8 cm) and for Faget area (also with 3 types of diameters: 5, 6,5 and 8 cm).

Table 2 Margina Area, Timis County, drain tube diameter of 0,05 m

	DrenVSubIr	Espadren	$V_{DrenVSubIr}/V_{Espadren}$
L(m)	6,94962	9,63	0,721664
h_0 (m)	0,13604	0,2614	0,520428
h_v (m)	0,02569	0,0257	0,999611
h_r (m)	0,28742	0,3129	0,918568
h_i (m)	0,15085	-	-
a	3,26676	3,2750	0,997484

Table 3 Margina Area, Timis County, drain tube diameter of 0,065 m

	DrenVSubIr	Espadren	$V_{DrenVSubIr}/V_{Espadren}$
L(m)	7,12337	10,03	0,710206
h_0 (m)	0,14292	0,2835	0,504127
h_v (m)	0,02569	0,0257	0,999611
h_r (m)	0,26914	0,2908	0,925516
h_i (m)	0,16225	-	-
a	3,26676	3,2750	0,997484

Table 4 Margina Area, Timis County, drain tube diameter of 0,08 m

	DrenVSubIr	Espadren	$V_{DrenVSubIr}/V_{Espadren}$
L(m)	7,09648	10,38	0,683669

h_0 (m)	0,14185	0,3033	0,467689
h_v (m)	0,02569	0,0257	0,999611
h_r (m)	0,24804	0,2710	0,915277
h_i (m)	0,18442	-	-
a	3,26676	3,2750	0,997484

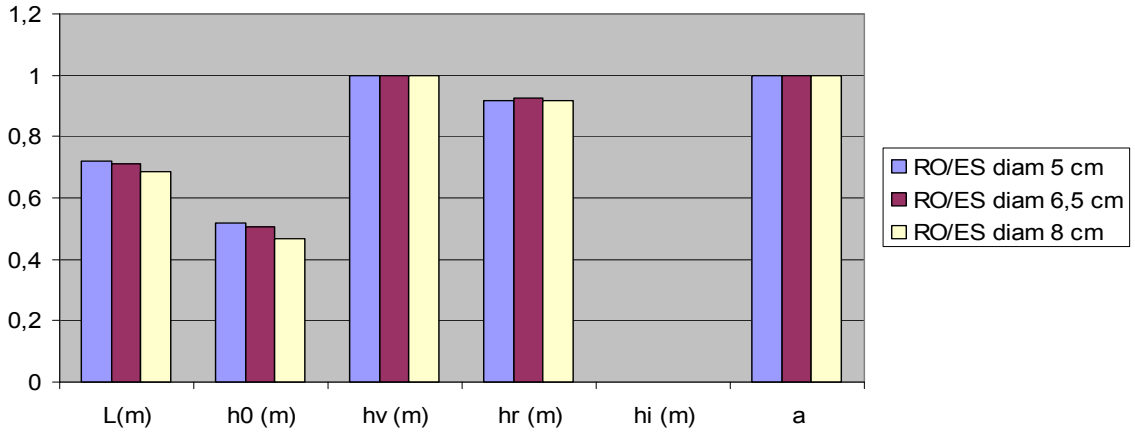

Figure 1 The variation of differences between the values obtained with DrenVSubIr and Espadren programs as function of drain diameter for Margina area, Timis County

Table 5 Tabel Faget Area, Timis County, drain tube diameter of 0,05 m

	DrenVSubIr	Espadren	$V_{DrenVSubIr}/V_{Espadren}$
L(m)	12,86173	16,29	0,789548
h_0 (m)	0,21460	0,3444	0,623113
h_v (m)	0,01183	0,0118	1,002542
h_r (m)	0,24499	0,2438	1,004881
h_i (m)	0,12858	-	-
a	3,26676	3,2750	0,997484

Table 6 Tabel Faget Area, Timis County, drain tube diameter of 0,065 m

	DrenVSubIr	Espadren	$V_{DrenVSubIr}/V_{Espadren}$
L(m)	13,10273	16,76	0,781786
h_0 (m)	0,22272	0,3644	0,611196
h_v (m)	0,01183	0,0118	1,002542
h_r (m)	0,22800	0,2238	1,018767
h_i (m)	0,13475	-	-
a	3,26676	3,2750	0,997484

Table 7 Tabel Faget Area, Timis County, drain tube diameter of 0,08 m

	DrenVSubIr	Espadren	$V_{DrenVSubIr}/V_{Espadren}$
L(m)	13,06562	17,16	0,7614
h_0 (m)	0,22146	0,3818	0,580042
h_v (m)	0,01183	0,0118	1,002542
h_r (m)	0,21033	0,2063	1,019535
h_i (m)	0,15638	-	-
a	3,26676	3,2750	0,997484

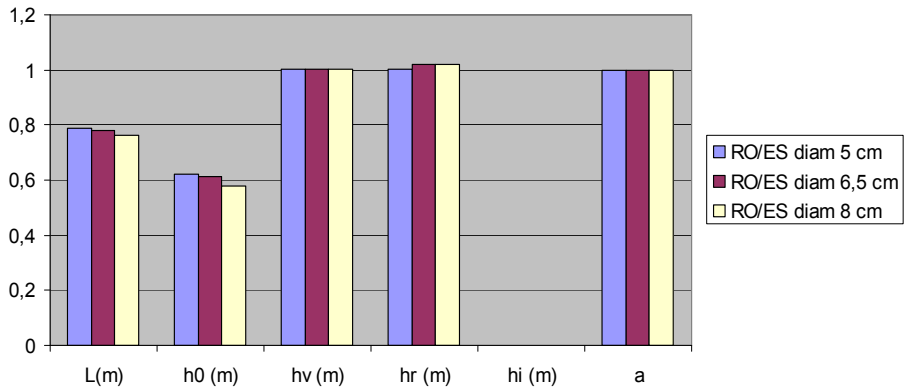

Figure 2 Fig. The variation of differences between the values obtained with DrenVSubIr and Espadren programs as function of drain diameter for Faget area, Timis County

For the calculation of distances between drains we choose Ernst method, the case of profile with two soil layers, the line of separation being below the drain line. The first problem which had appeared is referring to the hydraulic conductivity of the soil layers. Espadren program allows the case of homogenous soil while the Romanian program, DrenVSubIr doesn't. In this case we selected the case of the profile with two soil layers.

DrenVSubIr calculated for the mentioned two areas and head losses at water entrance in drain even the formulas proposed by Ernst don't specify the necessity of calculating this term.

Generally speaking, the values obtained in computing distances between drains by using Espadren were higher than the values obtained with DrenVSubIr, the differences being smaller (between 10 and 15%) in case of soils with high hydraulic conductivity and sizeable (between 40 and 50%) in the case of soils with low hydraulic conductivity.

Also, referring to the case of soils with low hydraulic conductivity (below 0,15 m/day) it can be observed that the maximum of distances between drains calculated with DrenVSubIr is obtained for 0,065 m drain pipe diameter while, the calculations realized with Espadren are indicated a growing trend of distances between drains, from 0,05 m drain pipe diameter to 0,08 m drain pipe diameter. Sizeable differences were observed and in the case of horizontal head losses and in the case of radial head losses, especially for the soils with very low hydraulic conductivity, differences which reached 75% and even 90%.

The weight of different head losses (horizontal, vertical, radial and at the entrance) as function of drain pipe diameter and the program which was used, are presented in the next graphs for Faget and Margina areas from Timis County.

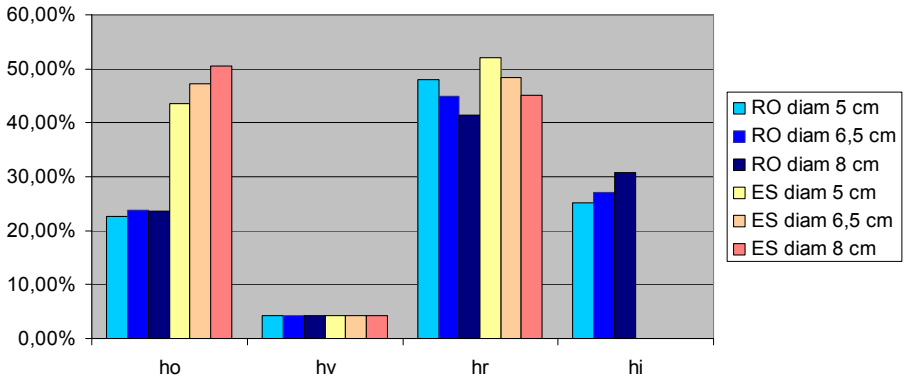

Figure 3 The weight of different head losses (horizontal, vertical, radial and at the entrance) as function of drain pipe diameter and the program which was used for Margina Area, Timis County

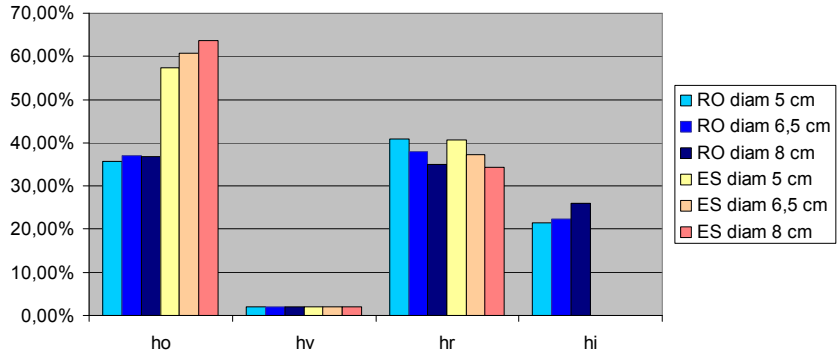

Figure 4 The weight of different head losses (horizontal, vertical, radial and at the entrance) as function of drain pipe diameter and the program which was used for Faget Area, Timis County

4. CONCLUSIONS

These two programs, DrenVSubIr and Espadren, which were used in this paper are representing relative new programs in the frame of drainage design. They can offer the most proper information regarding the water table level and evolution, and as a consequence, they can offer tools for assessing drainage impact on environment. The industry of drainage programs knew in the last period a significant development, many researchers bringing their contribution in developing new platforms which are representing with high accuracy and fidelity the components and processes from surface drainage and drainage arrangements. This paper presented only a small part from the capabilities of these programs, referring to the importance of head losses variation and distribution.

5. ACKNOWLEDGMENTS

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