COMPARISON BETWEEN THE PEACH-TREE WATER CONSUMPTION AND THE REFERENCE EVAPOTRANSPIRATION IN THE CONDITIONS FROM WESTERN ROMANIA

Domuţa C. *, Şcheau Violeta *, Şcheau V.*, Şandor Maria **, Bandici Gh.* Sabău N.C. *, Samuel Alina *, Borza Ioana *, Domuţa Cr. *

*University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048 Oradea; Romania, e-mail: domuta_cornel@yahoo.com

**Agricultural Research and Development Station Oradea, Calea Aradului No. 1, Roamnia, e-mail scdaoradea@yahoo.com

Abstract

The paper presents the results obtained during 2000-2003 at nonirrigated and irrigated by drip and micro sprinkler peach-tree. These methods are compared with those for evapotranspiration reference determination: Thorntwaite, pan Class A, Piche evaporimeter, Penman-Monteith. There is a specific situation regarding the peach-tree, the water consumption and the values of the reference evapotranspiration. The results obtained underline the need of the crop coefficient use for the reference evapotranspiration transformation into peach-tree optimum water consumption.

Key words: peach tree, water consumption, ET_0 Thornthwaite, ET_0 Bac, ET_0 Piche, ET_0 Penman - Monteith

INTRODUCTION

The plants' water consumption knowledge is very important for both irrigation design and irrigation scheduling (Grumeza et all, 1989, Grumeza and Kleps, 2005). The best methods for reference evapotranspiration don't give similar results with the values of the plants water consumption (Doorembos and Pruitt, 1992, Domuţa, 1995, 2003, 2005) and the crop coefficient (Kc) for transformation of the reference evapotranspiration in the optimum water consumption of the plants are necessary. The paper presents the results obtained during 2000-2003 in Oradea.

MATERIALS AND METHODS

The researches were carried out in an orchard planted in 1996. The cultivar used was Superb of Autumn. The peach-tree water consumption was obtained using the soil water balance method; the depth of the water balance was of 0-150 cm. Three variants were studied: 1) Nonirrigated; 2) Drip irrigated 3) Micro sprinkler irrigated. In the irrigated variant, the soil water reserve on 0-150 cm was maintained between the easily available water content and the field capacity determining the soil moisture every ten days. The irrigation regime included an irrigation rate of 376.7 mm in 2000 143.0

mm in 2002, 152.0 mm in 2003. The annual rainfall during the studied period was of 527.4 mm in 2000, 868.5 mm in 2001, 437.5 mm in 2002, 501.1 mm in 2003. The Bac evaporation and the Piche evaporation were determined every day at 8 o'clock by the same person. Three Bac evaporimeters and three Piche ones were used. Thorntwaite and Penman-Monteith values of the reference evapotranspiration were calculated using a known formula (Botzan, 1966, Domuța, 2005).

RESULTS AND DISCUSSION

The differences between the water consumption of the peach-tree and the reference evapotranspiration (ET_o)

The daily water consumption of the nonirrigated peach-tree increased from April (2.43 mm/day) to June (3.66 mm/day) and decreased after that. In irrigated conditions, in both drip and micro sprinkler conditions, the maximum daily water consumption was registered a month later than in nonirrigated conditions. In irrigated conditions the values of the daily water consumption of the peach-tree were bigger than the values registered in the nonirrigated variant every month (table 1).

Table 1

Daily water consumption (ETR) and daily optimum water consumption (ETR_{opt}) of the peach-tree in comparison with the reference evapotranspiration (ET_o) determined using different methods, Oradea 2000-2003

Variant	April	May	June	July	August	September
1.ETR	2.43	3.56	3.66	3.39	1.62	1.13
2.ETR_{opt} drip irrigation	2.61	3.72	4.22	4.89	3.72	1.54
3.ETR_{opt} micro sprinkler	2.74	3.87	4.78	5.13	3.43	1.75
4.ET_o Thorntwaite	1.91	3.82	4.45	4.68	4.27	2.54
5.ET_o Bac evaporimeter	2.6	4.14	4.63	4.8	4.76	2.70
6.ET_o Piche evaporimeter	3.64	5.21	6.22	6.49	6.45	3.52
7.ET_o Penman-Monteith	2.56	4.07	4.92	4.55	4.67	2.49
Statistically appreciation of the differences between ETR and ET_o						
LSD 5%	0.7	0.9	1.1	1.3	1.2	1.0
LSD 1%	1.4	1.6	2.2	2.5	2.6	2.1
LSD 0.1%	3.6	3.9	4.2	4.7	4.9	3.9
Statistically appreciation of the differences between ETR_{opt} in drip irrigation and ET_o						
LSD 5%	0.4	0.6	0.4	0.4	0.7	0.6
LSD 1%	1.2	1.5	0.9	1.0	1.4	1.3
LSD 0.1%	2.5	2.7	1.9	2.1	2.3	2.2
Statistically appreciation of the differences between ETR_{opt} in micro sprinkler irrigation and ET_o						
LSD 5%	0.9	0.6	0.5	0.7	0.6	0.9
LSD 1%	2.1	1.5	1.3	1.5	1.6	1.6
LSD 0.1%	3.7	2.4	2.7	2.5	2.3	3.1

In comparison with the peach-tree water consumption in nonirrigated conditions, the values obtained for the reference evapotranspiration (ET_o) determined by the Thorntwaite, Bac and Piche evaporimeters and Penman-Monteith methods present different situations. All the months, the closest values to the ETR were obtained in ET_o Thorntwaite, in April, May, June and July the differences were insignificantly and in August and September were distinguishable significant.

In comparison with ETR_{opt} of the peach-tree with drip irrigation, the closest monthly values of the reference evapotranspiration were registered using the Bac evaporimeter in April, June, and July and using the Thorntwaite method in May, August and September. In comparison with ETR_{opt} on the peach-tree irrigated using the micro sprinkler method, the closest values were obtained using the Thorntwaite method in May and August, the Bac evaporimeter in July, Penman-Monteith in April, June and September. This situation emphasized the statistically assured differences between ETR and ET_{opt} of the peach-tree and ET_o determined using different methods and the need of the crop coefficient „Kc" use for the ET_o transformation into the water consumption of the peach-tree.

The differences between the total water consumption of the peach-tree and the reference evapotranspiration (ET_o)

Between both peach-tree water consumption in nonirrigated conditions and in conditions of drip or micro sprinkler irrigation, the values of the reference evapotranspiration (ET_o) calculated using 4 methods, the differences are statistically assured (table 2).

In comparison with the water consumption of the nonirrigated peach-tree, the closest value was obtained using the Thorntwaite method; a similar situation was obtained when the values of the drip irrigated variant were compared. When the Penman-Monteith method was used, the closest value of the water consumption in micro sprinkler irrigation was obtained.

Table 2

Differences between the water consumption (ETR) of the nonirrigated peach-tree, the optimum water consumption (ET_{opt}) of the irrigated peach-tree and the reference evapotranspiration (ET_o) determined using different methods, Oradea 2000-2003

Variant	mm/ha	%	%	%
1	2	3	4	5
1.ETR	551.3	100	81	79
2.ETR_{opt} drip irrigation	683.0	124	100	98
3.ETR_{opt} micro sprinkler irrigation	700.2	127	103	100
4.ET_o Thorntwaite	662.9	120	97	95
5.ET_o Bac evaporimeter	722.6	131	106	103
6.ET_o Piche evaporimeter	963.9	175	141	137
7.ET_o Penman-Monteith	711.2	129	104	102
Statistically appreciation of the differences between ETR and ET_o				
LSD 5%	37.0			
LSD 1%	72.0			
LSD 0.1%	137.0			
Statistically appreciation of the differences between ETR_{opt} in drip irrigation and ET_o				
LSD 5%	21.4			
LSD 1%	57.0			
LSD 0.1%	112.0			
Statistically appreciation of the differences between ETR_{opt} in micro sprinkler irrigation and ET_o				
LSD 5%	21.0			
LSD 1%	51.2			
LSD 0.1%	109.8			

Crop coefficient „Kc"

The data regarding the peach-tree water consumption in drip and micro sprinkler irrigation conditions and the reference evapotranspiration (ET_o) determined using the Thorntwaite, pan Class A, Piche and Penman-Monteith methods, permitted the calculation of the crop coefficient (Kc). These coefficients transform the reference evapotranspiration into peach-tree water consumption in drip and micro sprinkler irrigation conditions. Tables 3 and 4 present the values of the crop coefficient for every reference evapotranspiration method. These coefficients can be used in the irrigation design – Kc for ET_o Thorntwaite or ET_o Penman-Monteith, because the registration of the climate data includes a big number of years, or in irrigation scheduling – Kc for ET_o pan Class A and Piche evaporimeter.

Table 3

Values of the crop coefficient „Kc" for the transformation of the reference evapotranspiration (ET_o) in the optimum water consumption of the drip irrigated peach-tree, Oradea 2000-2003

Method	April	May	June	July	August	September
1.Thorntwaite	1.42	0.98	1.04	1.03	1.01	0.78
2.Bac evaporimeter	1.05	0.97	1.03	1.00	0.98	0.81
3.Piche evaporimeter	0.74	0.75	0.77	0.74	0.55	0.47
4.Penman-Monteith	1.06	0.94	0.96	1.06	0.76	0.69

Table 4

Values of the crop coefficient „Kc" for the transformation of the reference evapotranspiration (ET_o) in the optimum water consumption of the micro sprinkler irrigated peach-tree, Oradea 2000-2003

Method	April	May	June	July	August	September
1.Thorntwaite	1.47	1.00	0.56	1.10	0.78	0.69
2.Bac evaporimeter	1.07	1.09	1.07	1.06	0.74	0.65
3.Piche evaporimeter	0.78	0.74	0.75	0.71	0.54	0.50
4.Penman-Monteith	1.11	0.96	0.92	1.15	0.73	0.74

CONCLUSIONS

1) There are different situations of the reference evapotranspiration (Eto) values in comparison with the daily water consumption of the peach-tree in drip and micro sprinkler irrigation. These situations sustain the need for the crop coefficients (Kc) use in irrigation scheduling.
2) Comparing the peach-tree water consumption of the nonirrigated variant with the reference evapotranspiration values, the closest value was registered using the Thorntwaite method. In comparison with the water consumption from the variant with drip irrigation, the same situation was registered.
3) In comparison with the total water consumption of the peach-tree from the variant with micro sprinkler irrigation, the closest average value was registered using the Penman-Monteith method.

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