Effect of different levels of irrigation on some components of maize

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Abstract: Due to lack of water resources in arid and semi-arid regions, this study aimed to investigate the effect of different levels of irrigation on some components of maize under drip irrigation at Research farm, Faculty of Water Engineering, Shahid Chamran University of Ahwaz, in a complete block design Random was executed. Treatments included irrigation based on 100%, 75% and 50% of aquatic plant requirement. Analysis of variance showed that water stress had a significant effect on yield and yield components at 1% probability level. The highest grain yield and biomass in irrigation treatments were 100% and 8.30 and 20.28 ton / ha, respectively, and the lowest values were observed in treatments 50%, 4.38 and 16.47 t ha-1, respectively. Also, the highest plant height, ear length and harvest index were 173.22 cm, 23.83 cm and 41.01 respectively in irrigation treatments of 100% water requirement and the least values of these parameters were 135.27 cm, 20.73% Cm and 26.63 in 50% water requirement.
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1. Introduction

In most parts of the world, especially in Iran, in the dry and semi-arid belt, the main factors limiting agricultural production are water scarcity. In recent decades, due to the increase in the level of Faryab land and the drilling of wells in the country, the use of groundwater resources for irrigation has increased significantly. According to estimates, the groundwater balance is negative at the national level and the water deficit is at least 4 billion cubic meters (Khorsandi et al., 2010). One of the undesirable consequences of this is reducing the water level in the wells to lower levels of groundwater aquifers (Nasrollahi, 1393). Also, recent droughts and the decline in surface runoffs emphasize the need for more water management (Mohammad Hassan Lee et al., 2012). Therefore, it is important to use any method to save water and increase the area under cultivation. One of these is low irrigation. Low irrigation is a strategy to make products under water shortage conditions, coupled with product cuts, and is a measure that determines the limit for water use and surface area yields (Sepaskhah et al., 2006). On the other hand, new methods of irrigation under pressure include ways to increase yield, increase irrigation efficiency and water use efficiency.

Of the new irrigation systems, the drip irrigation system, which is located in a series of irrigation systems, is one of the methods that has found a special place in agriculture. Studies show that drip irrigation can cause water to be distributed uniformly, accurately control water use, reduce evaporation and deep penetration, increase yield and reduce soil degradation and salinity (Karlberg and Fritz, 2004).

In a study by Karimi et al. (2011), the performance and water use efficiency at different levels of maize water requirements including 80, 100 and 120% in striped drip irrigation system were investigated. The highest yield was obtained by treatment of 120% water requirement with the amount of 12.9 tons per hectare and water consumption efficiency of 1.96 kg / m 3.

Masjedi et al. (2008) for Hybrid Single Cross 704 maize under favorable conditions, biological yield was 24.55, grain yield was 12.14 tons per hectare and harvest index was 49.4.

Far and Fasi (2009) used low-irrigation in different stages of maize. The results showed that flowering is the most sensitive stage to low irrigation in maize. Irrigation at this stage reduced biomass, yield and harvest index. The average grain yield in stress condition at flowering stage was 6.91 ton / ha and had a significant difference in grain yield in full irrigation.

The effects of water stress on yield and yield components of maize in Kerman province showed that the effect of low irrigation was significant in different ways and the best method for applying low irrigation for maize is local root dryness method (Rezaei Orakviye et al., 2012).

Artek and Kara (2013) studied the effect of low irrigation on levels of 100%, 85%, 55% and 40% of water requirement on maize yield. The results of this study showed that the highest amount of evapotranspiration was due to irrigation treatment and the lowest was 40% water requirement. Also, the highest and lowest yields were with 14.857 and 11.515 tons per hectare, respectively, for 100 percent and 40 percent water requirement respectively.

Soltani Mohammadi (2011) investigated the interaction of water stress and salinity on grain yield and yield components of maize in different stages of growth in Ahwaz climate. The experiments were carried out at three levels of irrigation, three levels of salinity and three stages of vegetative growth, flowering and after flowering. The results showed that interaction of water stress and salinity in all three experiments was not significant on studied traits (number of seeds per ear, 100 seed weight, grain yield, biological yield and harvest index).

The results of the study, Josie et al. (2011), showed that the effect of different irrigation levels on yield and yield components of sunflower plant in Ahvaz was significant at 1% probability level.

Osborne et al. (2002) reported that stress caused by water shortage in pre-flowering, flowering and flowering stages reduced maize yield by 25, 50 and 21 percent, compared to control treatment.

Reducing water resources and increasing prices today has pushed farmers to use high-efficiency irrigation systems to irrigate crops.

In the past few decades, the possibility of using drip irrigation methods for different crops has been investigated and it has been determined that under equal conditions, drip irrigation method can reduce irrigation water for different products than conventional irrigation methods.

Due to the water crisis in arid and semi-arid regions, the use of water management techniques in the field such as low irrigation techniques in agricultural production is necessary. The purpose of this study was to investigate the effect of different levels of irrigation on some grain maize yield components in Khuzestan.

2. Material and Methods

This research was carried out at the experimental farm number 1 of the Faculty of Water Engineering, Shahid Chamran University of Ahwaz, with a geographical position of 48 degrees and 39 minutes of east and 31 degrees and 18 minutes of northern latitude and 20 meters above sea level. The cultivar K SC 705 was planted on March 21, 1395 in plots measuring 3 × 3 (m / m) with four rows of cultivars at a distance of 75 cm and a length of 3 meters and a density of 70000 plants per hectare. Harvest operations were carried out on June 28, 1396 done.

This research as conducted as split plot based on RCB design in 3 levels and 3 replications. The treatments are: I1 Complete irrigation equivalent to 100% plant water requirement, I2: 75% plant water requirement and I3: 50% plant water requirement. For whole treatments, till the initial stage of growth (6-8 leaf), irrigation was complete and irrigation treatments were applied after this stage.

The irrigation system was in the form of a drop that was made through irrigation tapes. In order to determine the irrigation time and volume, the data of the Class A evaporation pan was used in the field. Through the volume meter on the main pipeline, the amount of water entered into each plot was obtained. In Tables 1 and 2, the average values of qualitative irrigation water quality and soil during the growing season are presented.

For analyzing the parameters studied, the number of seeds per ear, biological yield, grain yield, 1000 grain weight and water productivity index from SAS software were used and for plotting the charts using EXCEL program, and the test of comparison of the meanings by multi-domain test method O Duncan did.

Table 1. Quality Characteristics of Irrigation Water

EC (ds/m)	pH	Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	Hco_3^-	Co_3^{2-}	So_4^{2-}	Cl^-	Treatment
		(meq/l)								
1.98	8.26	9.3	7.2	10.53	0.04	5.7	0	9.75	12.20	I

Table 2. Physical and chemical properties of the plot tested

Depth (cm)	PWP (Percentage of mass)	FC (Percentage of mass)	pH	Ec (ds/m)	Bulk density (g/cm^3)	soil pattern	Particular Frequency and Particle Size (Percent)		
							sand	silt	clay
0-30	11.06	21.54	7.92	3.68	1.42	L	39.3	45.6	15.1
30-60	10.93	22.16	8.09	4.05	1.40	L	36.7	48.5	14.8
60-90	10.88	21.69	8.13	4.33	1.40	L	37.8	46.2	16

3. Results and Discussions

The results of variance analysis showed that the effect of different levels of irrigation on plant height, ear length, biological yield, grain yield and harvest index had a significant effect on 1% probability level. (Table 3)

Table 3. Results of variance analysis

Mean Squares (MS)						
Harvest index	grain performance	Biomass	Ear length	Plant height	Degrees of freedom	Source of change
0.9015	0.01350	0.04430	0.07620	0.5216	2	Treatment
**156.3920	**11.6620	**11.4946	**7.2484	**1083.947	2	Irrigation levels
0.21836	0.005956	0.02170	0.1361	1.905864	4	Error
1.3659	1.193	0.7904	1.662	0.898		CV%

ns: is not statistically significant, **: significant at the one percent level, *: significant at the five percent level

Plant height:

According to the results of the comparison test, it is considered that the plant height in different irrigation levels is different at different levels. The highest plant height with an average of 173.22 cm was observed for I1 irrigation and the lowest for irrigation I3 with an average of 135.27 cm.

As a result, with decreasing irrigation water, plant height also decreased significantly (Fig. 1). According to the mean comparison results, maize plant height in I2 and I3 was 12% and 22% lower than control I1, respectively.

Ear length:

As the analysis of variance table showed, irrigation effect was effective at 1% probability level on ear length. Comparisons of meanings also indicated that with decreasing irrigation percentage, ear length decreased. Thus, the maximum length of the ear was 23.83 cm in I1 treatment and the minimum clip length was 20.73 cm in I3 treatment, which was 13% lower. The changes in the length of the ear in different irrigation treatments are presented in Fig. 2.

Fooratan (2011). In studying the effect of irrigation levels on maize yield in Ahwaz, the highest ear length was reported for 100% water requirement with a mean 15.98 cm and the lowest ear length was reported for 60% water requirement with a mean of 11.77 cm.

Sadeghi et al. (2007) in evaluating the effect of different levels of irrigation on yield and yield of four cultivars of maize, the effect of drought stress on ear length was significant at 1% probability level And the highest ear length was obtained in non stress conditions with an average of 16.2 cm and the lowest ear length in severe stress conditions with an average of 14.5 cm.

Biomass:

Comparison of mean showed that with decreasing irrigation percentage, biological yield also decreased significantly. So that the highest biological yield (20.28 ton/ ha) was obtained in 100% irrigation and 50% irrigation showed the lowest biological yield (16.47 ton/ ha). Also, the amount (19.17 ton/ha) in irrigation was 70% (Fig. 3). In non-stress conditions, with increasing soil moisture, the airborne mass increases, while in the conditions of water stress, the air organs quickly lose their water (Alizadeh, 2002). Therefore, in this condition, the dry weight of the shoot is reduced by reducing vegetative growth and decreasing the photosynthesis.

Paknejad et al. (2006) showed that dry weight and irrigation methods on yield and yield components of maize hybrids showed that biomass decreases due to drought stress and its amount in control treatment was lower than all treatments, Shows more.

grain yield:

In the study of irrigation effect on grain yield, it was observed that reduction of irrigation percentage decreased tonnage per hectare.

In irrigation, 100% and 50% respectively were the highest (8.30 ton/ha) and the lowest (4.38 ton/ha) of grain yield and in irrigation treatment, 70% (6.71 ton/ha), respectively (Fig. 4). The amount of water consumed in I2 and I3 treatments was 20.7% and 41.4%, respectively, and decreased yield by 19% in I2 treatment and 47.2% in I3 treatments. This great difference in yield can be attributed to the fact that the application of drought stress to the plant reduces the size and / or stops the growth of the leaves and reduces the plant's photosynthetic surface, thereby reducing plant growth and, finally, reducing yield Seeds and biological yields (Pairo et al., 2006).

Harvest index:

Harvest index is a criterion for expressing the economic ratio to total production, which is especially important in managerial decisions and promotional recommendations. According to the results of analysis of variance, the irrigation percentage was significant on harvest index at 1% level. Comparison of means showed that the highest harvest index was obtained in I1 treatment with a mean of 1.01. At the same time,

with decreasing irrigation percentage, the harvest index was decreased by 14% in I2 treatment and 35% in I3 treatment compared to control (Fig. 5).

Sinkler et al. (1990) argue that the harvest index of maize is practically constant because, as drought stress reduces grain yield, total dry weight also decreases unless severe stress reduces grain yields and thus the harvest index Decreases. Pandie et al. (2001) also found that harvest index under water stress condition was more sensitive to unfavorable growth compared to vegetative growth.

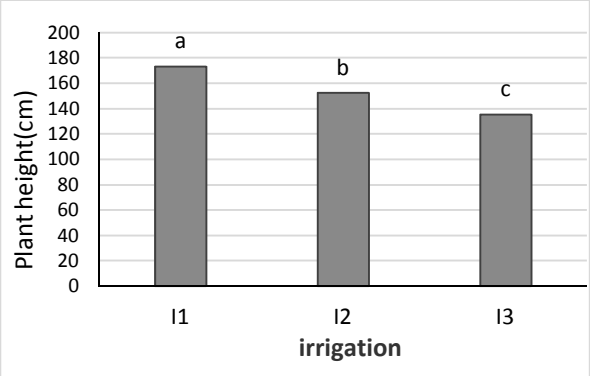

Figure 1. The effect of irrigation levels on plant height

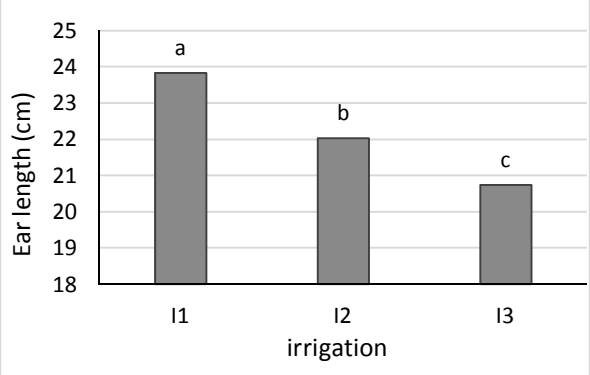

Figure 2. The effect of irrigation levels on ear length

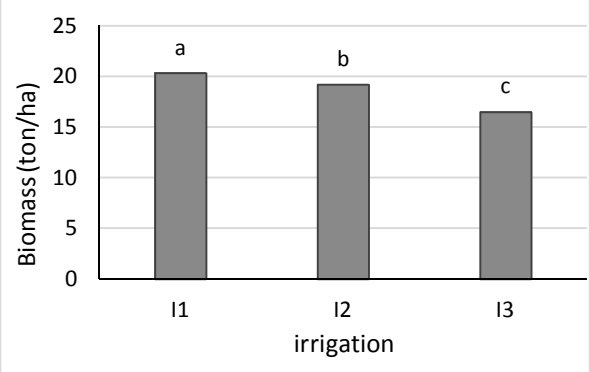

Figure 3. The effect of irrigation levels on biomass

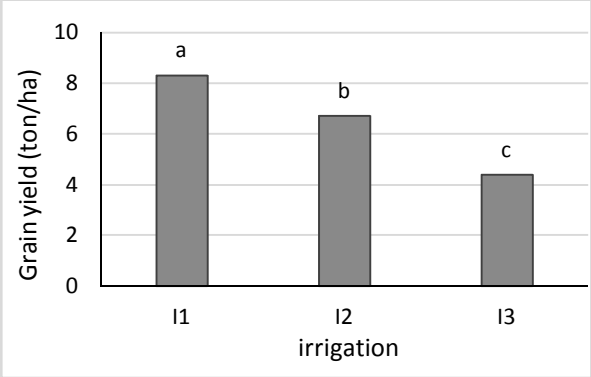

Figure 4. The effect of irrigation levels on grain yield

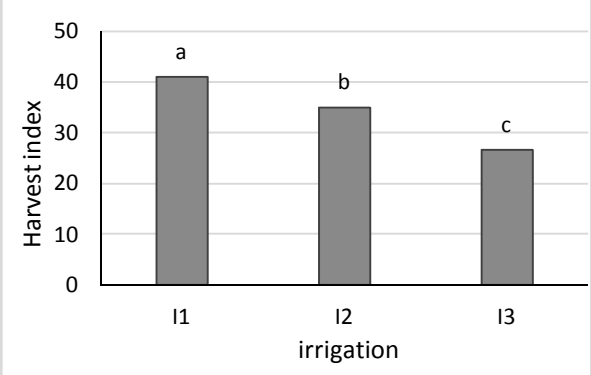

Figure 5. The effect of irrigation levels on harvest index

According to the results of similar studies, products with higher yields are more sensitive to water scarcity. For example, the species of maize that have more yield than conventional ones under reduced irrigation conditions (Saberi et al., 2006).

In order to investigate the effect of drip irrigation and planting arrangement on maize yield in Moghan region, the effect of different levels of irrigation on grain yield and other traits was significant at 1% probability level and the highest grain yield The irrigation regime was 125% water requirement with the amount of 8.23 ton/ ha and the lowest yield was 50% water treatment with 5.25 ton/ha. Findings of Karimi et al. (2011), Artek and Kara (2013) and Jozezi et al. (2011) confirm the above results.

4. Conclusion

By reducing irrigation levels from I1 to I3, all yield traits were significantly reduced So that irrigation of 75% of the water requirement of the plant caused the plant height, ear length, biological yield,

grain yield and harvest index compared to the control treatment, respectively, 12, 7, 5, 19 and 14%.

And 50% water irrigation reduced the mentioned traits by 22, 13, 18, 47 and 35%, respectively.

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