

USE OF THE PICHE EVAPORIMETER IN THE IRRIGATION SCHEDULING OF THE TOMATOES IN THE CONDITIONS FROM THE SOLARIUM

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Abstract

The paper is based on the researches carried out during 1999-2001 in solariums from Husasău de Criș. The direct link statistically assured between daily Piche evaporation and daily water consumption of the tomatoes emphasized the opportunity of the Piche evaporimeter use in irrigation scheduling of the tomatoes in the conditions from the solarium. The use is based on the soil water balance on 0-50 cm depth in the monthly chart using daily data of the Piche evaporation and specifically crop coefficient "Kc". In average of the studied period, the values of the crop coefficient were of: 0.75 in March, 0.51 in April, 0.66 in May, 0.76 in June, 0.90 in July, 0.62 in August and 0.64 in September.

Key words: solarium, tomatoes, Piche evaporimeter, irrigation, scheduling

INTRODUCTION

Piche evaporimeter is used in the irrigation scheduling of the field crops from France, Italy. Since 1969, this method is studied in different research fields from the potential irrigated areas of Romania (Grumeza et al, 1989, Grumeza and Kleps, 2005, Domuța, 1995, 2005, Domuța et al, 2000). Our researches evidence the results obtained when using the Piche evaporimeter for irrigation scheduling of the tomatoes in the conditions from the solarium.

MATERIALS AND METHODS

The researches were carried out during 1999-2001 in the conditions of the solarium from Husasău de Tinca. Solarium surface was of 200 m² and Piche evaporimeters (three pieces) were placed in the middle of the solarium. The levels of the water from Piche evaporimeter were noted down every day at 8 o'clock in the morning and by comparing them with those predetermined; the final values of the Piche evaporimeter were obtained.

The values of the air temperature inside the solarium are presented in table 1. March was the month with the lowest temperature and July (in

1999) and August (2000 and 2001) were the months with the highest temperatures.

Table 1

Average values of the air temperature inside and outside the solarium, Husasău de Tinca 1999-2001

Year	Place of determination	March	April	May	June	July	August	September
1999	Inside solarium	16.5	17.8	18.7	23.0	31.2	26.1	22.2
	Outside solarium	12.8	11.9	15.0	20.6	24.2	21.2	17.6
2000	Inside solarium	1.5	19.4	22.6	24.8	27.3	27.4	22.8
	Outside solarium	10.5	14.7	17.9	21.5	25.9	25.1	19.3
2001	Inside solarium	14.8	16.4	21.4	19.9	22.4	26.0	20.2
	Outside solarium	10.5	10.5	16.7	16.2	18.7	22.3	15.8
Average	Inside solarium	15.6	17.9	20.9	22.6	27.0	26.5	21.7
	Outside solarium	11.3	12.4	16.5	19.4	22.9	22.9	17.6

Regarding the temperatures outside the solarium, the lowest values were registered in April, but the highest temperatures were registered in July (1999 and 2000) and in August (2001).

Optimum water consumption of the tomatoes was obtained maintaining the soil water reserve on watering depth (0-50 cm) between easily available water content and field capacity. This thing was possible by prelevating soil samples ten to ten days and determining soil moisture. Monthly, the soil moisture was determined on 0-150 cm depth. Tomatoes water consumption was calculated by soil water balance method, depth used was 0-150 cm.

Piche evaporimeter method is included in the indirect methods for irrigation scheduling. The indirect methods for irrigation scheduling is based on the crop coefficient (K_c) used and on the soil water balance on watering depth.

Crop coefficients (K_c) are calculated reporting the optimum water consumption to the reference evapotranspiration (ET_0), Piche evaporation in our case.

RESULTS AND DISCUSSION

Piche evaporation

Analysis of the monthly average of the Piche evaporation emphasizes a different situation in every year of the researched period.

In 1999, monthly values had a constant increase from March (3.91 mm/day) to July (7.64 mm/day); after that the values decreased. The biggest variation interval was registered in August. In 2000, the values of the Piche evaporation increased from March (3.55 mm/day) to June (6.76 mm/day), in July a smaller value (6.05 mm/day) was registered, in August the biggest value was determined (7.54 mm/day) and in September the smallest value (2.95 mm/day) was registered. The biggest variation interval of the daily Piche evaporation was registered in August. In 2001, the situation was different, in May a first top of the monthly values was registered and in July, the second; the biggest variation interval was registered in September (table 2).

Table 2

**Piche evaporation values (mm/day) in the solarium conditions,
Husasău de Tinca 1999-2001**

Year	Specification	March	April	May	June	July	August	September
1999	Average	3.91	5.67	5.96	6.33	7.64	5.62	3.10
	Variation interval	3.7-4.1	4.6-6.6	4.8-6.7	5.8-6.7	6.2-8.7	3.8-7.9	2.2-3.4
2000	Average	3.55	5.8	6.49	6.76	6.05	7.54	2.95
	Variation interval	3.1-4.0	4.0-6.9	5.9-7.4	6.1-7.5	5.7-6.4	5.5-8.4	2.0-4.9
2001	Average	3.83	5.06	5.62	5.40	6.44	6.36	3.6
	Variation interval	3.5-4.2	3.7-5.9	5.5-6.5	5.1-5.9	5.7-7.1	6.1-6.9	2.3-5.7
Average	3.76	5.51	6.02	6.16	6.71	6.51	3.22	

The average of the studied period indicates values from 3.76 mm/day in March to 6.71 mm/day in July and a decrease of the Piche evaporation in August (6.51 mm/day) and in September, 3.22 mm/day.

Tomatoes water consumption

For maintaining the soil water reserve on 0-50 cm between easily available water content and field capacity a specifically irrigation regime was used every year: 464 mm/ha and 15 rates in 1999, 591 mm/ha and 19 rates in 2000, 479 mm/ha and 14 rates in 2001. The biggest monthly irrigation rates were registered in July: 139 mm/ha in 1999, 164 mm/ha in 2000 and 125 mm/ha in 2001 (table 3).

Table 3

**Irrigation regime used in tomatoes to maintain the soil water reserve on 0-50cm
between easily available water content and field
capacity in the solarium conditions, Oradea 1999-2001**

Year	March		April		May		June		July		August		September		Total	
	Σm	n	Σm	n	Σm	n	Σm	n	Σm	n	Σm	n	Σm	n	Σm	n
1999	30	1	35	1	82	3	97	3	139	4	102	3	-	-	484	15
2000	30	1	35	1	92	3	101	4	164	5	137	4	32	1	591	19
2001	30	1	31	1	70	3	92	3	125	4	110	2	30	1	479	14
Average	30	1	33.6	1	81	3	97	3	143	4	113	3	21	1	518	16

Total water consumption values were of 669 mm/ha in 1999, of 818 mm/ha in 2000 and 640 mm/ha in 2001. Irrigation was the main source of the water consumption covering. From soil reserve tomatoes used 185 mm/ha, 27.6% from total water consumption. The biggest quantity of water used from soil reserve was registered in 2000, 22.7 mm/ha (27.7% from total water consumption). In 2001, the smallest water quantity, 161.0 mm/ha (25.1% from total water consumption) was registered (table 4).

Table 4

**Total water consumption [$\Sigma(e+t)$] and covering sources in the
tomatoes crop from solarium, Husasău de Tinca 1999-2001**

Year	$\Sigma(e+t)$ mm	Covering sources of the water consumption			
		Soil water reserve		Irrigation	
		mm	%	Mm	%
1999	669	185	27.6	484	72.4
2000	818	227	27.7	591	72.3
2001	640	161	25.1	479	74.9
Average	709	191	26.9	518	73.1

Specific values of the tomatoes' daily water consumption were registered. All the years the maximum value was registered in July: 5.94 mm/day/ha in 1999, 6.58 mm/day/ha in 2000 and 5.29 mm/day/ha in 2001 (table 5).

Table 5

**Daily water consumption of the tomatoes in the condition from the solarium, Husasău
de Tinca**

Year	March	April	May	June	July	August	September
1999	2.92	2.92	3.97	4.47	5.94	3.77	1.6
2000	3.09	3.09	4.42	5.36	6.58	4.35	3.05
2001	2.38	2.38	3.47	4.26	5.29	3.94	1.28
Average	2.8	2.8	3.96	4.70	5.93	4.02	1.98

The correlation between the Piche evaporation and the daily water consumption of the tomatoes

There is a direct link between the daily Piche evaporation and the daily water consumption of the tomatoes. Mathematically, the expression of

this link is $y = 0,3972x^2 - 3,0985x + 8,2299$ and the correlation coefficient is $R^2 = 0,8079$.

Crop coefficient Kc

The values of the crop coefficients Kc for transformation of the Piche evaporation in optimum water consumption have specific values for every month of the studied years. In every year, the biggest value was registered in July: 0.78 in 1999, 1.09 in 2000 and 0.82 in 2001 (table 6).

Table 6

Crop coefficient (Kc) for transformation of the Piche evapotranspiration in tomato optimum evapotranspiration in the solarium conditions, Husasău de Tinca 1999-2001

Year	March	April	May	June	July	August	September
1999	0.75	0.54	0.67	0.71	0.78	0.67	0.52
2000	0.87	0.53	0.68	0.79	1.09	0.58	1.03
2001	0.62	0.47	0.62	0.79	0.82	0.62	0.36
Average	0.75	0.51	0.66	0.76	0.90	0.62	0.64

Irrigation scheduling using the Piche evaporimeter

The use of the Piche evaporimeter in tomatoes' irrigation scheduling in the solarium conditions is based on the monthly chart regarding the soil water balance on the watering depth, 0-50 cm in our case. Soil water reserve must be determined only once in the tomatoes planting day. In the next days of the tomatoes vegetation period, the soil water reserve is obtained by using a calculation method. For example:

- tomatoes plating days: 27.03
- soil water reserve: 141 mm/ha
- Piche evaporation in 27.03 = 3.0 mm/day
- crop coefficient for March = 0.75
- optimum water consumption = $3.0 \times 0.75 = 2.25$

After the calculation, a soil water reserve of tomatoes is obtained at the end of the day 27.03. This example is presented below:

BALANCE CHART

Month: March

Crop: tomato; Watering depth=0-50 cm; Easily available water content=138.6 mm/ha; Field capacity=176.4 mm/ha; Irrigation rate=37.8 mm/ha;

Day	Initial reserve	Irrigation	Total in the soil	Piche evaporimeter	Kc	$\Sigma(e+t)$ for tomatoes	Final water reserve	Irrigation datum
27	141	-	141	3.8	0.75	2.85	138.15	28.03
28	138.15	37.8	175.95	4.2	0.75	3.15	172.8	-
29	172.8	-	172.8	4.6	0.75	3.0	169.8	-
30	169.8	-	-	-	-	-	-	-

CONCLUSIONS

Piche evaporimeter can be used in the irrigation scheduling of the tomatoes crop from the solarium because the relation between the daily Piche evaporation and tomatoes' water consumption is statistically assured.

Three evaporimeters placed in the middle of the solarium are recommended. The height of the evaporimeter's place is 1.7 m.

Piche evaporimeter use in the irrigation scheduling of the tomatoes is based on the soil water balance of 0-50 cm and on the use of the specific crop coefficient Kc. In average of the period 1999-2001, the values of the crop coefficient are: 0.75 in March, 0.51 in April, 0.66 in May, 0.76 in June, 0.90 in July, 0.62 in August and 0.64 in September.

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