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ARAŞTIRMA MAKALESİ RESEARCH ARTICLE

Comparison of response of soybean irrigated by surface and subsurface drip irrigation method to deficit irrigation using canopy temperature under the Mediterranean conditions

Akdeniz koşullarında yüzey ve yüzeyaltı damla sulama yöntemi ile sulanan soya fasulyesinin sulama açığına tepkisinin taç sıcaklığı kullanılarak karşılaştırılması

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Ö Z E T / A B S T R A C T

Aims: Irrigation water use efficiency is an important issue for both agricultural production and optimization of water resources in arid and semi-arid regions where water resources are limited. Surface drip irrigation (DI) is used in most of these areas. However, subsurface drip irrigation (SDI) has become widespread in recent years. Therefore, the effects of SDI method on the plant and contributions on the water saving should be examined and compared with the DI method in different plant and climate conditions. The aim of this study was to compare the effects of surface drip (DI) and subsurface drip irrigation (SDI) methods on canopy temperature measured with infrared thermometer and to evaluate deficit irrigation effects on soybean grown at the Batı Akdeniz Agricultural Research Institute (BAARI), Antalya, Turkey in 2017.

Methods and Results: The study was designed in a randomized complete block design to include two irrigation methods (surface drip (DI) and subsurface drip irrigation (SDI)) and four different irrigation treatments (0%, 60%, 80%, and 100%) in three replications. The canopy temperatures were measured by an infrared thermometer between 12:00 and 15:00 hours before and after irrigation.

Conclusions: The results showed that the canopy temperatures of the plants irrigated with the SDI method throughout the season were up to 2.5°C lower than the DI method. Also, the yield values obtained from the SDI method (439.1 kg da^{-1}) were statistically higher than DI method (395.2 kg da^{-1}). When compared to the DI method, a water saving of approximately 78.3 mm was obtained in SDI method.

Significance and Impact of the Study: It was determined that the canopy temperatures of soybean irrigated with SDI method were lower compared to the DI method. In addition, there was a high level of exponential relationship and negative correlation between canopy temperatures and yield, applied irrigation water and evapotranspiration in both irrigation methods.

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INTRODUCTION

Global warming and drought is the most important environmental factor that limits plant development and reduces vegetative production in agricultural areas in Mediterranean regions. This factor also adversely affects the limited water resources of the world. In the Mediterranean Region, which is one of the most affected areas by global warming, it is aimed to reach the maximum efficiency of the use of irrigation water for improvement of agricultural production and optimization of water resources. Irrigation systems should be properly managed to achieve maximum efficiency in irrigation water use. Use of subsurface drip irrigation (SDI) method can provide an improvement in irrigation water use efficiency.

Drip irrigation method (DI) is constantly changing with the development of technology. Subsurface drip irrigation (SDI) which is a different form of drip irrigation, generally defined as the application of water below the soil surface through emitters with discharge rates in the same as drip irrigation (ASAE 2001). The SDI method directly delivers water to the root zone of the plant, so the soil surface does not wet and thus the loss of evapotranspiration is considerably reduced. As SDI reduces surface evaporation, it saves water and at the same time increases the yield and quality of the plant by reducing the risk of weeds and diseases (Camp 1998; Lamm *et al.* 2003; Payero *et al.* 2005; Reich *et al.* 2009). These properties make advantageous to use SDI. SDI applications were found suitable for a large number of crops (Camp 1998). Researches on crops to evaluate the effect of SDI on yield showed that crop yield obtained from SDI method were equal or greater than crop yield obtained from DI method (Phene *et al.* 1987; Camp 1998). The advantages and disadvantages of using subsurface drip irrigation should be investigated in different plants and climatic conditions, their effects on yield and their contribution to water saving by applying deficit irrigation should be examined.

Evaluating the water situation in the plant is important both for the yield of the crop and for the efficient use of water resources in agriculture. Furthermore, it is advantageous to know the crop water status for irrigation scheduling, since crops respond to both the soil and aerial environment (Yazar *et al.* 1999). Infrared thermometers are fast and reliable tools that measure the canopy temperature of the crop and provide information on the water status (Hatfield 1990). When a plant is under stress due to lack of water, it tends to close the stomata to decrease transpiration leading to an increase in canopy temperature. Canopy temperature, under both water stress and no stress conditions, may provide information on crop water status and proper irrigation management (Idso *et al.* 1981; Jackson *et al.* 1981; Hatfield 1990).

Soybean, which is one of the most important legumes, contains a high percentage of protein and increase soil characteristics through its ability of root nodulation. In Turkey, soybean planted area and production are 352947 da and 150000 tons, respectively (TUİK 2020). Due to insufficient soybean production, thousands of tons of oil and oil seeds are imported every year. In 2016, about 2.3 million tons of soybean and 10 thousand tons of soybean oil were imported (Kıllı and Beycioğlu 2019). Quality of soybean production should be improved and different management technologies should be developed. Irrigation scheduling is the most important application that increases the yield and quality of plants. Canopy temperature, measured by an infrared thermometer, is an important parameter used in the management of irrigation water.

Nielsen (1990) used the canopy temperature values obtained by using an infrared thermometer for irrigation scheduling for the soybean plant. Tekelioğlu *et al.* (2017) demonstrated that infrared thermometer can be used to schedule irrigation of the soybean plant under Mediterranean (Antalya) conditions of Turkey. Evett *et al.* (2000) compared threshold-time canopy temperature combinations for irrigation scheduling with manually operated irrigation scheduling using three irrigation rates (33%, 67% and 100% of meeting full crop ET) in corn and soybean. They concluded that threshold canopy temperature treatments have generally higher or similar yield compared to manually operated irrigation treatment.

Although there are many studies evaluating the effects of DI method on the characteristics of soybean (Evett *et al.* 2000; Payero and Irmak 2006; Candogan *et al.* 2013; Irmak *et al.* 2014; Ospanbayev *et al.* 2017; Tekelioğlu *et al.* 2017) studies on the use of SDI method is lacking. These two methods should be compared with each other to determine which irrigation method increases yield and quality and saves water. These methods should also be evaluated in terms of canopy temperature for possible use in crop water stress studies.

The aim of this study was to compare the effects of surface drip (DI) and subsurface drip irrigation (SDI) methods on canopy temperature measured with infrared thermometer in soybean grown at Batı Akdeniz Agricultural Research Institute (BAARI), Antalya, Turkey.

MATERIALS and METHODS

The study was carried out between August and October 2017 at Batı Akdeniz Agricultural Research Institute

(BAARI), Antalya, Turkey. The research station was located at a latitude of 36° 52’ N, a longitude of 30° 50’ E, and an altitude of 28 m. The physical and chemical characteristics of soil were presented in Table 1. Average meteorological data during the experimental period and long-term measurements in Antalya were given in Table 2.

Table 1. Physical and chemical characteristics of the soil

Depth (cm)	Sand (%)	Clay (%)	Silt (%)	Texture	$CaCO_3$ (%)	EC (dS m^{-1})	pH	Field Capacity (g g^{-1})	Permanent Wilting Point (g g^{-1})	Bulk Density (g cm^{-3})
0-30	13	44	43	Clay Loam	25.6	0.103	8.3	0.23	0.13	1.31
30-60	13	40	47	Clay Loam	24.8	0.108	8.3	0.24	0.11	1.38
60-90	13	38	49	Loam	23.7	0.156	8.4	0.22	0.12	1.43

Table 2. Monthly mean climatic data throughout the growing season of the soybean at the experimental site for long-term and the experimental year

Years	Months	Temperature (°C)	Rainfall (mm)	Evaporation (mm)	Wind (m sn^{-1})	Relative humidity (%)
1954-2015	June	25.5	7.6	177.5	1.9	55.2
	July	28.3	3.4	195.5	1.9	54.3
	Aug.	28.2	1.8	172.4	1.7	56.7
	Sep.	24.4	12.3	134.4	1.8	58.8
	Oct.	20.0	80.1	150.6	2.0	61.0
2017	June	26.3	-	125.6	1.8	63.1
	July	30.5	-	161.1	1.9	57.4
	Aug.	29.0	-	155.2	1.9	64.4
	Sep.	26.9	-	137.3	1.8	62.8
	Oct.	22.2	12.6	111.5	1.7	53.2

The salinity of the water used in the irrigation was 0.561 dS m^{-1} and pH 7.3. ATAEM-7 cultivar was used as the crop material in the study. Soybean seeds were planted 70 cm apart between rows, 10 cm in rows at a depth of 5-6 cm in 14 July 2017. In sub-surface drip irrigation, laterals were placed at a depth of 40 cm below the soil surface. The canopy temperatures were measured daily by an infrared thermometer (Spectrum Technologies Inc.) at a field of view of 45º between 12:00 and 15:00 hours, from four directions (East, West, North, and South) in each plot. In the experiment, a total of twelve irrigation applications were made based on the treatments, seven of which were in the period of canopy temperature measurement. In order to determine the crop canopy temperatures properly, it was started to measure when the plant height reached 100 cm for full irrigation treatment. In order to determine the effect of different irrigation methods on the canopy temperature of soybean, canopy temperature measurements were made eleven times during the growing season, at the beginning of irrigation, at the end of irrigation, and in the middle of two irrigation applications.

Table 3. Irrigation methods and treatments used in the study

Irrigation Methods		Irrigation Treatments
Irrigated	Subsurface drip irrigation (SDI)	SDI-I_{100}
		SDI-I_{80}
		SDI-I_{60}
	Surface drip (DI))	DI-I_{100}
		DI-I_{80}
		DI-I_{60}
Rainfed		Rainfed (I_0)

The study was designed in randomized complete block design to include two irrigation methods (subsurface drip irrigation (SDI), (surface drip (DI)) and four different irrigation treatments (I_0, I_{60}, I_{80} and I_{100}) in three replications. The irrigation treatments were formed with two irrigation methods (DI and SDI) and four irrigation water levels as 0% (rainfed (I_0)), 60% (I_{60}), 80% (I_{80}) and 100% (full irrigation (I_{100}). The full irrigation treatment was performed when 30% of the available water holding capacity in the 0-90 cm soil profile was depleted, while the deficit irrigation treatments were applied at 80% (I_{80}) and 60% (I_{60}) of the full irrigation treatment. Irrigation methods and treatments were shown in Table 3.

The crops harvested from the middle two rows of each plot were passed through a threshing machine, grains were separated, dried and cleaned. The weights were determined and grain yield for decare was calculated according to the yield. Variance analysis was applied to evaluate yield statistically and Duncan Multiple Comparison Test was used to compare the means (Gomez and Gomez, 1984). The relationships between plant canopy temperatures and yield, applied irrigation water and evapotranspiration were determined with the help of a nonlinear exponential relationship. In addition, the correlation test was conducted to determine the direction of the relationship between these parameters.

RESULTS and DISCUSSION

Soil water content changes in the treatments were determined before each irrigation with the gravimetric method in soil profile between 0-90 cm. Changes in soil water content measured throughout the season for SDI and DI were given in Figures 1 and 2, respectively.

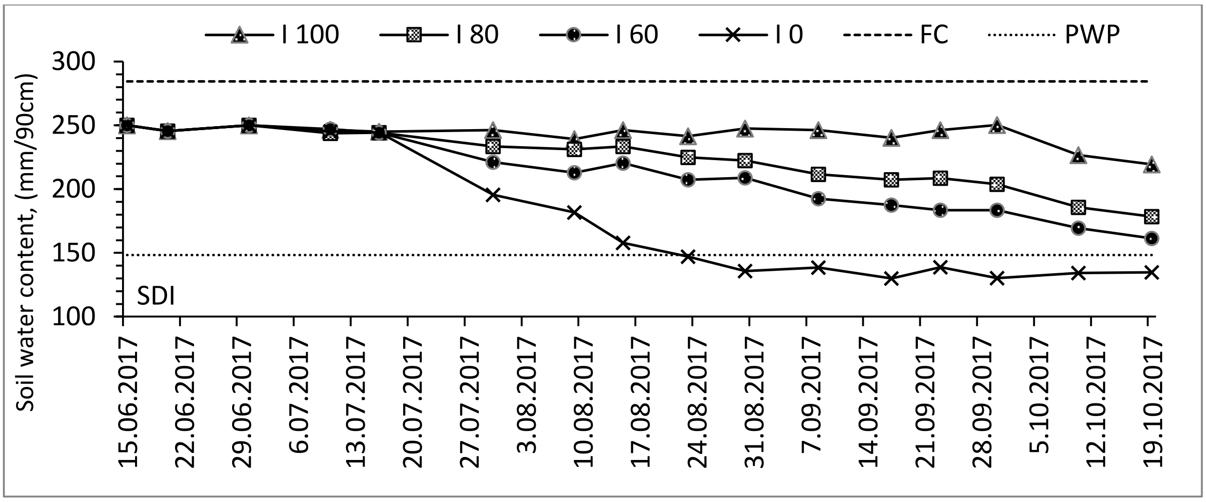

Figure 1. Change of soil water content in subsurface drip irrigation treatments (SDI) during the experimental period.

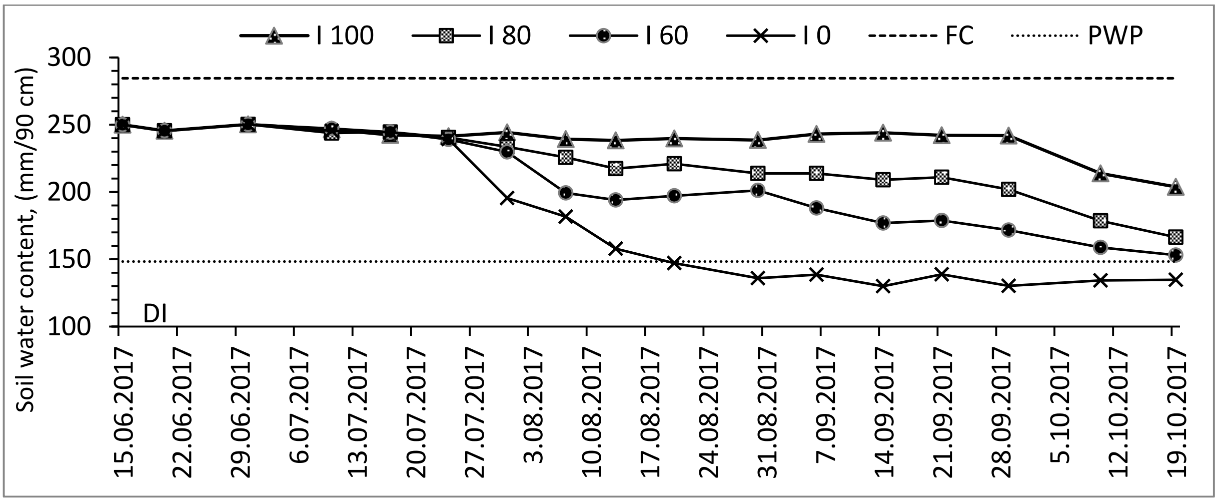

Figure 2. Change of soil water content in surface drip irrigation treatments (DI) during the experimental period.

When figures 1 and 2 were examined, it was found that the soil moisture content fluctuates between field capacity and wilting point in all irrigation treatments except rainfed treatment (I_0). At the same time, as the amount of water applied increases in both figures, the soil moisture content also increases. Water budget parameters in the SDI and DI treatments of soybeans were given in Table 3. From Table 3, it was understood that seasonal ET values in I_0, DI-I_{60}, DI-I_{80}, DI-I_{100}, SDI-I_{60}, SDI-I_{80}, and SDI-I_{100} treatments were 164.3, 461.6, 544.4, 611.7, 410.7, 481.3 and 527.3 mm, respectively.

Table 3. Water budget parameters in the SDI and DI treatments of soybeans

Treatments	I (mm)	P (mm)	ΔS (mm)	DP (mm)	ET (mm)
I_0	50.0	12.6	101.7	0.0	164.3
DI-I_{60}	357.7	12.6	91.3	0.0	461.6
DI-I_{80}	460.3	12.6	71.5	0.0	544.4
DI-I_{100}	562.8	12.6	36.3	0.0	611.7
SDI-I_{60}	310.7	12.6	87.4	0.0	410.7
SDI-I_{80}	397.6	12.6	71.1	0.0	481.3
SDI-I_{100}	484.5	12.6	30.1	0.0	527.3

When comparing all ET values obtained from the different irrigation methods of the same irrigation treatments, the SDI method was found to be lower than the DI method. The results obtained from I_{100} (Control) showed that approximately 78.3 mm of water was saved by using the SDI method in irrigation.

Many studies were conducted to determine the ET values of the soybean plant in Turkey. It was reported that the ET value of soybeans varies between 355 and 809 mm in Bursa by Candoğan and Yazgan (2016) and between 453.0 and 805.0 mm in Urfa by Yazar *et al.* (1991). In addition, Ozkara (1991) found that the soybean ET value was 444.9 in Menemen. The results obtained from this study were in good agreement with the literature.

Change of canopy temperature in DI and SDI treatments during the experimental period were given in Figure 3, 4 and 5.

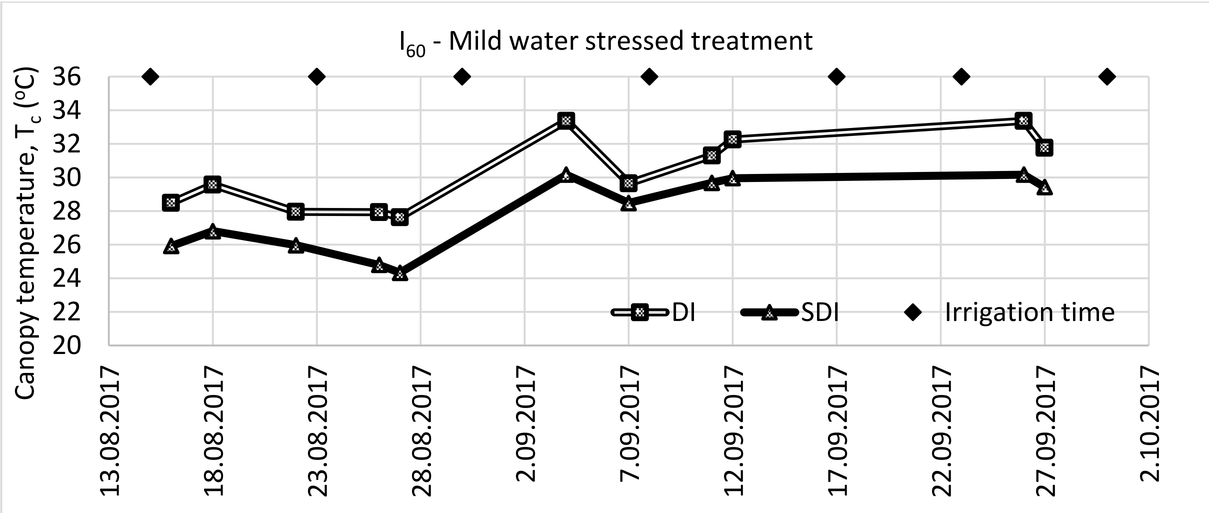

Figure 3. Change of canopy temperature in DI-I_{60} and SDI-I_{60} treatments

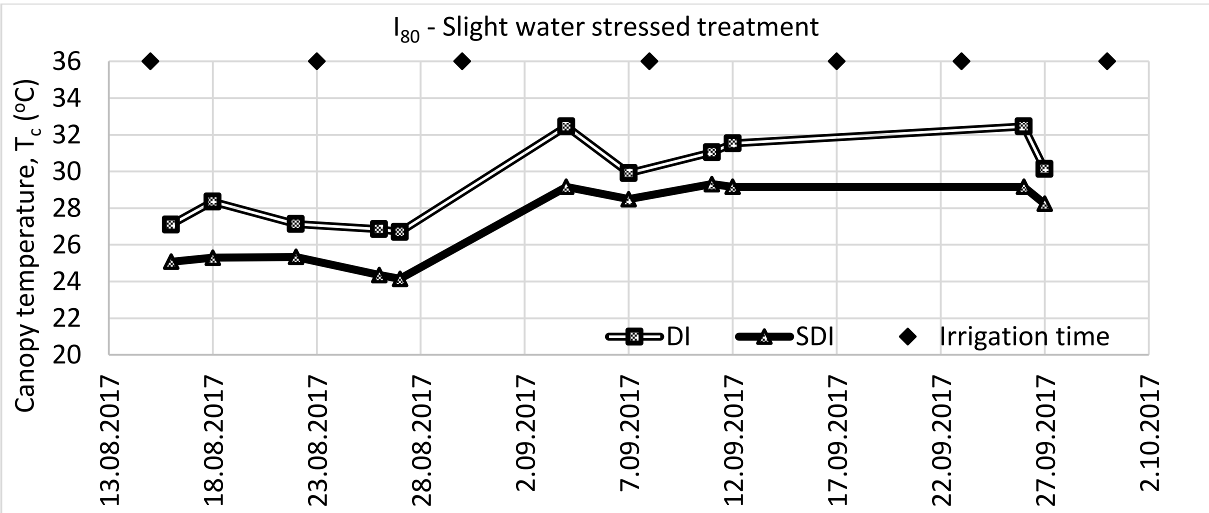

Figure 4. Change of canopy temperature in DI-I_{80} and SDI-I_{80} treatments

When the figures were examined, it was seen that the canopy temperatures of the crops irrigated with the SDI method were approximately 2.5 °C lower than DI method in all treatments throughout the season. This result indicated that the soybean plant irrigated with the SDI method was less stressful than irrigated with the DI method. When the interaction of the treatments was examined the highest canopy temperature was obtained from the DI-I_{60} treatment while the lowest canopy temperature was obtained from SDI-I_{80} and SDI-I_{100}. During the season, the average of canopy temperatures obtained from SDI was 27 °C while the average of canopy temperatures obtained from DI application was calculated as 29 °C. Evett *et al.* (2000) used wired, fixed IRT measuring the canopy temperatures in soybean and maize plants irrigated with surface and subsurface drip irrigation system. They reported that the optimum canopy temperature threshold for soybean was determined to be 27°C, although they also evaluated the threshold temperature of 29 °C for soybean. Anda *et al.* (2019) studied on two different soybean varieties to assess evapotranspiration rates, canopy temperatures (T_c), and crop water stress index (CWSI) using three levels of water supply (unlimited water, 50% of water requirement in atmometer, and rainfed conditions). During the season, they calculated the canopy temperatures obtained from unlimited water treatment as an average of 28.5 ± 1.97 and 28.3 ± 2.23 for two different varieties. In our study, the average canopy temperature from SDI-I_{100} (full irrigation) and DI-I_{100} was 26.84 °C and, 29.16 °C, respectively. When we compare the canopy temperatures of stress-free treatments from the two studies, we can say that the results are similar. The effect of different irrigation methods and irrigation treatments on yield (kg da^{-1}) was given in Table 4.

Yield values ranged from 225.8 to 632.6 kg da^{-1}. The mean yield values obtained from the SDI method (439.1 kg da^{-1}) were statistically higher than DI method (395.2 kg da^{-1}). In addition, the yield was increased depending on the irrigation water applied in both irrigation methods. When the interaction between different irrigation methods and irrigation treatments was examined, there was no statistically significant difference. The highest and lowest yield was obtained in the SDI-I_{100} (632.6 kg da^{-1}) and, for DI and SDI, I_0 (225.8 kg da^{-1}) treatments, respectively.

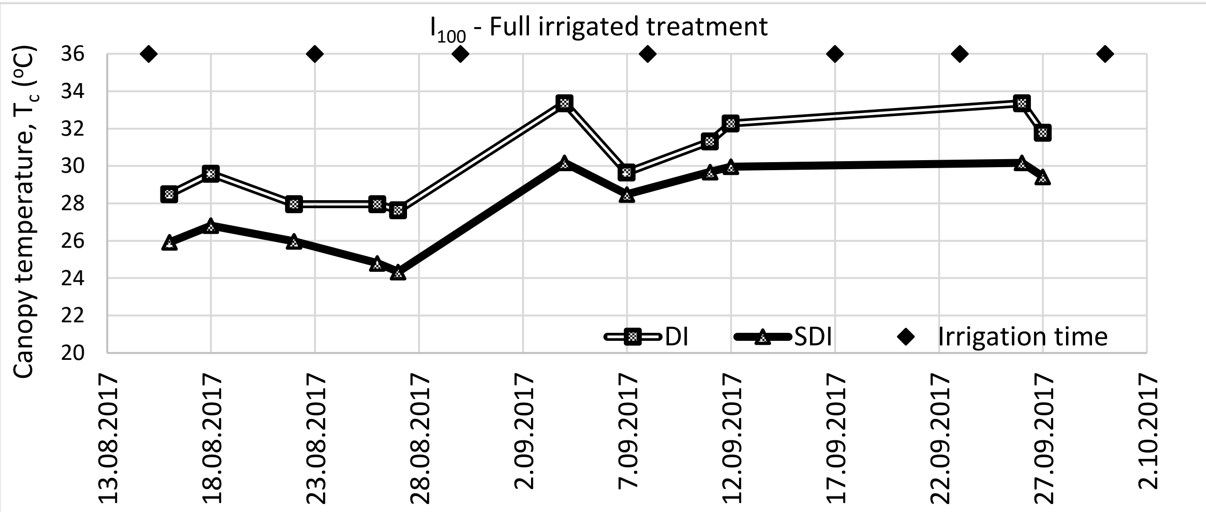

Figure 5. Change of canopy temperature in DI-I_{100} and SDI-I_{100} treatments

Table 4. The effect of different irrigation methods and irrigation treatments on yield (kg da^{-1})

Irrigation methods	**Irrigation treatments**				**Mean of irrigation methods**
	I_0	I_{60}	I_{80}	I_{100}	
DI	225.8	314.9	479.5	560.5	395.2 b
SDI	225.8	389.9	507.9	632.6	439.1 a
Mean of irrigation treatments	225.8 D	352.4 C	493.7 B	596.5 A	
Significance level	*Irrigation treatments (IT): ***		*Irrigation methods (IM) : ***	*IT x IM: ns*	

The capital letters showed the comparison of the averages given along the horizontal (along the row) and the small letters were given in vertical (along the column) at the 5% significance level according to the LSD test. **: %1 significance level of probability; ns: not significant.

These results show that the SDI method compared to the DI method increases the yield of the soybean. Candoğan and Yazgan (2016) investigated the effects of full and deficit irrigation on the yield and quality of soybeans applied in different growth stages in humid climatic conditions over a two-year period. Researchers obtained the highest seed yield (400.4 kg da^{-1}) from the treatment of full irrigation (based on the replenishment of 100% of soil water depletion from a soil depth of 90 cm at 7-day intervals throughout the development period) and the lowest yield (197.4 kg da^{-1}) from the rainfed treatment. Tekelioğlu *et al.* (2017) investigated the crop water stress index method which used infrared thermometry (IRT) to schedule irrigations of soybeans irrigated with drip irrigation. For this purpose, they obtained various data from six different irrigation treatments (0, 0.25, 0.50, 0.75, 1.00 (full irrigation), 1.25 of the cumulative evaporation in Class A pan is 25±5 mm). They reported that the highest yield from the treatments of 0.75 (359.11 kg da^{-1}), 1.00 (410.6 kg da^{-1}), 1.25 (475.90 kg da^{-1}), but they did not find a statistically significant difference among them. Evett *et al.* (2000) tested a system that uses four time – temperature threshold combinations, and these were compared to manually – irrigated plots where three irrigation rates (33%, 67% and 100% of meeting full crop ET) were used. They reported that soybean threshold temperatures were 27 °C and 29 °C, and threshold times were 256 and 171 min. All IRT treatments in first year yielded more (0.402 to 0.432 kg m^{-2}) than manual ones (0.328 to 0.401 kg m^{-2}). They also emphasized that the yield stability for 27 °C IRT treatments was higher than 100% treatment. When the yield values and canopy temperatures were evaluated together, it was determined that the plants irrigated with SDI method had less water stress and more yield value. When the irrigation treatments were examined, the lowest canopy temperature was obtained from SDI-I_{100}, at the same time the highest yield was obtained from SDI-I_{100}. The highest canopy temperature among the irrigated treatments was obtained from the DI-I_{60} while the lowest yield obtained from DI-I_{60} treatment. In these conditions, we can say that the SDI method reduces the canopy temperature by reducing stress, which is an important factor to increase yield.

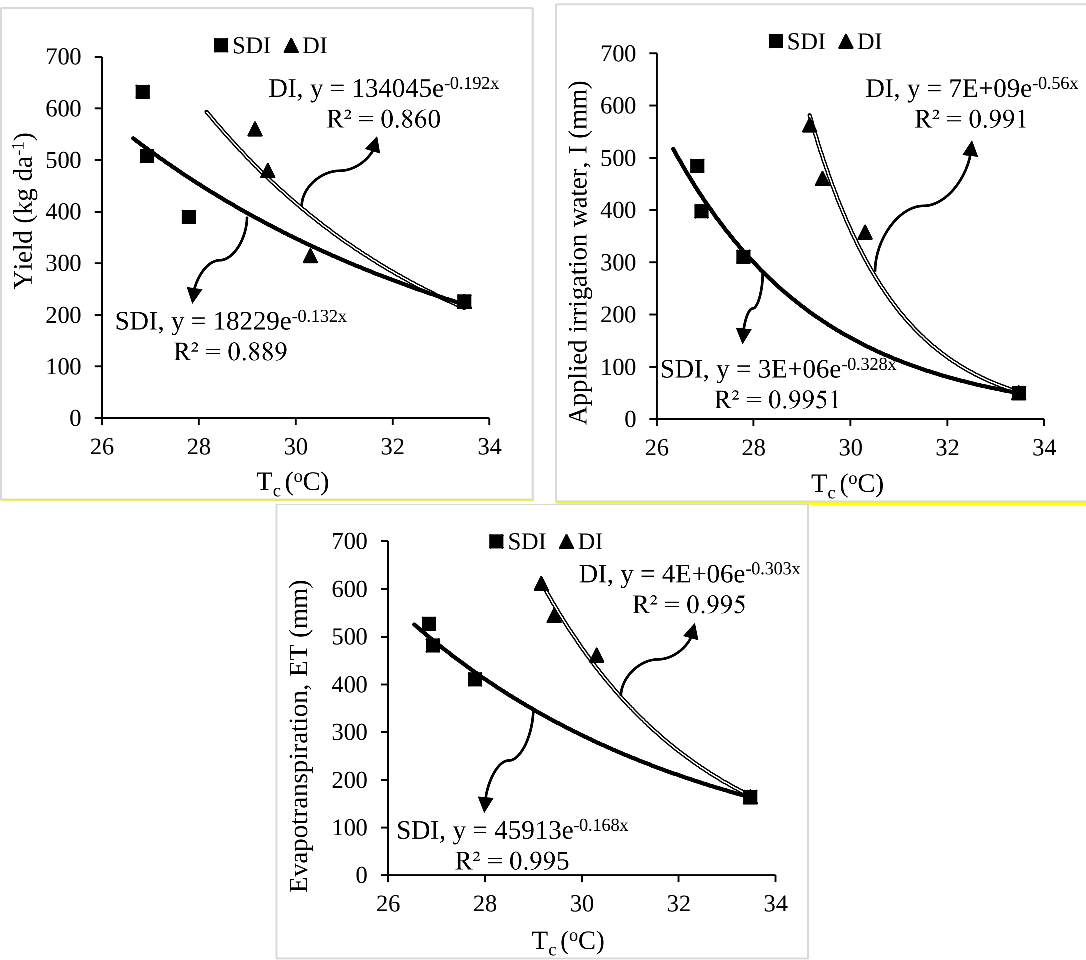

Figure 6. Relationships between mean canopy temperature and evapotranspiration, applied irrigation water and, yield parameters of soybean

In this study, the relationships between canopy temperatures measured from different irrigation treatments and yield, evapotranspiration and applied irrigation treatment were determined. These relationships were given in Figure 6.

The correlation test was performed to determine the direction and power of the relationship between crop canopy temperature and yield, applied irrigation water (I) and evapotranspiration (ET) values. The results of the correlation test were given in Table 5.

Table 5. Correlation coefficients indicating the direction and power of the relationship between crop canopy temperature and yield, applied irrigation water (I) and evapotranspiration (ET) of soybean depending on the amount of irrigation water

Parameters	Irrigation methods	Correlation coefficients (r)
T_c - Yield	DI	-0.883
	SDI	-0.882
T_c-I	DI	-0.986
	SDI	-0.964
T_c - ET	DI	-0.996
	SDI	-0.984

Although it was known that soybean yield increases significantly depending on the amount of irrigation water applied, previous studies (Egli 2008; Bao *et al.* 2015) showed that soybean cultivation could be also done based on rain without irrigation application. Since soybean could be grown with rainfed conditions, exponential relationships were preferred rather than linear relationships between canopy temperatures and ET, yield and I. As a matter of fact, Hou *et al.* (2019) reported that there was an exponential relationship between canopy temperature and yield. When Figure 6 was examined, determination coefficients showing the relationship between canopy temperature and yield in SDI and DI irrigation applications were determined as 0.89 and 0.86, respectively. Although there was a high level of relation in both irrigation methods, a higher relation was found in SDI method. When the correlation coefficients in Table 5 were examined, it was found that there was a high inverse correlation between canopy temperature and yield in both irrigation methods. This result showed that the yield decreased as the crop canopy temperature increased due to water stress. Similarly, Hou et al. (2019) reported that the soybean crops yield decreased due to increasing canopy temperature.

When Figure 6 and Table 5 were examined, it was determined that there was a high level of exponential relationship (SDI-R^2: 0.995 and DI-R^2: 0.991) and a strong negative correlation between canopy temperature and the amount of irrigation water applied (SDI-r: -0.964 and DI-r: -0.986) for both irrigation methods in soybean. Previous studies (Demirtaş *et al.* 2010; Pejić *et al.* 2011; Irmak *et al.* 2014) reported that there was a significant relationship between the amount of irrigation water and drought stress in soybean. In addition, the crop canopy temperature is also widely used to calculate the crop water stress index (CWSI), which is a parameter that indicates the water status of the crop (Tekelioğlu et al. 2017; Nielsen 1990). As with I and yield, there was a high level of exponential relationship and negative correlation between ET and canopy temperature for all irrigation methods (Figure 6 and Table 5). Hou et al. (2019) stated that the magnitude of transpiration change was greater than that of the canopy temperature, both parameters were strongly interrelated with each other, but they were non-linearly correlated. When the results obtained were evaluated in general, depending on the irrigation water applied, a strong inverse relationship was determined between canopy temperatures obtained from plants and ET, yield and I, while it was not found the difference between these relationships between irrigation methods.

In conclusion, the results obtained from this study showed that plants irrigated with the SDI method compared to the DI method had lower canopy temperatures and higher yield values. In addition, when the control treatments of both irrigation methods were compared, approximately 85 mm of water was saved from the crops irrigated with the SDI method. Therefore, it can be concluded that SDI method uses less water than

DI method and will contribute to optimization of water resources. Also yield values were higher in the SDI method. As a result, it was concluded that subsurface drip irrigation reduces the water stress and can save more water from available water under Mediterranean conditions and can increase the crop yield. In both irrigation methods (SDI and DI), depending on the amount of irrigation water, a high level of exponential and strong negative correlation was determined between canopy temperatures and yield, ET and, I parameters obtained from experimental treatments.
It is thought that the strong relationship between canopy temperatures and yield can be used in yield estimation by combining canopy temperatures to be measured by satellites or unmanned aerial vehicles.

ÖZET

Amaç: Su kaynaklarının sınırlı olduğu kurak ve yarı kurak bölgelerde hem tarımsal üretim hem de su kaynaklarının optimizasyonu için sulama suyu kullanım verimliliği önemli bir konudur. Bu alanların çoğunda yüzey damla sulama yöntemi (DI) yaygın olarak kullanılmakla birlikte, yüzey altı damla sulama yöntemi (SDI) son yıllarda yaygınlaşmıştır. Bu çalışmada, yüzey (DI) ve yüzey altı damla sulama (SDI) yöntemleri ile sulanan soya bitkisinin infrared termometre ile ölçülen taç sıcaklığı üzerindeki etkilerini karşılaştırmak ve soya fasulyesi üzerindeki eksik sulamaya etkilerini değerlendirmek amaçlanmıştır.
Yöntem ve Bulgular: Çalışma, iki farklı sulama yöntemi (yüzey damla sulama (DI) ve yüzey-altı damla sulama (SDI) ve dört farklı sulama düzeyinde (%0, %60, %80 ve %100) üç tekerrürlü olarak tesadüf blokları deneme deseninde yürütülmüştür. Bitki taç sıcaklıkları, sulamadan önce ve sonra 12:00 ile 15:00 saatleri arasında kızılötesi termometre ile ölçülerek elde edilmiştir.
Genel Yorum: Sonuçlar, sezon boyunca SDI yöntemi ile sulanan bitkilerin taç sıcaklıklarının DI yöntemine göre 2.5°C'a kadar daha düşük olduğunu göstermiştir. Ayrıca bu çalışmada SDI yönteminden elde edilen verim değerleri (439.1 kg da^{-1}) DI yöntemine (395.2 kg da^{-1}) göre istatistiksel olarak daha yüksek çıkmıştır. DI yöntemi ile karşılaştırıldığında, SDI yönteminde yaklaşık 78.3 mm su tasarrufu elde edilmiştir.
Çalışmanın Önemi ve Etkisi: SDI yöntemi ile sulanan soya fasulyesinin taç sıcaklıklarının DI yöntemine göre daha düşük olduğu belirlenmiştir. Ek olarak, her iki sulama yönteminde de taç sıcaklıkları ile verim, uygulanan sulama suyu ve evapotranspirasyon arasında yüksek düzeyde üstel bir ilişki ve negatif korelasyon olduğu saptanmıştır.

Anahtar Kelimeler: İnfrared termometre, *Glycine max*, kısıntılı sulama, Antalya, yarı-kurak.

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CONFLICT OF INTEREST
The author declares that there is no conflict of interest in the study.

AUTHOR’S CONTRIBUTIONS
The contribution of the authors is equal.

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