UDC: 635.649-167.4(497.711)"2005/2007)
Original scientific paper

DETERMINATION OF EVAPOTRANSPIRATION UNDER DIFFERENT IRRIGATION AND FERTILIZATION TECHNIQUES IN GREEN PEPPER CROP PRODUCTION

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Abstract
The field experiment was conducted with green pepper crop *Bela dolga* grown in experimental plastic house near by the Faculty of Agricultural Sciences and Food in Skopje, during the period of May to October in 2005, 2006 and 2007. The main aim of this investigation was to determine evapotranspiration (ETP) in two-stem pruned ("V"system) green pepper crop under different irrigation and fertilization techniques and regimes. Also, the evapotranspiration coefficient was determined during this investigation, which can be used as parameter for indirect calculation of total crop water requirements during the vegetation. Therefore, four experimental treatments were applied in this study. Three treatments were irrigated by drip irrigation and drip fertigation (KK1, KK2, KK3), while the last one was irrigated by furrow irrigation with conventional application of fertilizer (control treatment $Ø_B$). From the average results obtained in three years of investigation, it can be concluded that there are negligible differences in ETP and ETk between the treatments KK1 and KK2 (drip fertigation every 2 and 4 days), what is result of closer irrigation interval of these two treatments. As a result of longer frequencies between the irrigations, the treatment KK3 (drip fertigation scheduled by tensiometers) showed 4,5-5,5% higher evapotrasnpiration in comparison with KK2 and KK1, and from 24 to 25,5% higher ETk in comparison with KK1 and KK2. The results for ETP and ETK in treatments KK1 and KK2 showed statistically significant differences in comparison with treatment KK3. The effect of the irrigation and fertilization techniques on evapotranspiration and ETk are presented by the results from the treatment KK3 and $Ø_{B.}$ Namely, the control treatment showed 15% higher ETP, or almost 30% ETk in comparison with KK3. The results are statistically significant at 0,01 level of probability.

Key words: potential evapotranspiration, evapotranspiration coefficient, drip fertigation, furrow irrigation, green pepper.

Introduction

Evapotranspiration represents the water loss from a combined surface of vegetation and soil (Hatfield *et al.*, 1990). Generally, evapotranspiration (ET) is referred as a combination of two separate processes whereby water is lost from the soil surface by evaporation and from the crop by transpiration. Evaporation and transpiration occur simultaneously and there is no easy way of distinguishing between the two processes. Apart from the water availability in the topsoil, the evaporation from a cropped soil is mainly determined by the fraction of the solar radiation reaching the soil surface. This fraction decreases over the growing period as the crop develops and the crop canopy shades more and more of the ground area. When the crop is small, water is predominately lost by soil evaporation, but once the crop is well developed and completely covers the soil, transpiration becomes the main process (Allen *et al.*, 1998).

The term potential evapotranspiration (ETP) was introduced by Thornthwaite in 1948, and was defined as the maximum rate of water loss by crop through the transpiration and evaporation under ideal conditions of soil moisture and vegetation. In natural conditions, evapotranspiration is presented by ETa, or actual evapotranspiration (Iljovski, 1992; Iljovski and Cukaliev, 1994; Bošnjak, 1999). The evapotranspiration rate from a reference surface, not short of water, is called the reference crop evapotranspiration or reference evapotranspiration and is denoted as ETo. The reference surface is a hypothetical grass reference crop with specific characteristics.

As is well known, the factors who affects of the evapotranspiration are: weather parameters, crop characteristics, soil conditions, irrigation techniques, applied agro-technical measures, etc. Allen *et al.*, (1998) reported that the only factors affecting ETo are climatic parameters. Consequently, ETo is a climatic parameter and can be computed from weather data. ETo expresses the evaporating power of the atmosphere at a specific location and time of the year and does not consider the crop characteristics and soil factors. The FAO Penman-Monteith method is recommended as the sole method for determining ETo.

Crop evapotranspiration can be measured or calculated using a variety of approaches. Generally, in irrigation practice, the methods for measuring and estimation of ET can be classified as direct and indirect methods (Evett, 2007; Howell and Meron, 2007; Iljovski and Cukaliev, 2002; Dragović, 2000; Bošnjak, 1999). The indirect methods are based on empirical and mathematical models, where the climatic parameters are of primary importance, and most of them do not consider the crop characteristics or soil factors. Therefore, for greater precision the direct methods are characterized, because most of them simulate natural conditions or ET is determined directly in the field. The most used direct methods in irrigation practice for measuring of ETP are lysimeters, soil water balance method, method of field conditions with experimental trials and etc. (Iljovski and Cukaliev, 2002; Dragović, 2000; Bošnjak, 1999). Therefore, the main objectives of this study were to determine and compare evapotranspiration (ETP) under different techniques and regimes of irrigation and fertilization in green pepper crop production in Skopje region and to evaluate evapotranspiration coefficient as affected by methods of application of water and fertilizers. The determination of crop evapotranspiration in our investigation was realized by soil water balance method.

Material and methods

The field experiment was conducted with two-stem pruned (“V” system) green pepper crop ‘Bela dolga’ grown in experimental plastic house near by the Faculty of Agricultural Sciences and Food in Skopje (42^{o} 00' N, 21^{o} 27' E), during the period of May to October in 2005, 2006 and 2007. The soil type is coluvial (deluvial) soil (FAO Classification) disturbed with urban activities. The soil chemical characteristics of the experimental field are presented in Table 1.

Table 1. Soil chemical characteristics of the experimental field

Layer cm	$CaCO_3$ %	Organic matter %	pH		ECe dS/m	Available N mg/100 g soil	Available forms mg/100 g soil	
			H_2O	KCl			P_2O_5	K_2O
0-20	3,24	0,90	8,02	7,30	2,40	3,10	17,79	32,15
20-40	3,80	0,84	8,08	7,26	2,28	2,47	13,36	19,38
40-60	3,59	0,56	8,03	7,35	2,25	2,80	8,40	16,10

According to the recommendations and literature data for the region (Maksimović, 2002; Lazić *et al.*, 2001; Jankulovski, 1997), green pepper planted in our condition and yields up to 60 t/ha, needs the following amount of nutrients: N 485 kg/ha, P_2O_5 243 kg/ha and K_2O 585 kg/ha. The application of the fertilizer for the treatments was done in two portions (before planting and during the growing season), what is common practice in our country. For all treatments, the first portions of the fertilizers was done before planting of green pepper, while the rest of the fertilizers needed for achieving the targeted yield was applied through the fertigation system for drip fertigation treatments (Table 2) and conventional fertilization on soil for control treatments (spread in two portions, flowering and fruit formation). All investigated treatments have received same amount of fertilizers, but with the different methods and frequencies of application of water and fertilizers. The idea was to investigate the influence of irrigation and fertilization method on ET and ETk in green pepper crop production.

Table 2. Type and amount of fertilizers in drip fertigation

N 485	P_2O_5 243	K_2O585	kg/ha	N:P:K	
		48	318 kg/ha	15:15:15	before replanting
/	195	128	375 kg/ha	0:52:34	drip fertigation
/	/	411	802 kg/ha	0:0:51+18S	drip fertigation
437	/	/	952 kg/ha	46:0:0	drip fertigation
485	243	585			

Remark: the same amounts and quantity of fertilizers were used for furrow irrigation treatment

The fertigation equipment for drip fertigation treatments was Dosatron 16, with a plastic barrel as reservoir for concentrated fertilizer. The whole amount of fertilizer was dissolved in the barrel and barrel was sealed to avoid evaporation of the water. The source of water was the water supply system for the city of Skopje (very high quality of water).The irrigation of the experiment (treatment KK1, KK2 and $Ø_B$) was scheduled according long-term average daily evapotranspiration for green pepper crop for Skopje region (Table 3). Long term average evapotranspiration was calculated by FAO software CROPWAT for Windows 4.3 using crop coefficient (kc) and stage length adjusted for local condition by Faculty of Agricultural Sciences and Food. Because the use of drip irrigation and application of the water was only on part of the total surface, the daily evapotranspiration of drip irrigation treatments was decreased for 20% (coefficient of the coverage). In each experimental year, the irrigation and fertigation regime have occurred from 20-25 May until

10-15 October. The irrigation scheme used in the experiment was designed according to randomized block design for experimental purposes with four treatments in three replications.

Table 3. Daily and monthly crop water requirements for green pepper crop for the Skopje region

Months	V	VI	VII	VIII	IX	X
mm/day	1.9	3.6	5.5	5.0	3.7	1.8
mm/monthly	59	108	171	155	111	54

Generally, the experimental treatments were set up according to the daily evapotranspiration rate. The idea was to investigate not only irrigation and fertilization techniques, but also irrigation and fertilization frequency and their effect on ETP and ETk.

Treatment 1 (KK1): Drip fertigation according to daily evapotranspiration with application of water and fertilizer every two days;

Treatment 2 (KK2): Drip fertigation according to daily evapotranspiration with application of water and fertilizer every four days;

Treatment 3 (KK3): Drip fertigation according to tensiometers measurements;

Treatment 4 ($Ø_B$): Furrow irrigation according to daily evapotranspiration with application of water every seven days and classic fertilization (spreading of fertilizer on soil).

The size of each plot (replication) was 6.6 m^2 (25 plants in 0.75 m of row spacing and 0.35 m plant spacing in the row). Each plot (replication) was designed with five rows of crop. There were five plants in each row.

The crop evapotranspiration was determined by direct measurement with soil water balance method at soil layer 0-100 cm depth (Tanaskovic *et al.*, 2006; Dragović, 2000; Bošnjak, 1999; Allen *et al.*, 1998; Cukaliev, 1996). The method consists of assessing the incoming and outgoing water flux into the crop root zone during the vegetation. In our investigation, the main parameters for estimation of ETP were irrigation (I) and initial or active soil moisture at the beginning of vegetation (Wi) as incoming water flux and active soil moisture on the end of vegetation (We) as potential outgoing water flux. As was mentioned above, our investigation was realized in experimental plastic house, where precipitations (P) were ignored. Also, as a result of controlled irrigation practice, surface runoff (RO) and deep percolation (DP) were excluded from this estimation. The subsurface water and water transported upward by capillary rise (CR) didn't have influence on water income in the root zone, and they were ignored. Therefore, crop evapotranspiration (ETP) was determinate under equation ETP = (I+Wi)-We. The crop evapotranspiration coefficient ETk was estimated as ratio between ETP and dry matter yield. Collected data were subjected to statistical analysis of variance and means were compared using the least significant difference (LSD) at the 1 and 5% level of probability ($P<0.01$ and $P<0.05$) test.

Results and discussion

The meteorological conditions during the research

The pepper crop has exceptional requirements according to the climatic conditions. If climatic conditions are unfavorable or if they vary, the productivity and yield of the pepper crop can be significantly decreased. The pepper crop needs a lot of heat during whole growing period, what is connected with its native place of origin, the tropical zone (Gvozdenović, 2004; Jankulovski, 1997).

If the temperature is below 15^{o}C, there are possibilities to increase the falling of flowers (Gvozdenović, 2004; Lazić *et al.*, 2001). Also, the flowers and fruits can fall if the temperature goes up to 35^{o}C (Đurovka *et al.*, 2006). The optimal temperature for growing of pepper in controlled environment is 20-25^{o}C during the day time and 18-20^{o}C during the night (Đurovka *et al.*, 2006). Bosland and Votava (2000) reported that the best pepper yields can be obtained when the air temperature during the day time is between 18-32^{o}C, especially in the stage of fruit formation. The average seasonal temperature in our investigation for the experimental plastic house (average in the growing period) during 2005, 2006 and 2007 was 22.83^{o}C, 22.95^{o}C and 24.1^{o}C respectively (Table 4). During the period of the biggest fructification (June-August) the average temperature in all three years was in the frame of the optimum values recommended by Bosland and Votava (2000).

Table 4. Monthly average air temperature (^{o}C) in Skopje region (according to the National Hydro-meteorological Service) and in the experimental plastic house (by our measurements), during the green pepper vegetation

Year / Months	Average temperature (^{o}C) in Skopje region			Average temperature (^{o}C) in the experimental plastic house		
	2005	2006	2007	2005	2006	2007
V	18,0	17,8	18,6	20,9	20,5	21,6
VI	20,9	20,6	23,9	24,1	23,6	27,1
VII	24,1	23,4	27,1	28,2	27,2	31,0
VIII	22,1	23,3	25,1	26,1	26,9	28,9
IX	19,1	19,5	17,7	22,2	22,7	20,6
X	12,7	14,0	12,7	15,5	16,8	15,4
Average	19,48	19,77	20,85	22,83	22,95	24,10

Generally, pepper crop has great crop water requirements during the vegetation period, which is the result of the poorly developed root system and huge biomass exposure to strong transpiration (Lazić *et al.*, 2001; Jankulovski, 1997; Iljovski and Cukaliev, 1994). It is well known that pepper crop is most sensitive to water shortage (drought) during the flowering and fruit formation. The Skopje area in that period is characterized with highest temperatures and insolation, so the evapotranspiration is at its highest rate. Usually rainfalls are down to a minimum in that period.

Data presented in Table 5 shows that all three years of testing were characterized as very wet years with a lot of rainfall in the growing season. As was mentioned above, our testing was conducted in a controlled environment (plastic house), where water income does not have any influence on the crop evapotranspiration, which means that the total water income was presented by irrigation water requirements (almost 75%) and initial or active soil moisture at the beginning of vegetation (almost 25%).

For normal pepper crop growing and for high and quality yields, the optimal relative humidity should range from 60 to 70%. Gvozdenović (2004) reported that lower relative air humidity followed by high temperature can affect flower and fruit falling. Jankulovski (1997) reported that relative air humidity in plastic houses should be around the 70%.

With the exception of October, the average relative humidity during all three years of our investigation was close to recommended values for the plastic houses.

Data for relative air humidity during the investigation are shown in Table 6.

Table 5. Monthly precipitation (mm) in Skopje region

Year	2005	2006	2007
Months	Precipitation (mm)	Precipitation (mm)	Precipitation (mm)
V	72,4	19,2	96,2
VI	38,4	94,7	34,8
VII	36,9	39,0	1,2
VIII	73,3	29,2	52,7
IX	34,2	43,3	27,2
X	50,1	56,9	140,0
Average	305,3	282,3	352,1

In any case, it should be pointed out that our investigation was realized in a controlled environment of an elementary type (plastic house), where the temperature and relative air humidity were heavily controlled and regulated, only with manual opening of side vents. In this relation, Jankulovski (1997) reported that regulation of microclimate condition in plastic houses is harder than in green houses.

Table 6. Monthly average relative humidity (%) in Skopje region (according to National Hydro-meteorological Service) and in the experimental plastic house (by our measurements), during the green pepper vegetation

Year / Months	Average relative humidity (%) in Skopje region			Average relative humidity (%) in the experimental plastic house		
	2005	2006	2007	2005	2006	2007
V	63	59	65	72	74	73
VI	56	64	56	63	71	61
VII	55	59	38	60	63	53
VIII	65	57	51	71	60	60
IX	68	60	58	74	66	68
X	71	70	75	81	80	83
Average	63	61,5	57,2	70,2	69	66,3

Influence of irrigation and fertilization techniques on ETP, ETk and green pepper yield

As was mentioned above, the crop evapotranspiration (ETP) was determined by direct measurement with soil water balance method at soil layer 0-100 cm depth, under permanent content of soil moisture and nutrients, as well as permanent agro-technical measures. The water balance method in our investigation was realized by assessment of the water income and active soil moisture at the end of vegetation into the crop root zone. The water income was estimated through the irrigation water requirements and initial or active soil moisture at the beginning of vegetation. Irrigation water requirement for the treatments KK1, KK2 and $Ø_B$ is presented as water quantity applied during the vegetation (read on the volumetric meter); with periodic soil samplings for controlling of momentary soil moisture and realized irrigation regime. The irrigation water requirement for the treatment KK3 was obtained by tensiometers readings installed in the soil. The Initial or active soil moisture at the beginning of vegetation is presented as the difference between field capacity (FC) and permanent wilting point (PWP). Cukaliev (1996) has calculated initial or active soil moisture at the beginning as a difference between momentary soil moisture and permanent wilting point, but in our case we refilled the soil moisture up to field capacity before starting with the irrigation regime. The active soil moisture at the end of vegetation is calculated as a difference between momentary soil moisture at the end of vegetation and permanent wilting point. The difference between water income (irrigation water requirements and active soil moisture at the beginning) and active soil moisture at the end of vegetation is the potential evapotranspiration. The results for water balance and ETP, separately by year of investigations are presented in Table 7, 8 and 9. From the results shown in Table 7, it can be concluded that the content of active soil moisture at the end of vegetation in the treatments KK1 and KK2 is from 53 to 71% higher in comparison with KK3.

Table 7. Water balance and ETP (m^3/ha) for 2005

Treatment	Wi	I	Total income	We	ETP	Comparison with KK1 (%)	Comparison with KK2 (%)
KK1	1824	4882	6706	1903	4803	100	102,3
KK2	1824	4999	6823	2126	4697	/	100
KK3	1824	4510	6334	1242	5092	106,0	108,4
$Ø_B$	1824	5819	7643	1829	5814	121,1	123,8

The main reason for higher content of active soil moisture at the end of vegetation in the treatments KK1 and KK2 is irrigation application rates scheduled according to the average daily evapotranspiration with continuous keeping of soil moisture in the frame of field capacity (short irrigation frequencies, 2 or 4 days). Tanaskovik *et al.*, (2006) reported similar results in drip fertigation treatments at two and four days in tomato crop production. On the other hand, the treatment with tensiometers readings (KK3) and drip irrigation frequency every 8 or 10 days (which is not the typical frequency for drip irrigation), presented lower active soil moisture at the end of vegetation. Generally, it can be concluded that the final irrigation application rates (2-3 rates) at the end of vegetation in the treatments KK1 and KK2 couldn’t be applied, in order to decrease the participation of irrigation water requirement (I) in total water income, without negative effects on the yields. If the results for ETP in 2005 are presented in comparative values, then potential evapotranspiration in the treatments KK2 and KK1 is lower by 23,8 and 21,1 % in comparison with $Ø_B$, while in comparison with KK3 ETP it is about 8,4 and 6% lower.

Table 8. Water balance and ETP (m^3/ha) for 2006

Treatment	Wi	I	Total income	We	ETP	Comparison with KK1 (%)	Comparison with KK2 (%)
KK1	1824	4517	6341	1548	4793	100	102,3
KK2	1824	4543	6367	1680	4687	/	100
KK3	1824	4176	6000	1100	4900	102,2	104,5
$Ø_B$	1824	5328	7152	1512	5640	117,7	120,3

In 2006, as result of proper controlling of the final irrigation application rates, the active soil moisture at the end of vegetation in the treatments KK1 and KK2 was lower by 22,9 to 26,5% when compared to the previous year. The potential evapotranspiration in treatments with drip fertigation was lower by 15 to 20,3 % compared to the treatment with furrow irrigation and spreading of fertilizers.

The decreasing trend of active soil moisture at the end of vegetation continued in following year, which can be connected to a higher temperature in comparison with 2005 and 2006. Also, the results for potential evapotranspiration in all treatments are connected with the temperature. Various researchers indicate the direct influence of temperature on ET (Evett 2007; Iljovski and Cukaliev 2002; Allen *et al.*, 1998; Doorenbos *et al.*,1986; Doorenbos *et al.*, 1984). Namely, the results for ETP in 2007 are almost for 275 to 543 m^3/ha higher compared with 2006, when the least evapotranspiration was registered.

Table 9. Water balance and ETP (m^3/ha) for 2007

Treatment	Wi	I	Total income	We	ETP	Comparison with KK1 (%)	Comparison with KK2 (%)
KK1	1824	4550	6374	1306	5068	100	/
KK2	1824	4716	6540	1400	5140	101,5	100
KK3	1824	4489	6213	880	5333	105,2	103,6
$Ø_B$	1824	5517	7331	1142	6189	122,1	120,4

Table 10. Average results for ETP, yield and ETk, for all three years of investigation

Treatment	ETP m^3/ha	ETP comparison with KK2 (%)	Yield (t/ha)	D.M. yield (t/ha)	ETk	ETk comparison with KK1 (%)
KK1	4888	101	73,15	12,24	399,3	100
KK2	4842	100	69,18	11,98	404,2	101,2
KK3	5108	105,5	63,42	10,19	501,3	125,5
$Ø_B$	5881	121,5	56,99	9,07	648,4	162,4
LSD: 0,05	56,45		1,80	0,72	34,09	
LSD: 0,01	76,16		2,43	0,98	46,85	

From the results presented in Table 10, it can be concluded that there are negligible differences in ETP and ETk between the treatments KK1 and KK2 (drip fertigation every 2 and 4 days), what is a result of closer irrigation interval of these two treatments. Statistically, there is no significant difference in ETP and ETk between treatment KK1 and KK2. So, in this case, the decision for the frequency of drip fertigation in a range of two to four days should be made according to the yield, not according to the ETP and ETk. Drip fertigation frequency every two days achieves a yield that is significantly higher than the yield if fertigation is applied with four day frequency (KK2). Bar Yosef (2003) reported better pepper yields in treatment with drip fertigation 2 or 3 times a day (71 t/ha) compared with every day (68 t/ha) or every 2 day drip fertigation (66 t/ha). Also, various researches reported better yields in pepper and other crops by using of high-frequency surface drip irrigation and fertigation in comparison with low frequency surface drip irrigation and fertigation (Tanaskovik, 2011; Iljovski *et al.*, 2003; Tekinel and Kanber, 2002; Phene, 1995; Oğuzer *et al.*, 1991; Topçu 1988). On the other hand, as a result of longer intervals between the applications, the treatment KK3 (drip fertigation scheduled by tensiometers) showed 4,5-5,5% higher evapotrasnpiration in comparison with KK2 and KK1, and from 23,9 to 25,5% higher ETk in comparison with KK1 and KK2. The results for ETP and ETK in treatments KK1 and KK2 showed statistically significant differences in comparison with treatment KK3. According to the results of the average green pepper crop yields presented in Table 10, it is clear that the high drip fertigation frequency create better environment for increasing of yields in comparison with low drip fertigation treatment (KK3). So, our results show that the time difference between two applications of water and fertilizers higher than four days will significantly decrease the yield and increase ETP and ETk of green pepper crop due to increased water stress. Metin Sezen *et al.*, (2006) in their investigations with different irrigation regime in pepper crop, reported the best yield in the treatment with drip irrigation frequency of 3 to 6 days with average ET from 519,5 mm, while in the drip irrigation treatment with irrigation frequency from 6 to 11 days and 9-15 days yield and water use efficiency decrease. Doorenbos *et al.* (1986) reported that prolonged water deficit limits growth and reduces yields in tomato crop.

The effect of irrigation and fertilization techniques on ETP is presented by the achieved results in treatments KK3 (drip fertigation with tensiometers readings) and $Ø_B$ (furrow irrigation and spreading of fertilizers). Namely, in almost the same irrigation intervals, the treatment KK3 obtained almost 15% lower ETP compared with $Ø_B$, which is a result of the application of fertilizers through the drip irrigation system. The results are statistically significant at 0,01 level of probability. Also, the drip fertigation treatment showed a statistically significant higher yield compared with furrow irrigation and spreading of fertilizer. The effect of the drip fertigation can be explained by the fact that with drip fertigation the root zone is simultaneously supplied with water and readily available nutrients. Haynes (1985) reported that if nutrients are applied outside the wetted soil volume they are generally not available for crop use. Hagin *et al.*, 2002 reported that in a fertigation system, the timing, amounts, concentrations and ratios of the nutrients are easily controlled and compared by a conventional fertilizer application and irrigation. Dasberg and Or (1999) reported that increased yields using drip irrigation can be attributed to several factors: higher water use efficiency because of precise application directly to the root zone and lower losses due to reduced evaporation, runoff and deep percolation; reduced fluctuations in the soil water content resulting with avoidance of water stress etc. A number of other investigators give reports with higher yields, efficient use of water and fertilizers and lower ETP in different crops when fertilizers were injected through the drip system in comparison with conventional application of fertilizers (Tanaskovik *et al.*, 2011; Cukaliev *et al.*, 2008; Tanaskovik *et al.*, 2006; Halitligil *et al.*, 2002; Al-Wabel *et al.*, 2002; Castellanos *et al.*, 1999; Petrevska K. J. 1999; Papadopoulos, 1996).

The total dry matter yield in drip fertigation treatments, show the same pattern as a fresh fruit yield. The results are statistically significant at 0,01 level of probability. Halitligil *et al.*, (2002) reported that with the same quantity of fertilizer but different methods of application, drip fertigation shows higher dry matter yield in comparison with treatment with spreading of fertilizers on soil.

The positive effect of drip fertigation on ETk is presented by the differences between the treatments KK3 and $Ø_B$. From the results, it can be concluded that the treatment KK3 has an almost 30% lower ETk coefficient in comparison with furrow irrigation and spreading of fertilizers on the soil. The average ETk coefficient achieved in treatments KK1 and KK2 are pretty close to average transpiration coefficient of 330 presented by Lazić *et al.*, (2001). Tanaskovik (2005) and Petrevska (1999) achieved a lower ETk coefficient in tomato crop with drip fertigation in comparison with furrow irrigation and spreading of fertiliser.

Generally, the obtained results for ETP in our investigation are lower than those recommended by Iljovski and Cukaliev (1994), from 7000 to 8000 m^3/ha and Doorenbos *et al.*, (1986), from 600 to 900 mm. This is a result of the proper and controlled irrigation and fertilization regime during all three years of investigation, especially in drip fertigation treatments. It is important to mention that our results are connected to proper water management in agricultural production, especially in the forthcoming period when the climate changes are expected to have an influence on water resources in our country.

Conclusions

The least average potential evapotranspiration (ETP) is achieved in the treatments with drip fertigation at 2 (4888 m^3/ha) and 4 days (4842 m^3/ha). Statistically, there is no significant difference. On the other hand, as a result of longer intervals between the applications, the treatment KK3 (drip fertigation scheduled by tensiometers) showed 4,5-5,5% higher evapotrasnpiration in comparison with KK2 and KK1. The results for ETP in the treatments KK1 and KK2 showed statistically significant differences in comparison with treatment KK3 (5108 m^3/ha). The effect of irrigation and fertilization techniques on ETP is presented by the achieved results in treatments KK3 and $Ø_B$. Namely, in almost the same irrigation intervals, the treatment KK3 obtained almost 15% lower ETP compared with $Ø_B$ (5881 m^3/ha), which is a result of the application of fertilizers through the drip irrigation system. The results are statistically significant at 0,01 level of probability.

The highest average yields are achieved in treatments KK1 and KK2 with 71,11 t/ha and 68,40 t/ha, while in treatment KK3 the average yield was almost 6-9 t/ha lower (62,61 t/ha). The results are statistically significant at 0,01 level of probability. It is clear that the high drip fertigation frequency creates a better environment for increasing of yields in comparison with low drip fertigation treatment. The least average yield is achieved in treatment $Ø_B$ (54,74 t/ha). The treatments with drip fertigation statistically showed a significantly higher yield compared with furrow irrigation and spreading of fertilizer. Also, the total dry matter yield in drip fertigation treatments, show the same pattern as a fresh fruit yield. The results are statistically significant at 0,01 level of probability.

The treatments KK1 and KK2 show the best ETk coefficient or 400 in average. The highest ETk was achieved in treatment $Ø_B$ almost 650, which is a result of improper irrigation and fertilization technique. The positive effect of drip fertigation on ETk is presented by the differences between the treatments KK3 and $Ø_B$. From the results, it can be concluded that the treatment KK3 has an almost 30% lower ETk coefficient in comparison with $Ø_B$. Statistically, the results are significant at 0,01 level of probability.

Generally, the obtained results for ETP and ETk in our investigation are lower than those recommended by the literature. This is as result of the proper and controlled irrigation and fertilization regime during all three years of investigation, especially in drip fertigation treatments. It is important to mention that our results are connected to proper water management in agricultural production, especially in the forthcoming period when the climate changes are expected to have an influence on water resources in our country.

Finally, from our research we can conclude that the optimal frequency for irrigation and fertigation of green pepper crop in similar conditions is from two to four days. The final decision of the frequency of drip fertigation in a range of two to four days should be done according to the yield, not according to the ETP and ETk.

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