Assiut J. Agric. Sci., (48) No. (1-1) 2017 (331-346) *ISSN: 1110-0486*
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Effect of Water Stress on Maize Grown under Drip Irrigation System

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Received on: 7/11/2016 **Accepted for publication on:** 12/12/2016

Abstract

This study aims to evaluate the effect of water stress on growth, nutrients uptake and yield of maize grown under drip irrigation. For this purpose field experiment in a randomized complete block design (RCBD) was carried out at the Agricultural Experimental Station farm of the Faculty of Agriculture, Assiut University, Egypt during the during the summer seasons of 2014 and 2015. Maize plants were irrigated by 100 or 75% of water requirements (I_{100} and I_{75}).

The obtained results of this study show that the irrigation of maize by I_{100} significantly (*P*<0.05) increased the plant growth. Uptake of N, P, and K by maize irrigated by I_{100} increased by 11, 7 and 16 % in the first season and by 13, 11 and 15% in the second season compared to that irrigated by I_{75}. Increasing the irrigation level to 100% caused a 20 and 6% increase in the straw yield in the first and second season, respectively, also it caused a 20% increase in the biological yield in the first season compared to I_{75}. The grain yield of maize irrigated by I_{75} was higher by 5 and 10% in the first and second season, respectively, compared to I_{100}. Water use efficiency (WUE) was higher by 41and 56% in the first and second season, respectively, in the case of I_{75} compared to I_{100}. The data of the current study indicated that water stress caused a slightly reduction in the straw and biological yield of maize, on the other hand it caused a slightly increase in the grain yield.

From this study it recommended maize irrigated by 75% of water requirements was higher of grain yield than that received 100% of water requirements.

***Keywords**: Drip irrigation, Maize, Water stress, Nutrients uptake, Water Use Efficiency, Yield*

Introduction

It is well know that the water resources in Egypt are limited to the share of Egypt in the flow of the Nile River by 55.5 billion m^3. The deep groundwater in the deserts (mostly non-renewable) and a small amount of rainfall in the northern coastal area and Sinai. Meanwhile, water demand is continually increasing due to population growth, industrial development and the increase of living standards. Because of population growth, the per capita share of water has dropped dramatically to less than1000 (about 700) m^3/capita, which, by international standards, is considered the "water poverty limit". The value may even decrease to 584 m^3 /capita in the year 2025 (Abd El-Rahman, 2009). Water is the main limiting factor on yield production in the hot and dry summer period of semiarid regions. When water resources are a limiting factor in yield production, irrigation programs need to be applied to enable maximum production per unit of irrigation water. Deficit irrigation is one way of maximizing water use efficiency for higher yields per unit of irrigation water applied (Bekele and Tilahun, 2007). Water scarcity in the next decades is a real threat to food production especially in arid and semi-arid areas where water is the limiting factor in the expansion of cultivated land. Therefore, water management that maximize yield per unit of water consumed by plant is highly desired. In Egypt, limitation of water resources coupled with high population forced to a great competition for water supply that makes conservation and efficient use of water obligatory (Ibrahim, 1999; Gaber, 2000). This has stimulated the researchers to find new irrigation technologies, systems and irrigation strategies to improve water use efficiency. In modern irrigation systems, especially under arid or semi-arid conditions, water and nutrients are supplied simultaneously (fertigation). Under drip irrigation system water and nutrients have been used in highly efficient way.

Water stress (commonly known as drought) can be defined as the absence of adequate moisture necessary for normal plant grow and to complete the life cycle (Zhu, 2002). The lack of adequate moisture leading to water stress is common occurrence in rain fed areas, brought about by infrequent rains and poor irrigation (Wang *et al.,* 2005). Water deficits affect every aspect of plant growth, including the anatomy, morphology, physiology and biochemistry. In maize, the reduction in grain yield caused by drought ranges from 10 to 76% depending on the severity of the drought and the growth stage at which it occurs (Bolaoos *et al.,* 1993).

Maize is one of the most important cereal crops in the world. Moisture stress is an important factor affecting the growth of maize, especially in arid and semiarid regions (Eissa *et al.,* 2013). Maize has been reported in the literature as having high irrigation requirements and sensitive to water stress (Rhoads and Bennett 1990; Stone *et al.,* 2001). In arid and semi-arid regions, the daily evapotranspiration rates of maize often exceed 10 mm day^{-1} for significant time periods (Howell *et al.,* 1995). Maize are crops with high water requirements, have the ability to tolerate a short period of drought. However, water stress influences various physiological and biochemical processes. This may inhibit plant growth, decrease developmental activities of the cells and tissues and cause a variety of morphological, physiological and biochemical modifications. In contrast to other stress factors, drought stress does not occur abruptly, but develops slowly and increases with time in intensity and cause damages (Larcher, 2003). Drought affects water and nutrient supply to the plants thus affecting adversely plant development and yield (Jones and Qualset, 1984; Erdem *et al.* 2001). Water, being a universal solvent, is required for most of the metabolic activities of a plant and its shortage is expected to affect various physiological and biochemical processes in plants. Maize is one of the most important crops in the world and using drip irrigation in its production is commonly known. Irrigation and fertilization are crucial factors for successful establishment of annual food crops such as cereal crops (Eissa *et. al.,* 2013; Konopka *et. al.,* 2009). Maize is a major cereal crop in Egypt due to its importance in human nutrition, animal and poultry where intervention in the industry dry feed rates of up to 70% and in the baking industry by 20%, and also intervened in some industries such as extraction of glucose, fructose and oil.

The present research aims to determine the effect of water deficit treatments on: (1) the plant growth, (2) the N, P, and K uptake, (3) yield and yield components and (4) water use efficiency of maize in the semi-arid conditions.

Materials and Methods

Field experiment

The present investigation was carried out at the Agricultural Experimental Station farm of the Faculty of Agriculture, Assiut University, Egypt, which is located around the point of 27^{o}12 N latitude and 31^{o} 09 E longitude and at 51 m altitude. The soil was classified as TypicTorri Fluvents according to Soil Taxonomy (Soil Survey Staff, 2014). The main physical and chemical properties are summarized in Table 1. The experiment included two irrigation regimes (100% of water requirements and 75 %water requirements). The experimental design was randomized complete block design (RCBD) with three replicates. The experimental site was irrigated using a drip irrigation system. The in-line GR dripper laterals were installed 0.7 m apart. The emitters were spaced 0.30 m apart with a flow rate of 2.1 L h^{-1}. Maize grains (*Zea mays* L., cv Single Hybrid 10) at rates of 24 kg ha^{-1} were sown on the 14th June, 2014 and the 13th June, 2015 in the first and second season, respectively. Grains were sown on one side of the dripper's jet. Two grains were drilled in holes 3-4 cm deep and at 30 cm distance between plants spacing along the drip line and after 15 days the plants were thinned at one plant per each. The approximate plant population was 48000 plants per ha. All the agriculture practices were applied at the recommendations set by the Ministry of Agriculture and Land Reclamation (Egypt). 630 kg urea (46%N) per hectare was applied with the irrigation water at five equal doses applied weekly, started after 15 days of sowing, 149 kg of calcium super phosphate (15.5% P_2O_5) per hectare was added directly to the soil in one dose before planting. Potassium fertilizer at a rate of 120 kg potassium sulphate (48% K_2O) per hectare was added with the irrigation water in two equal does after 37 days and 50 days of planting to conserve it from teaching fertilizer rates.

Table 1. The main physical and chemical soil properties (0-30 and 30-60 cm) of the tested soil.

Properties	Unit	0-30 cm	30-60 cm
particle size distribution Sand (%)	(%)	24.1	24.3
Silt (%)	(%)	62.4	62.5
Clay (%)	(%)	13.5	13.2
Textural grade	-	Silty Loam	Silty Loam
Field capacity	(v %)	42.7	42.5
Witling point Bulk density	(v %) (Mg/m^3)	21.1 1.29	20.1 1.30
$CaCO_3$	(%)	5.42	5.08
pH (1:2.5 suspension)	-	7.54	7.78
EC (soil paste)	($dS\ m^{-1}$)	0.99	0.95
Organic matter	($g\ kg^{-1}$)	2.41	2.25
Total nitrogen	($mg\ kg^{-1}$)	560	520
Available nitrogen	($mg\ kg^{-1}$)	67.2	62.4
Available Olsen P	($mg\ kg^{-1}$)	11.78	11.32
Available-K		258.1	477.4

Each value represents a mean of three replicates

Calculation of irrigation water requirements

The daily reference evapotranspiration (ET_o) was estimated using Penman–Monteith's modified equation (Allen *et al.,* 1998). The actual evapotranspiration (ET_c) was calculated according the equation ($ET_c = ET_o \times K_c$). K_c values used for maize were 0.60, 0.83, 1.20, 0.90 for growth stages initial, development, mid, and end, respectively (Allen *et al.,* 1998). Based on the climate data in Table 2, the ET_c values for maize were calculated. The estimated ET_o was 698 and 687 mm and the ET_c was 645 and 634 mm in 2014 and 2015, respectively. The total irrigation water requirement during the whole growth season was 8344 and 8209 $m^3\ ha^{-1}$ in the first and second season, respectively (the application efficiency for drip irrigation (Ea = 85%) and the leaching fraction was considered as 10% of water requirement). The irrigation treatments started after 20 days of transplanting. During the first 20 days (initial stage), the maize plants were irrigated according to the calculated irrigation requirements, while in other stages (development, mid, and end) the plants irrigated by 100 or 75% of water requirements. Water use efficiency (WUE) was calculated using the equation (WUE = GY / ET_c), where GY equals grain yield, ET_c equals seasonal actual evapotranspiration (mm). Irrigation water use efficiency (IWUE) was estimated using the formula (IWUE = GY / IW), where IW equals seasonal crop water applied (mm). The data in table 3 show the actual evapotranspiration, consumptive water use and irrigation water applied at different maize growth stages during the summer seasons of 2014 and 2015.

Table 2. Average monthly maximum (T_{max}) and minimum (T_{min}) temperature, relative humidity (RH), wind speed (WS) and reference evapotranspiration (ET_o) during 2014 and 2015 growing seasons.

Month	T_{max}	T_{min}	RH (%)	WS ($km\ day^{-1}$)	ET_o (mm)
June,2014	37.8	22.3	33.2	148.8	7.54
July,2014	38.3	23.6	32.0	153.6	7.66
August,2014	38.4	23.9	33.8	172.8	7.67
September,2014	35.8	22.1	33.6	189.6	6.87
October,2014	31.3	16.9	36.7	117.6	4.44
June,2015	36.6	21.3	37.4	156.3	7.43
July,2015	38.8	22.8	35.9	98.4	6.74
August,2015	40.3	24.8	38.6	100.8	6.71
September,2015	38.5	23.8	38.5	175.2	6.93
October,2015	33.0	19.5	51.3	195.6	5.35

Rainfall was 0 for the two growth season. Data were obtained from Assuit weather station (Central Laboratory for Agricultural Climate).

Calculation of water consumptive use (CU)

Actual evapotranspiration was estimated by the sampling method and calculated according to the following formula:

$$C.U = \{D \times Bd \times (Q_2 - Q_1)/100\} / P$$

Where:

C.U. = actual evapotranspiration (cm).

D = soil depth (cm).

Bd = bulk density of soil (Mg/m^3).

P = water density (Mg/m^3).

Q_2 = the percentage of soil moisture one day after irrigation (field capacity)

Q_1 = the percentage of soil moisture before next irrigation.

Soil water content was monitored before and after each irrigation event starting 20 days after sowing at soil depth intervals of 0–30 and 30–60 cm. Soil samples were taken at positions immediately under the drippers by soil auger. The samples were weighted and then oven dried (105°C). Percentage of soil moisture content at the tow depths was calculated on oven dry basis. The amount of water consumed in each irrigation treatment was obtained from the difference between soil moisture content before the following irrigation and one day after irrigation (field capacity).

Collection of plant samples

Composite plant samples, each consists of three plants, were taken from each experimental unit after 60 days of planting. Plant height and fresh weights were recorded. These samples were cleaned, washed with tap and distilled water, air dried, then dried in oven at 70 °C until constant weight, ground and stored for chemical analysis. Maize plants were harvested on October 7th, 2014 and October 8th, 2015 in first and second seasons respectively and the grain and total yield were recorded. Also, weights of ears, weight of grain per ear and seed index (100 seeds) were recorded grain and straw samples from each experimental unit were taken.

Soil and plant analysis

Composite soil sample was collected before cultivation from the ar (0- 30, 30- 60) cm. Air-dried, crushed, and sieved through a 2-mm sieve. Then, the main physical and chemical properties of were determined according to Burt (2004). soil bulk density was determined using undisturbed soil samples of the different layers of the soil profile using cylinder method (Klute, 1986). The particle size distribution of soil samples was carried out according to the international pipette method (Klute, 1986). Soil pH was measured in 1:2.5 soil to water suspension using a digital pH meter. The electrical conductivity of the saturated soil paste (EC_e) was estimated using the salt bridge method (Rhoades, 1982). Organic matter was determined wet oxidation method by (K2Cr2O7 1N and H2SO4 conc.) and titrating with standardized 0.5 M [(NH4)2SO4.FeSO4.6H2O] according to (Jackson, 1973). Total calcium carbonate content was determined using a collins calcimeter. Available soil nitrogen was extracted by 2 M potassium chloride, and then nitrogen in the extract was determined using micro-kjeldahl method Burt (2004). The soil available phosphorus was extracted using 0.5 M sodium bicarbonate solution at pH 8.5 according to Olsen *et al.* (1954). The ratio of the soil to extract ant was 1:20and extract was filtered and measured calorimetrically using stannous chloride phosphomolybdic-sulfuric acid system as describe by (Jackson, 1973). Available potassium was extracted by (ammonium acetate 1M at pH 7 ratio 1: 10) method and measured by flame photometry(Jackson, 1973).

Plant samples were digested in H_2SO_4 and H_2O_2 as described by Parkinson and Allen (1975) then were analyzed for N, P, and K as described by Page *et al*. (1982).

Statistical analysis

Data obtained in each season were statistically analyzed. Statistical computer program MSTAT-C, Crop & Soil Sciences Dept. Michigan State University was used. Mean values were compared for each other using Duncan's test at *P*<0.05. MSTAT (1987) micro computer program.

Table 3. Daily reference evapotranspiration (ET_0) (mm), actual evapotranspiration (ET_c) (mm), water consumptive use (CU) (mm) and irrigation water applied (mm) at different maize growth stages during the summer seasons of 2014 and 2015

		Growth stage								Total		Average of the two seasons
		Initial stage		Development stage		Mid-season stage		Late-season stage				
		14 June to 3 July (20day)	13 June to 2 July (20day)	4 July. to 2 Aug. (30day)	3 July. to 1 Aug. (30day)	3 Aug. to 11 Sept. (40day)	2 Aug. to 10 Sept. (40day)	12 Sept. to 1 Oct. (20day)	11 Sept .to 30 Sept. (20day)	14 June. to 1 Oct. (110 day)	13 June to 30 Sept. (110 day)	
		2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	
ET_0 (mm)		137.50	137.10	199.30	200.50	257.90	257.90	103.05	91..44	697.75	686.94	692.35
ET_c (mm)	100%	82.50	82.26	165.98	166.25	303.55	303.55	92.75	82.29	644.77	634.35	639.56
	75%	82.50	82.26	124.48	124.69	227.66	227.66	69.56	61.72	483.58	475.76	479.67
(C.U) mm	100%	==	===	180.53	185.41	325.32	335.24	91.32	93.95	597.17	614.60	635.89
	75%	===	===	139.30	143.43	235.51	240.12	70.23	65.41	445.04	448.96	447.0
Applied irrigation water (mm)	100%	106.76	106.45	214.79	215.14	392.83	392.83	120.02	106.50	834.41	820.92	827.67
	75%	106.76	106.45	161.09	161.36	294.62	294.62	90.02	79.87	625.18	615.69	620.44

Results and Discussion

1. Effect of water stress on the growth of drip irrigated maize

The data in Fig. 1, 2, and 3 show the effect of the irrigation levels on the growth of 60 days-old maize. The irrigation of drip irrigated plants by I_{100} significantly (*P*<0.05) increased the plant height and fresh and dry weights by 5, 12, and 3% in the first season and by 6, 11, and 8% in the second season compared to I_{75}. It is clear that all the measured growth characters negatively affected by the lower water supply treatment as compared with the normal water supply treatment in both seasons. These results are in agreement with those obtained by Abd El-Hafez *et al*. (2001), Abdel Aziz and El-Bialy (2004), Galbiatti *et al.* (2004) and Omran (2005) who concluded that yield and its attributes of maize plants were gradually increased as a result of increasing in the availability of soil moisture content. The availability of water is an important factor in the growth of maize plants. Maize is one of the most efficient field crops in producing higher dry matter per unit quantity of water (Viswanatha *et al.*, 2002; Megyes *et al.,* 2005). Meleha (2006) reported that growth of maize is highly related to irrigation depth and it increases with increasing the irrigation level. These results are in harmony with those obtained by Abd El-Hafez *et al.* (2008), Abdel Maksoud *et al.* (2008) and Kara and Biber (2008).

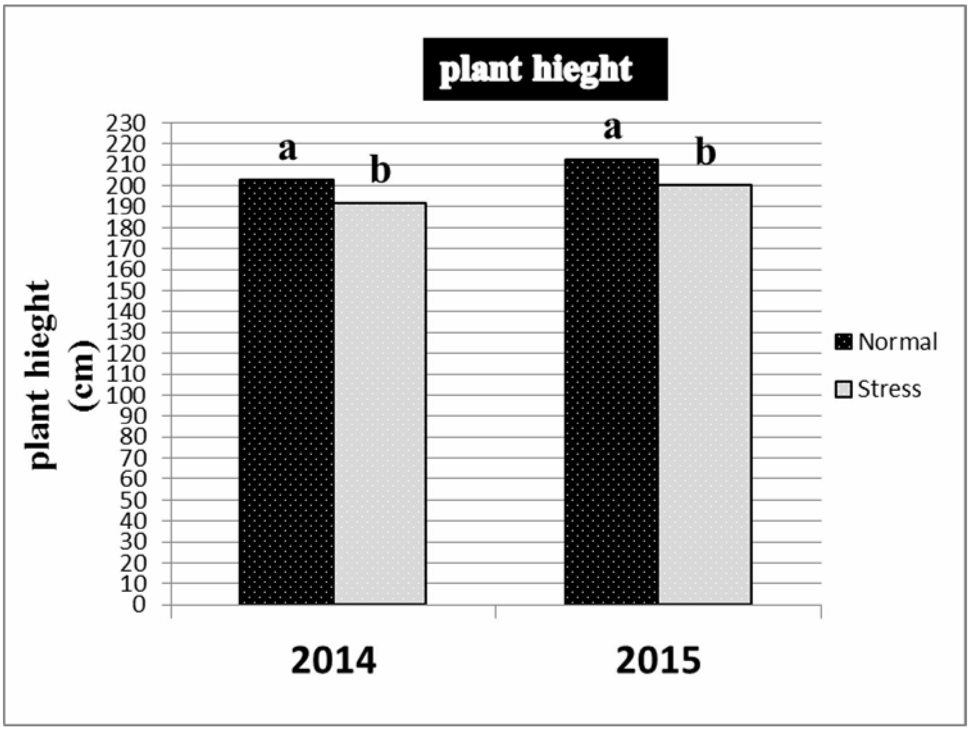

Fig. 1. Plant height of 60 days-old maize (cm) as affected by irrigation rates

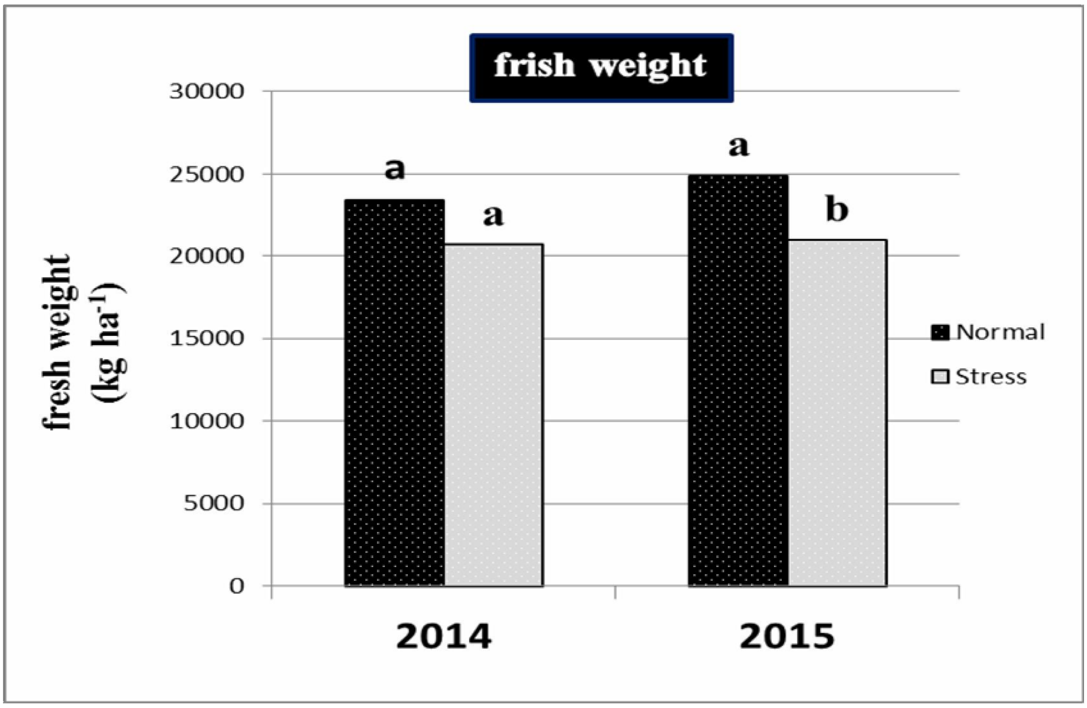

Fig. 2. Fresh weight (kg/ ha) of 60 days-old maize as affected by irrigation rate.

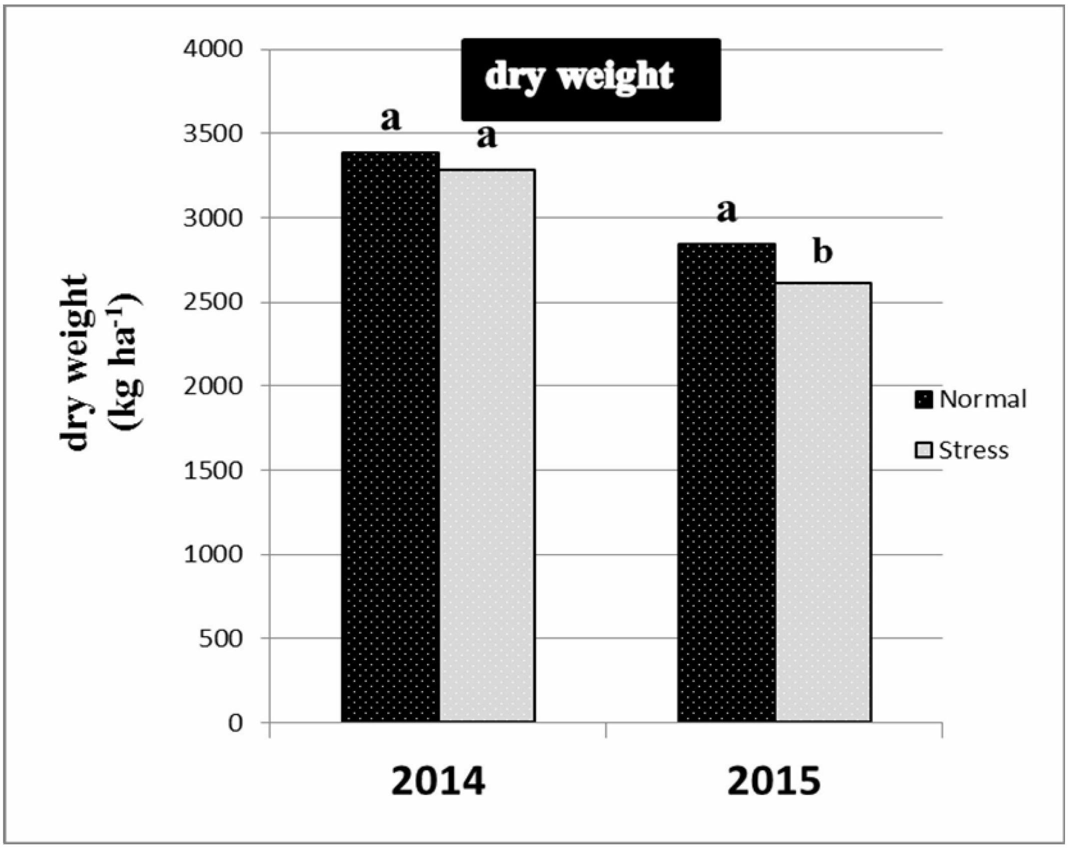

Fig. 3. Dry weight (kg/ ha) of 60 days-old maize as affected by irrigation rate.

2. Effect of water stress on the N, P, and K uptake by drip irrigated maize

Nitrogen (N), phosphorus (P), and potassium (K) concentrations and uptake by 60 days-old maize affected significantly (*P*<0.05) by the irrigation levels as shown in Table 4. Increasing the irrigation level to 100% of water requirement increased the uptake and concentrations of N, P, and K in the shoot tissues of 60 days-old maize. Nitrogen concentrations in the shoots of maize irrigated by I_{100} were higher by 22 and 4% than those irrigated by I_{75} in the first and second season, respectively. Phosphorus and potassium concentrations in the shoots of maize irrigated by I_{100} were higher by 16 % than those irrigated by I_{75} in the first season. Uptake of N, P, and K by maize irrigated by I_{100} increased by 11, 7 and 16% in the first season and by 13, 11 and 15 % in the second season compared to that irrigated by I_{75}. The current study clearly showed that water stress reduced the concentrations and uptake of N, P, and K by drip irrigated maize. From the previous results it could be mentioned that the increase of N, P and K% in maize plants may be attributed to increasing of soil moisture. As soil moisture content increased solubility and mobility of N, P and K are increased (El-Nagar, 2003; Othman-Sanaa *et al.,* 2005; Ibrahim and Kandil, 2007). Deficit irrigation had a negative effect on N, P, and K concentrations in the shoots of maize plants. As a result of vegetative growth reduction, the absorption of nutrient elements could be decreased (Pascale *et al.*, 2001). Similar results were obtained by Silber *et al.* (2003).

Table 4. The concentrations N, P, and K (g kg^{-1}) and uptake (kg ha^{-1}) by 60 days-old maize as affected by the irrigation rates

Irrigation level	2014						2015					
	N		P		K		N		P		K	
	conc.	Uptake	conc.	Uptake	conc.	Uptake	conc.	Uptake	conc.	Uptake	conc.	Uptake
I_{100}	25.30^a	86.16^a	5.58^a	18.13^a	22.97^a	75.99^a	23.17a	66.02^a	5.94^a	15.64^a	23.11^a	66.01^a
I_{75}	20.80^b	77.48^b	5.15^a	17.01^a	18.93^b	65.40^b	22.33^a	58.48^b	5.48^a	15.61^a	21.91^a	57.14^b

Means denoted by the same letter indicate no significant difference according to Duncan's test at *P*<0.05

3. Effect of water stress on ears weight, grains weight per ear, and seed index of drip irrigated maize

The data in Table 5 show the ears weight (EW), grains weight per ear (GWE), and seed index (SI) of drip irrigated maize as affected by the irrigation treatments. In general the irrigation treatments have significant effects in the mentioned parameters. The low level of irrigation (I_{75}) caused a 9 and 5 increases in the ears weight (EW), grains weight per ear (GWE) in the first season and 7 and 10% in the second season compared to the high level of irrigation (I_{100}). Also the low level of irrigation (I_{75}) caused a 8 and 10% decrease in the seed index (SI) in the first and the second season compared to the high level of irrigation (I_{100}). The current study indicated that water stress increased the ears weight (EW) and grains weight per ear (GWE) of drip irrigated maize. Our results were in agreement with the results of Mansouri-far *et al.* (2010). They reported that when the amount of water decreased, the seed index was decreased. Also, Ogretir (1993) reported that the application of deficit irrigation on maize at the flowering period decreased the seed index.

Table 5. Ears weight (EW), grains weight (GWE) per ear, and seed index (SI) (gm.) of maize as affected by irrigation rates

Irrigation level	2014			2015		
	EW	GWE	SI	EW	GWE	SI
I_{100}	106.86^{b}	85.14^{a}	28.77^{a}	104.87^{b}	72.00^{b}	27.97^{a}
I_{75}	116.15^{a}	89.48^{a}	26.27^{b}	112.42^{a}	79.46^{a}	25.23^{b}

Means denoted by the same letter indicate no significant difference according to Duncan's test at P<0.05

4. Effect of water stress on yield and yield components of drip irrigated maize

The data in table 6 show the effect of irrigation treatments on the yield of drip irrigated maize. Irrigation treatments did not have any significant effects on the biological yield of maize in the two seasons. The irrigation treatments affected significantly on the grain and straw yield in the first season, but did not have any significant effects on the second season. However, the grain yield of maize irrigated by I_{75} was higher by 5 and 10% in the first and second season, respectively, compared to I_{100}. Increasing the irrigation level to 100% of water requirements caused a 20 and 6% increase in the straw yield in the first and second season, respectively, also it caused a 20% increase in the biological yield in the first season. The data of the current study indicated that water stress caused a slightly reduction in the straw and biological yield of maize, on the other hand it caused a slightly increase in the grain yield. These results are in agreement with those obtained Hammad and Ali (2014) who studied the effect of irrigation treatments (irrigation after the depletion of 50 and 80% of available soil water) and they found that increasing irrigation level increased the plant highest and shoot dry mater biomass by 31 and 73%, respectively. Increasing the plant highest and dry mater biomass will increase the straw yield rather than grain yield. Our findings are in agreement with Zhang and Oweis (1999), Zhang *et al.* (1999) and Kanga *et al.* (2002).

Table 6. Grain (GY) straw (SY), and biological yield (BY) (kg ha $^{-1}$) of maize as affected by irrigation rates.

Irrigation level	2014			2015		
	GY	SY	BY	GY	SY	BY
I_{100}	8004^{a}	25108^{a}	33112^{a}	6769^{a}	23127^{a}	29896^{a}
I_{75}	8411^{a}	21366^{b}	27444^{b}	7453^{a}	21740^{a}	29193^{a}

Means denoted by the same letter indicate no significant difference according to Duncan's test at P<0.05

5. Effect of water stress on water use efficiency of drip irrigated maize

The data in Fig. 4 and 5 show the water use efficiency (WUE) and irrigation water use efficiency (IWUE) of maize as affected by the different irrigation levels. Irrigation treatments affected significantly in the WUE and IWUE in the two growth seasons. WUE was higher by 41and 56% in the first and second season, respectively, in the case of I_{75} compared to I_{100}. IWUE of the wheat plants irrigated by I_{75} was higher by 41 and 40% in the first and second season, respectively, compared to I_{100}. Under water stress water was used efficiently more than normal irrigation. The higher values of water use efficiency observed under water stress treatment as compared to normal irrigation was mainly due to less water applied for these treatments and the high obtained grain yield. These results are in agreement with those repents by Howell *et al.* (1995). Zhang *et al.* (2004) reported that it is feasible to reduce irrigation amount in a certain growing stage of maize to maximize the irrigation water productivity. Deficit irrigation is one of the most important ways of maximizing water use efficiency (Bekele and Tilahun, 2007).

Conclusions

A field study for two years was conducted to evaluate the response of drip irrigated maize to water stress. Increasing the irrigation water to 100% increased the plant growth, nutrients uptake, and biological yield of maize. The grain yield of maize irrigated by 75% of water requirements was higher by 5-10% than that received 100% of water requirements. Irrigation the drip irrigated maize by 100% of water requirements increased the vegetative growth rather and this increased the straw and lead to a slightly reduction in the grain yield. Under drip irrigation system maize can be irrigated by only 75% of water requirements without any loss in the grain yield.

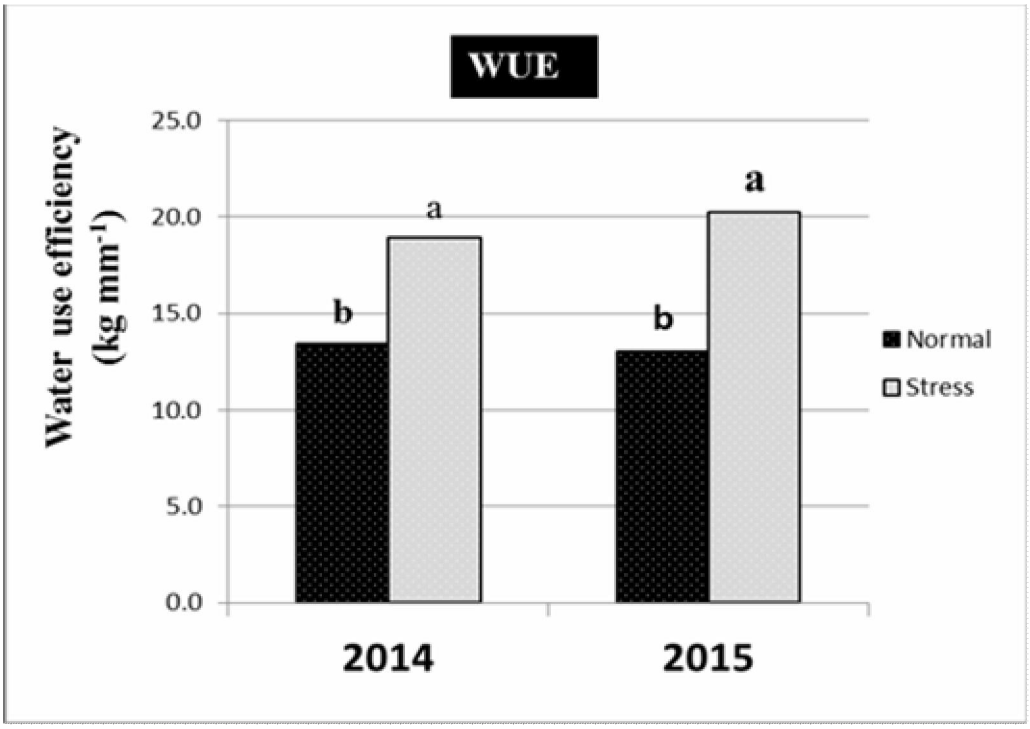

Fig 4. Water use efficiency (WUE) (kg grain yield mm^{-1} of water) of maize as affected by irrigation rates.

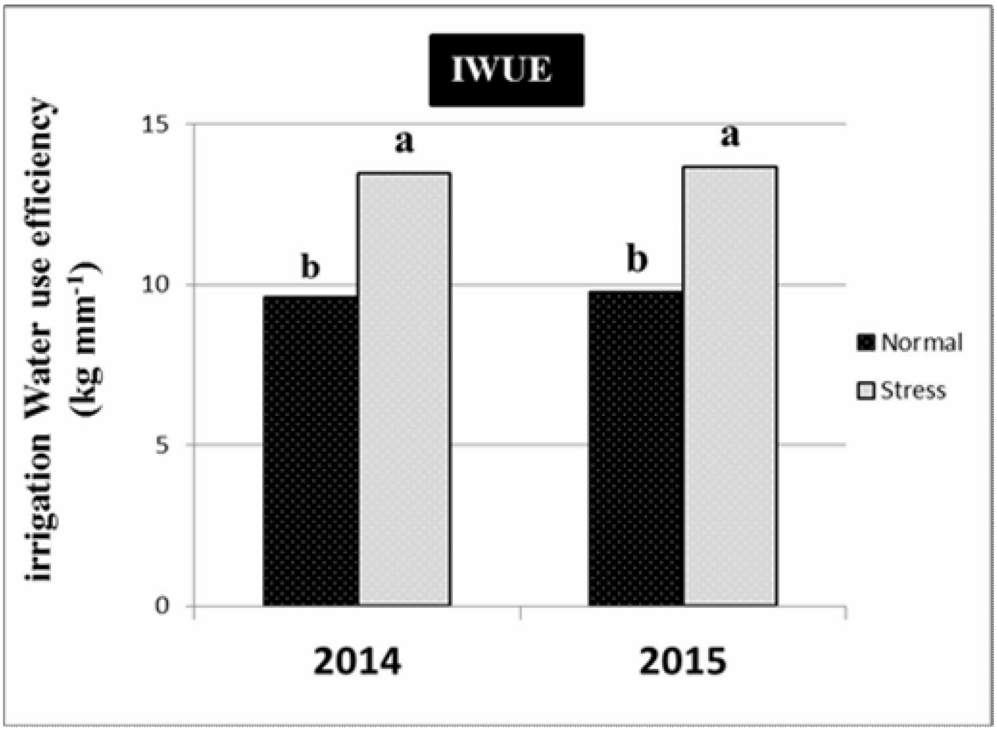

Fig 5. Irrigation Water use efficiency (IWUE) (kg grain yield mm^{-1} of water) of maize as affected by irrigation rates.

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تأثير الاجهاد المائي علي الذرة الشامية النامية تحت نظام الري بالتنقيط

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الملخص

وتهدف هذه الدراسة تقييم تأثير الإجهاد المائي على نمو وامتصاص العناصر الغذائية لمحصول الذرة الشامية النامية تحت نظام الري بالتنقيط. وأجريت تجربة حقلية كان تصميم التجربة قطاعات كاملة العشوائية (RCBD) في محطة البحوث الزراعية – كلية الزراعة– جامعة أسيوط– مصر خلال موسمي الصيف من عامي ٢٠١٤ و ٢٠١٥.

أهم النتائج التي أمكن التوصل اليها من خلال الدراسة نباتات الذرة المروية بـ ١٠٠ أو ٧٥% من الاحتياجات المائية (I_{100} و I_{75}). أدي ري الذرة الشامية بـ I_{100} إلى تاثير معنوي في زيادة نمو النبات وزيادة إمتصاص N وP وK في الذرة الشامية بنسبة ١١و٧ و١٦ % في الموسم الأول وبنسبة ١٣ و١١ و١٥ % في الموسم الثاني مقارنة المروية بـ I_{75}. وزيادة مستوى الري بنسبة ١٠٠% تسبب في زيادة بنسبة ٢٠و٦ % في محصول القش في الموسم الأول والثاني،على التوالي، كما أنه أدى إلى زيادة ٢٠% في المحصول البيولوجي في الموسم الأول مقارنة بـI_{75} . وكان محصول الحبوب في الذرة الشامية المروية بـ I_{75} أعلى بنسبة ٥ و ١٠ % في الموسم الاول والثاني، علي التوالي. كفاءة استخدام المياه (WUE) كانت أعلي بنسبة ٤١ و٥٦ % في الموسم الاول والثاني علي التوالي في I_{75} مقارنة بـ I_{100} . بيانات الدراسة الحالية تشير إلى أن الإجهاد المائي تسبب انخفاضا طفيفا في محصول القش والبيولوجي للذرة الشامية ، ومن ناحية أخرى فإنه بسبب زيادة طفيفة في محصول الحبوب.

من نتائج هذة الدراسة يمكن التوصية الذرة المروية بنسبة ٧٥% من احتياجاتها المائية كان أعلى في إنتاج الحبوب من التي تروي بنسبة ١٠٠ % من الاحتياجاتها المائية.

الكلمات المفتاحية : الري بالتنقيط ، الذرة الشامية ، الاجهاد المائي ، امتصاص العناصر الغذائية ، كفاءة استخدام المياه ، المحصول.