Scientific Papers. Series A. Agronomy, Vol. LIX, 2016
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

IRRIGATION SCHEDULING AND THE IMPACT OF IRRIGATION ON THE YIELD AND YIELD COMPONENTS OF SWEET CORN

Milena MOTEVA[1], Nelly GADJALSKA[2], Viktoria KANCHEVA[2], Todor TASHEV[2], Veska GEORGIEVA[3], Natalia KOLEVA[4], Ivan MORTEV[2], Vesela PETROVA-BRAHICHEVA[2]

[1]University of Architecture, Civil Engineering and Geodesy, 1 Hr. Smirnenski, Blvd.,1046 Sofia, Bulgaria
[2]Institute of Soil Science, Agrotechnologies and Plant Protection "N. Pushkarov", 3 Shose Bankya Str., 1331 Sofia, Bulgaria
[3]National Institute of Meteorology and Hydrology – BAS, 66 Tzarigradsko Shose, Blvd., 1784 Sofia, Bulgaria
[4]Forestry University, Faculty of Agronomy, Department Agriculture and Herbology, 10 Kliment Ohridski, Blvd., Sofia, Bulgaria

Corresponding author email: milena_moteva@yahoo.com

Abstract:

The goal is to establish the features of the irrigation scheduling of sweet corn for two irrigation technologies – drip irrigation and sprinkling and to establish their impact on the yield and yield components. A two-factorial field experiment with irrigation of Super Sweet 71,12 R hybrid was carried out in Sofia region. The main-plot factors were A - irrigation technology: A_1- sprinkling; A_2- drip irrigation; B - irrigation depth: B_1 – rainfed; B_2 – 50% of the maximum irrigation depth (MIrD); B_3 - 75% of MIrD; B_4 - irrigation with MIrD, which was relative to 80% of field capacity. The following productionelements were established – total ear fresh yield, marketable ear fresh yield, total ear number, marketable ear number, single marketable fresh ear mass, marketable ear row number, one row kernel number of a marketable ear, marketable ear fresh kernel mass. Plant characteristics were taken as plant height, leaves number per plant, ear legth, tassel length. Analysis of varience was applied to all data obtained. It was established that in conditions of a very dry and very warm growing season, sweet corn needs 3 irrigation applications and 180 mm net irrigation depth by sprinkling, and 5 irrigation applications and 75 mm net irrigation depth by drip irrigation. Drip irrigation creates better conditions for the green biomass development, while sprinkling creates better conditions for the productivity. The yield of the marketable ears under the impact of sprinkling was 11.4 Mg/ha and 62080 pieces, while under drip irrigation it is 9.5 Mg/ha and 57080 pcs. Irrigation had significant impact on the yield and the components of the yield. The irrigation depth had significant impact on the total ear fresh yield, marketable ear fresh yield, single marketable ear fresh mass and marketable ear kernel fresh mass. In terms of the yields obtained, sprinkling prevailed over drip irrigation.

Key words: *sweet corn, sprinkling, drip irrigation, irrigation scheduling, yield, yield components*

INTRODUCTION

Sweet corn (*Zea mays saccharata* Korn.) has gained popularity in Bulgaria over the past 10 years. Nowadays the consumers' demand for fresh sweet corn is strong. The crop is attractive because of its excellent taste and nutritional value due to the high content of sugars. Though the crop is profitable and easily marketed, Bulgarian market of sugar corn is still underdeveloped.

Due to the fact that sweet corn is consumed in a fresh condition, it is often recognized as a vegetable crop. Two circumstances are important for growing sweet corn in Bulgarian climate conditions – it has to be grown like the early conventional corn hybrids and has to be irrigated like the vegetable crops. Further, the already registered tendencies to climate warming and drought in our geographical region evoke special attention to irrigation as a stabilizing factor for obtaining high yields and high market prices in general (Kazandjiev et al., 2014). As to Pereira et al. (2009), with the increasing water scarcity nowadays there is a need to optimize water use in irrigation.

The countries, which traditionally grow sweet corn, apply irrigation. Sweet corn has a relatively shallow root system and requires an inch of water per week. Adequate watering is particularly critical during silking, tasseling and ear development. Dry hot weather during pollination, results in ears with "skips" in the kernels and poor tip fill (Jett, 2006).

The irrigation technologies practiced to sweet corn are furrow irrigation, gun irrigation system, solid set sprinkler systems, center pivot machines, and drip tape irrigation – on a bare soil or subsurface that makes irrigation and fertigation relatively easy (Smith et al., 1997; Growing Guide, 2005; Jett, 2006; Sweet Corn, 2010). The contemporary tendency in the irrigation technologies is to apply drip tape irrigation, which ensures maximum water use efficiency. Drip systems are best adapted to the contemporary shortage of water and energy. They are also most efficient in fertilizers' utilization and have the highest environmental performance among the other irrigation technologies. Deficit irrigation also gains more popularity. Oktaem et al. (2003), Oktem, (2008) and Oktem & Oktem, (2009) have established that the allowable for sweet corn irrigation water deficit is up to 20%, which doesn't cause serious disruptions in productivity. As to Rodrigues (2013), who compares drip irrigation with sprinkler irrigation of corn, drip irrigation systems lead to higher water use performance in terms of beneficial water use and water productivity but deficit irrigation is generally not economically feasible.

Irrigation of sweet corn in our soil and climatic conditions allows its cultivation as an alternative marketing crop and as a row crop in the crop rotations. Because of the economic and market conditions in our country, the production of sweet corn needs a production technology that provides maximum return and meets the environmental principles of sustainable production.

The goal of the paper is to establish the features of an irrigation scheduling of sweet corn of two irrigation technologies – drip irrigation and sprinkling and to establish their impact on the yield and yield components of the crop.

MATERIALS AND METHODS

A field experiment with irrigation of Super Sweet 71.12 R hybrid was carried out in 2015 in the region of Sofia, Bulgaria. The site is situated at 42.6^{o} N and 550 m a.s.l. The climate is temperate-continental and the region is one of the coldest and most humid in Bulgaria.

The experiment was two-factorial and was put in a randomized complete block design as a split-plot factorial arrangement in three replications. The main-plot factors were: *factor A - irrigation technology:* A_1 - Sprinkling; A_2 - drip irrigation; and *factor B - irrigation depth:* B_1 – rainfed; B_2 – 50% of the maximum irrigation depth (MIrD); B_3 - 75% of MIrD; B_4 - irrigation with MIrD, relative to 80% of field capacity (FC). The following variants were tested: A_1B_1 (control 1), A_1B_2, A_1B_3, A_1B_4, A_2B_1 (control 2), A_2B_2, A_2B_3, A_2B_4.

Land preparation and weed control were applied according to the standard agricultural practices in the region. The fertilizers were applied conventionally at sprinkling and as fertigation at drip irrigation.

The soil was chromic luvisols (FAO classification) with total water content TWC=327 mm, total available water content TAWC=165 mm, and bulk density α=1.5 g/cm^3. Soil moisture was determined by the gravimetric method, by taking soil samples in each 10 cm down to 1-m depth of the soil profile. Once soil moisture reached 80% of FC, an irrigation application was appointed.

The net application depth for sprinkling was calculated as: $m = 10H\alpha\left(\sigma_W^{FC} - \sigma_W^{80\%FC}\right)$, where: m – irrigation application depth, mm; H – thickness of the soil layer, m; α - bulk density of the soil, Mg/m^3; σ_W^{FC} - water content at FC, weighing %; $\sigma_W^{80\%FC}$ - water content, which is relative to 80% of FC, weighing %. The irrigation application depth for drip irrigation was calculated as: $m = 10H\alpha\left(\sigma_W^{FC} - \sigma_W^{80\%FC}\right)K$, where: K – the ratio between the actual irrigated area and the total sawn area (K =0.40) (Zhivkov, 2013).

The following production features were established – total ear fresh yield, marketable ear fresh yield, total ear number, marketable ear number, single marketable fresh ear mass, marketable ear row number, one row kernel number of a marketable ear, and marketable ear fresh kernel mass. Plant characteristics were taken as plant height, leaves number per plant, ear legth, and tassel length. Analysis of varience was applied to all data obtained.

The meteorological characteristics of the growing season May-August 2015 were estimated in a 40-year statistical row 1976-2015. It is seen from Table 1 that it has been dry, with rainfall total 215.2 mm and 70% probability of exceedance. The period of seed filling was very dry with 87.5% probability of exceedance, while the wetness condition in June and July were average. The monthly values were generally under the normals – especially those of May and July (Table 2). The rainfall totals of these months were 38.7 mm and 15.8 mm respectively, with residuals -45.7% and -76.2%. Unlike these months, May rainfall total was 105.2 mm, which was 41.3% higher than the 40-year normal. The distribution of the daily rainfalls, which is illustrated on Figure 1, shows that there has occurred an uninterrupted drought period from the first decade of July till the second of August.

As to the air temperature, the growing season May-August was very warm, with 15.0% probability of exceedance, while the period July-August was extremely warm - with 5.0% probability of exceedance (Table 1). The least stressing temperatures were observed in the period May-June, which probability of exceedance of the air temperature total was 32.5%. May, July and August had positive residuals of 11.0%, 15.5% and 8.1% from the relevant normals, while June had a negative one of -4.1% (Table 2 and Figure 2).

Table 1. Probability of exceedance of the totals of the meteorological elements in 2015, %

Index	*May-August*		*May-June*		*June-July*		*July-August*	
	mm; °C	%	mm; °C	%	mm; °C	%	mm; °C	%
Rainfall totals	215.2	70.0	143.9	55.0	121.0	57.5	71.3	87.5
Air Temperature totals	2477.5	15.0	1064.2	32.5	1259.1	17.5	1413.3	5.0

Table 2. Monthly values of the meteorological elements

Month	*Air temperature totals*			*Rainfall totals*		
	°C	Residuals, %	1976-2015 normals, °C	mm	Residuals, %	1976-2015 normals, mm
May	524.7	11.0	472.8	38.7	-45.7	71.2
June	539.5	-4.1	562.7	105.2	41.3	74.5
July	719.7	15.5	622.9	15.8	-76.2	66.5
August	693.7	8.1	641.7	55.5	-4.5	58.1

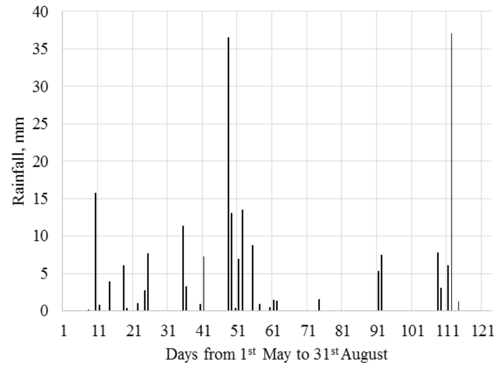

Figure 1. Distribution of the daily rainfalls in the period May-September 2015 г.

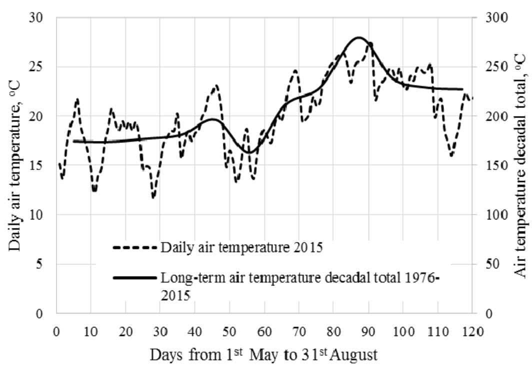

Figure 2. Dynamics of the daily air temperature in the period May-September 2015 г.

RESULTS AND DISCUSSIONS

Corn plants are large and fast-growing, so they need regular feeding and watering. Water management is very important, especially during the critical growth stages when any stress imposed on the plant can affect the yield. Particular care needs to be taken to avoid stress around pollination as poor tip fill will result if the plant is stressed. In accordance with the dynamics of the meteorological conditions in 2015 and the peculiarities of the irrigation technologies, several irrigation applications were given to the crop. By sprinkling were given 3 applications with maximum application depth of 60 mm in A_1B_4. A 25% reduction of the irrigation application depth was implemented in A_1B_3, where it was 45 mm, and 50% reduction in A_1B_2, where it was 30 mm (Table 3). The total seasonal water given to the crop by sprinkling was 180 mm, 135 mm and 90 mm respectively. The necessity of irrigation occurred during stem elongation, tasseling and silking. Irrigation by dripping was more frequent – 5 applications were given with average application depth – 15.0 mm in A_2B_4, 11.3 mm in A_2B_3 and 7.5 mm in A_2B_2. The relating irrigation depths were 75.0, 56.3 and 37.5 mm. The applications were given during stem elongation - 2, tasseling – 1, silking - 1, and ripening – 1. The irrigation depth in our conditions of a temperate-continental climate appeared to be lower than in more arid climates (Growing Guide, 2005), where the seasonal irrigation amount by sprinkling used to be 400-800 mm and by dripping – 350-400 mm. In our region, this is due to the fact that the period of high temperatures is shorter but there is also lack of precipitation. However, this period of the year is the period of the critical to water growing stages of sweet corn and irrigation is inevitably needed.

Table 3. Features of the irrigation scheduling

Variants	*Number of applications*	*Applications dates*	*Application depth, mm*	*Irrigation depth, mm*
		Sprinkling		
A_1B_1	-	-	-	-
A_1B_2	3	9-10.07, 21-22.07, 4-5.08	60	180
A_1B_3	3		45	135
A_1B_4	3		30	90
		Drip irrigation		
A_2B_1	-	-	-	-
A_2B_2	5	11.07, 16.07, 23.07, 31.07, 5.08.	15.0	75.0
A_2B_3	5		11.3	56.3
A_2B_4	5		7.5	37.5

The results from the analysis of variance of the main-plot factors impact are presented in Table 4. It is seen that the irrigation technologies – *factor A* – performed statistical differences mostly for the biometrical features of the plant. Under drip irrigation, the crop developed higher plant height, leaves number per plant, tassel length and ear length. Both technologies had the same impact on the total ear yield, total ear number and the marketable ear number per hectare (Table 4). Under the impact of drip irrigation, plant height was 127.8 cm but under the impact of sprinkling it was 119.0 cm. Leaves number per plant was 7.4 and 6.9 respectively, tassel length was 35 and 32 cm, ear length – 17.8 and 16.0 cm. As to the features of the marketable ear: the single marketable ear mass - didn't show statistical differences between both irrigation technologies, the single fresh ear mass was 188.2 and 177.3 g, the marketable ear row number – 12.5 and 11.8, the one row kernel number of a marketable ear was 26.2 and 27.2, the marketable ear fresh kernel mass was 92.3 and 84.4 g. The total ear fresh yield, the marketable ear fresh yield, the total ear number and the marketable ear number under drip irrigation and sprinkling were 13.6 and 15.4 Mg/ha, 9.4 and 11.4 Mg/ha, 90000 and 99580 pcs./ha, and 57080 and 62080 pcs./ha respectively, without any statistical differences. Only the marketable ear fresh yield under drip irrigation was statistically lower at probability P=0.05.

The irrigation depth – *factor B* - had statistically significant impact on all indices except for the row number of a marketable ear. Irrigation proved its impact for all the tested levels of soil moisturizing (Table 4). The total ear fresh yield increased from 10.1 Mg/ha under rainfed conditions to 14.4 Mg/ha under 50% irrigation deficit, to 15.0 Mg/ha under 25% irrigation deficit and to 18.5 Mg/ha under full irrigation. The marketable ear fresh yield increased more than twice (216.6%) at full irrigation, compared to that under rainfed conditions – from 6.5 Mg/ha to 14.1 Mg/ha. The marketable ear number increased from 5333 to 7083 respectively, which comprised 32.8%. The plant height increased from 109.9 to 132.3 cm (with 18.7%), the leaves number per plant – from 5.9 to 8.2 (with 38.7%), the tassel length – from 31 to 37 (with 19.8%), the ear length – from 12.9 to 17.2 cm (with 33.2%). Further, the single marketable fresh ear mass increased from 108.9 g to 245.4 g (with 25.3%), the marketable ear row number didn't increase statistically, one row kernel number of a marketable ear – from 22.2 to 31.0 under 25% irrigation deficit (with 39.3%), and the marketable ear fresh kernel mass – from 56.3 g to 104.8 g (with 86.1%).

Table 4. Main impacts of the tested factors

Indices Variants	*Total ear fresh yield, Mg/ha*	*Marketable ear fresh yield, Mg/ha*	*Total ear number, pcs./ha*	*Marketable ear number, pcs./ha*
Factor A – irrigation technology				
A_1 - sprinkling	15.388	11.438	99580	62080
A_2 – drip irrigation	13.654	9.463^{o}	90000	57080
Factor B – irrigation depth				
B_1 - rainfed	10.100	6.533	76670	53330
B_2 - 50% of MIrD	14.425^{++}	9.925^{++}	105000^{++}	51670
B_3 – 75% of MIrD	15.008^{+++}	11.192^{+++}	98330^{+}	62500^{+}
B_4 – MIrD (at 80% of FC)	18.550^{+++}	14.150^{+++}	99170^{+}	70830^{+++}

1st continuation of Table 4

Indices Variants	*Plant height, cm*	*Leaves number per plant*	*Tassel length, cm*	*Ear length, cm*
Factor A – irrigation technology				
A_1 - sprinkling	119.0	6.9	32	16.0
A_2 – drip irrigation	127.8^{+}	7.4^{+++}	35^{++}	17.8^{++}
Factor B – irrigation depth				
B_1 - rainfed	109.9	5.9	31	12.9
B_2 - 50% of MIrD	123.9^{++}	6.8^{+++}	32^{+}	18.5^{+++}
B_3 – 75% of MIrD	127.4^{+++}	7.7^{+++}	36^{++}	19.0^{+++}
B_4 – MIrD (at 80% of FC)	132.3^{+++}	8.2^{+++}	37^{+++}	17.2^{+++}

2nd continuation of Table 4

Indices Variants	*Single marketable fresh ear mass, g*	*Marketable ear row number*	*One row kernel number of a marketable ear*	*Marketable ear fresh kernel mass, g*
Factor A – irrigation technology				
A_1 - sprinkling	188.2	12.5	26.2	92.3
A_2 –drip irrigation	177.3	11.8	27.2	84.4
Factor B – irrigation depth				
B_1 - rainfed	108.9	12.4	22.2	56.3
B_2 -50% of MIrD	174.1^{+++}	12.0	28.6^{++}	96.8^{+++}
B_3 – 75% of MIrD	202.8^{+++}	11.9	31.0^{+++}	95.6^{+++}
B_4 – MIrD (at 80% of FC)	245.4^{+++}	12.4	25.1	104.8^{+++}

$^{o,+}$ significant at 5% level; $^{++}$ significant at 1% level; $^{+++}$ significant at 0.1% level

These differences, including the results from the variants of the irrigation depth, were statistically significant on all probability levels. These results correspond to those obtained by Oktem (2008), who announces for the highest fresh ear yields - 14.76 and 14.17 Mg/ha at an irrigation scheduling, which is based on 100% E_{pan}, whereas minimum fresh ear yields - 9.15 and 8.84 Mg/ha - on 70% of E_{pan}.

Sprinkling and drip irrigation had statistically significant impact on the ear yield – total and marketable ears (Table 5). This impact was significant at deficit drip irrigation with 75% of MIrD and with MIrD, while at sprinkling it was significant at irrigation with 75% and 50% of MIrD. Under the impact of sprinkling, the total ear fresh yield increased maximum with 102% and the marketable ear fresh yield – with 151.8%. Actually, these yields changed from 10.1 Mg/ha to 20.4 Mg/ha and from 6.5 to 16.4 Mg/ha. Analogously for drip irrigation, these two kinds of yield changed from 10.1 to 16.7 Mg/ha (an increase of 65.7%) and from 6.5 to 11.8 Mg/ha (an increase of 81.4%). These results were significant and P=0.001.

The ear number – either total or only marketable ears - also increased. Sprinkling had significant effect by all levels of the irrigation depth, while drip irrigation contributed to the ear number formation only by full irrigation (Table 6). The maximum total ear number under sprinkling was 105000 pcs./ha, while under drip irrigation – 93330 pcs./ha. The maximum marketable ear numbers were 75000 pcs./ha and 66670 pcs./ha respectively. The increase of the total ear number under full irrigation by sprinkling was 37.0% and by drip irrigation - 21.7%. The increase of the marketable ear number was 40.6% and 25.0% respectively.

Sprinkling had a significant effect on the biometric features of the plants only under full irrigation, while drip irrigation had statistical effect at all levels of irrigation – either full or deficit (Table 7). Under full irrigation, plant height increased up to 130 cm by sprinkling and 134 by drip irrigation, which was 18.7% and 22.2% respectively as compared to that under rainfed conditions (110 cm). The leaves number per pant increased from 5.9 under rainfed condition up to 7.8 (with 32.1%) and 8.6 (with 45.3%) under sprinkling and drip irrigation respectively. The tassel length was also significantly impacted by full irrigation at sprinkling and by all irrigation levels at drip irrigation. Its maximum length reached 36.1 cm and 37.9 cm at both irrigation technologies respectively. Sprinkling contributed for 16.9% increase and drip irrigation – for 22.7% increase as compared to the rainfed conditions (30.9 cm). Finally, the marketable ear length was 16.2 cm at full irrigation by sprinkling and 18.1 cm at full irrigation by dripping – with 25.9 and 40.5% more than under rainfed conditions (12.9 cm). It is notable that no marketable ears, more than 14 cm long, were formed under rainfed conditions. The deficit irrigation demonstrated better effect on the ear length. The latter reached an increase of 36.2% by 50% deficit irrigation, while the increase by 25% deficit drip irrigation was 61.2%.

Table 5. Impact of the irrigation depth on the fresh yield

Indices	*Total ear fresh yield, Mg/ha*		*A marketable ear fresh yield, Mg/ha*	
Variants	A – Sprinkling	B – Drip irrigation	A – Sprinkling	B – Drip irrigation
B_1 – rainfed	10.100	10.100	6.533	6.533
B_2 - 50% of MirD	15.617^{++}	13.233	11.517^{++}	8.333
B_3 – 75% of MirD	15.433^{++}	14.583^{++}	11.250^{++}	11.133^{++}
B_4 – MirD (at 80% of FC)	20.400^{+++}	16.700^{+++}	16.450^{+++}	11.850^{+++}

$^{+}$ significant at 5% level; $^{++}$ significant at 1% level; $^{+++}$ significant at 0.1% level

Table 6. Impact of the irrigation depth on the ear number

Indices	*Total ear number, pcs./ha*		*Marketable ear number, pcs./ha*	
Variants	A - Sprinkling	B - Drip irrigation	A - Sprinkling	B - Drip irrigation
B_1 - rainfed	76670	76670	53330	53330
B_2 - 50% of MIrD	106670^{+}	103330^{+}	53330	50000
B_3 – 75% of MIrD	110000^{+}	86670	66670^{+}	58330
B_4 – MIrD (at 80% of FC)	105000^{+}	93330	75000^{+++}	66670^{+}

$^{+}$ significant at 5% level; $^{++}$ significant at 1% level; $^{+++}$ significant at 0.1% level

As far as the yield components were concerned, the greatest impact of irrigation was observed on the single marketable ear fresh mass and on the marketable ear kernel fresh mass. Both components demonstrated great sensitivity to water. They reacted in to the smallest irrigation depths with around 60% and 80-90% increase.

The mass of a single fresh marketable ear increased with 140.4% under full sprinkling and with 110.2% under full drip irrigation. It reached 262 g and 229 g, respectively. The kernel fresh mass of a marketable ear was maximum 109 g and 101 g at 50% deficit irrigation by both technologies. These differences were statistically significant at P=0.001. The row number of a marketable ear didn't react to irrigation, and the number of the kernels in a row demonstrated scattered results under the impact of the irrigation depth.

Table 7. Impact of the irrigation depth on the plant characteristics

Indices	*Plant height, cm*		*Leaves number/plant*	
Variants	A - Sprinkling	B - Drip irrigation	A - Sprinkling	B - Drip irrigation
B_1 - rainfed	110	110	5.9	5.9
B_2 - 50% of MIrD	119	129^{++}	6.4	7.2^{+++}
B_3 – 75% of MIrD	117	138^{+++}	7.4^{+++}	7.9^{+++}
B_4 – MIrD (at 80% of FC)	130^{++}	134^{++}	7.8^{+++}	8.6^{+++}

$^{+}$ significant at 5% level; $^{++}$ significant at 1% level; $^{+++}$ significant at 0.1% level

Continuation of Table 7

Indices	*Tassel length, cm*		*A marketable ear length, cm*	
Variants	A - Sprinkling	B - Drip irrigation	A - Sprinkling	B - Drip irrigation
B_1 - rainfed	30.9	30.9	12.9	12.9
B_2 - 50% of MIrD	29.3	33.1^{+}	17.6^{++}	19.4^{+++}
B_3 – 75% of MIrD	32.8	38.8^{+++}	17.2^{++}	20.8^{+++}
B_4 – MIrD (at 80% of FC)	36.1^{++}	37.9^{+++}	16.2^{+}	18.1^{+++}

$^{+}$ significant at 5% level; $^{++}$ significant at 1% level; $^{+++}$ significant at 0.1% level

Table 8. Impact of the irrigation depth on the yield components

Indices	*A single marketable ear fresh mass, g*		*A marketable ear row number*	
Variants	A - Sprinkling	B - Drip irrigation	A - Sprinkling	B - Drip irrigation
B_1 - rainfed	109	109	12	12
B_2 - 50% of MIrD	176^{+}	172^{+}	12	12
B_3 – 75% of MIrD	206^{+++}	199^{++}	13	11
B_4 – MIrD (at 80% of FC)	262^{+++}	229^{+++}	13	12

Continuation of Table 8

Indices	*One row kernel number of a marketable ear*		*A marketable ear kernel fresh mass, cm*	
Variants	A - Sprinkling	B - Drip irrigation	A - Sprinkling	B - Drip irrigation
B_1 - rainfed	22	22	56	56
B_2 - 50% of MIrD	26	31^{++}	109^{+++}	101^{+++}
B_3 – 75% of MIrD	30^{++}	32^{+++}	105^{+++}	86^{++}
B_4 – MIrD (at 80% of FC)	27	24	100^{+++}	94^{+++}

$^{+}$ significant at 5% level; $^{++}$ significant at 1% level; $^{+++}$ significant at 0.1% level

CONCLUSIONS

1. In conditions of a very dry and very warm growing season of a temperate continental climate, sweet corn needs 3 irrigation applications and 180 mm net irrigation depth by sprinkling, and 5 irrigation applications and 75 mm net irrigation depth by drip irrigation
2. Drip irrigation creates better conditions for the green biomass development, while sprinkling creates better conditions for the process of productivity. The yield of the marketable ears under the impact of sprinkling was 11.438 Mg/ha and 62080 pcs./ha, while under drip irrigation - 9.463 Mg/ha and 57080 pcs./ha The difference was statistically significant, while none of the technologies showed statistical advantage in the number of marketable ears.
3. Irrigation has a significant effect on the yield, the yield components and the biometric plant features. The marketable ear fresh yield increased from 6.533 Mg/ha and 53330 pcs./ha under rainfed conditions to 9.925 Mg/ha and 51670 pcs./ha under 50% irrigation deficit, 21.192 Mg/ha and 6250 pcs. under 25% irrigation deficit and 14.150 Mg/ha and 70830 pcs./ha under full irrigation.
4. The irrigation depth by both irrigation technologies had significant impact mostly on the total ear fresh yield, the marketable ear fresh yield, the single marketable ear fresh mass and the marketable ear kernel fresh mass. The irrigation depths of deficit sprinkler irrigation had no significant effect on the biomechanical features of plants.
5. In terms of the yields obtained, sprinkling prevail over drip irrigation.

ACKNOWLEDGEMENTS

This research work was carried out with the support of Agricultural Academy, Institute of Soil Science, Agro-Technology and Plant Protection, Project POZM 183.

REFERENCES

Growing Guide: Sweet Corn Growers Handbook. 2005. Queensland Governmentp 57 p., www.deedi.qld.gov.au

Jett L.W., 2006. Growing Sweet Corn in Missouri. http://extension.missouri.edu/p/G6390.

Kazadjiev V., Moteva M., Georgieva V., 2014. Near and far future climate conditions for crop growing in Bulgaria. Proc. 12th Int. Congress on Mechanization and Energy in Agriculture, 3-6- Sept., Cappadokia, Turkey,183-189.

Oktem A., Simsek M., Gulgun Oktem A., 2003. Deficit irrigation effects on sweet corn (*Zea mays saccharata* Sturt) with drip irrigation system in a semi-arid region: I. Water-yield relationship. Agricultural Water Management,Vol. 61, 1: 63-74.

Oktem A., 2008. Effects of deficit irrigation on some yield characteristics of sweet corn. Bangladesh J Bot., 37(2): 127-131.

Oktem A., Gulgun Oktem A., 2009. Yield Characteristics of Sweet Corn under Deficit Irrigation in Southeastern Turkey. The Philippine Agricultural Scientist Vol. 92 No. 3: 332-337.

Pereira L.S., Cordery I., Iacovides I., 2009. Coping with Water Scarcity. Addressing the Challenges. Springer, Dordrecht, 382 p.

Rodrigues G.C., Paredes P., Goncëalves J., Alves I., Pereira L.S., 2013. Comparing sprinkler and drip irrigation systems for full and deficit irrigated maize using multicriteria analysis and simulation modelling: Ranking for water saving vs. farm economic returns. Agricultural Water Management, 126: 85-96.

Smith R., Aghuar J., Caprile J., 1997. Sweet corn production in California. Vegetable Research and Information Center, Vegetable Production Series. Uni of Calif., Publication 7223.

Sweet Corn, 2010. University of Kentucky, College of Ariculture, Cooperative Extension Service

Zhivkov Zh., 2013. Irrigation of agricultural crops. Ed. Intel Eltrans, S., 211 p.