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Full Length Research Paper

Impacts of irrigation and non-irrigation conditions on some morphological traits of corn (*Zea mays* L.) cultivars

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In order to study of impacts of irrigation and non-irrigation conditions on some morphological traits of corn (*Zea mays* L.) cultivars, a factorial experiment based on randomized complete block design with three replications was arranged at Ardabil, Iran, in 2010. Factors included eight maize cultivars (BC 678, BC 418, SC 700, BC 582, SC 301, BC 652, BC 566 and SC 704) and two conditions of planting (irrigation and non-irrigation). Results showed that leaf number, plant height, ear diameter without skin, ear weight per plant and grain yield in irrigated were higher than non-irrigated conditions. SC 700 and BC 566 have the highest and lowest traits respectively among the eight maize cultivars. The result shows that the grain yield in irrigated and non-irrigated conditions, the SC 700 varieties in non-irrigation farming about 20.17% (Whit 10688 kg/ha yield) and Bb C 566 cultivar about 22.09 percent (Whit 4330 kg/ha yield) have loss of yield than irrigated condition. Thus, SC 700 cultivar was the superior cultivars under both conditions in terms of high yield and it was distinguished as the most susceptible cultivar as well.

Key words: Corn cultivar, yield, plant high and ear diameter.

INTRODUCTION

Maize (*Zea mays* L.) is an important cereal crop of Iran. It is grown for fodder as well as for grain purpose in Iran. Approximately 320,000 hectares of field corn were grown with a production of 2560000 tons, an average grain yield of 8000 Kg per hectare was reported in Iran in 2010 (Nuraky et al., 2011). Corn (*Zea mays* L.) is one of the most important cereal crop grown principally during the summer season in Iran. The yield of corn in Iran is very low as compared to other corn producing countries (Seyed and Pirzad, 2011). It is well established that the majority of the people in the developing countries depend mainly on cereal grains as their staple food due to limited income and the high prices of animal foods (Awad et al., 2011). Hudak and Patterson (1995) showed that irrigation during seed filling period, improves yield. Also, in another work, it was reported that three times irrigations during seed filling period, increased the yield (Eskine and Ashkar, 1993). Stress appearance during the reproductive stage, reduces seed weight (Katerji et al., 2000). Amount of the yield loss depends on the stress range and plant growth stage at which, stress occurred. In fact, plant susceptibility to stress varies from germination to the maturity (Schmidtke et al., 2004).

One of the main drought resistance factors in plants is the ability of cells to tolerate a large amount of loosed water without serious un-repairable damages. As the cell losses water, vacuole usually crumples more than cell wall, so it causes the silt in the protoplasm. It seems that such damage results in the death of cells (Lessani and Mojtahedi, 2003). Yield loss of the plants under water deficit is one of the most important events for the plant

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Table 1. Analysis of variance for study traits.

S.V	DF	MS				
		Number of leaf	Plant height	Ear diameter without the skin	Ear weight per plant	Grain yield per hectare
Replication	2	0.021 ns	112.52 ns	0.609 ns	0.022 ns	742862.08 ns
planting conditions (C)	1	21.708**	10346.46**	2.655**	2.385**	66811602.08**
Cultivar (V)	7	0.68 ns	1185.506**	0.933*	0.991**	33817817.51**
C × V	7	0.297 ns	22.431 ns	0.189 ns	0.054 ns	1772736.94 ns
Error	30	0.384	171.35	0.309	0.062	4527178.68
CV %	-	7.94	7.26	13.41	16.13	23.55

*, ** and ns, significantly in 5%, 1% and non-significantly, respectively.

breeders to improve yield but difference in the yield potential mainly relates to the adaptation factors than merely to the stress itself, so, drought resistance indices are used to determine resistant genotypes (Mitra, 2001). Rate seasonal distribution of precipitation, temperature difference and soil conditions are of important factors affecting yield and yield components of sesame in the arid and semi-arid regions (Nath and Chakrabotry, 2001).

Fredrick et al. (2001) found that drought stress has no effect on the seed yield of the main stem of the determinate soybean, however; this is a main part of the total yield. Also, they realized that the ratio of seed yield of the main stem to the total seed yield was low in the stress conditions than normal (irrigated). In this condition, harvest index of the main stems was low for the irrigated soybeans. They illustrated that the number of main stems and seeds per main stem was not affected by drought stress. In addition, correlation between seed yield of the main stem and weight of the individual seeds per main stem was insignificant. Desclaus et al. (2000) and Foroud et al. (1993) reported that water deficit results in the decrease in the number of flowers, pods, seeds per pod, pod size and seed weight.

The aim of this research was to study the Impacts of irrigation and non-irrigation conditions on some morphological traits of corn (*Zea mays* L.) cultivars, and determining the most resistant and susceptible cultivars under drought conditions.

MATERIALS AND METHODS

A factorial experiment based on randomized complete block design with three replications was arranged at the agricultural research station of the Islamic Azad University, Ardabil Branch, Ardabil, Iran in 2010. Ardabil has cool winters and moderate springs and summers (38˚ 15' N, 48˚ 15' E) with an average annual precipitation of 400 mm and 1350 m height from sea level. Factors included two conditions of planting levels (irrigated and non-irrigated) and eight maize cultivars (BC 678, BC 418, SC 700, BC 582, SC 301, BC 652, BC 566 and SC 704). Experimental plots contained 5 cropping lines, 25 cm apart, and each 5 meters. 0.5 m distance was assigned between the two plots as boarder effect; distance between blocks was determined 2 m. The field was under fallow last year. Soil preparation included deep plough, disc harrow and soil leveling. To supply for required elements, 40 kg/ha zinc sulfate, 100 kg/ha super phosphate and 20 t/ha manure was applied to the soil based on soil test.

After complete filling of the seeds, while the leaves and stems became yellow, two side rows were removed and sampling was done from three middle rows by deleting 0.5 m distance from both sides of them. The rest of the plants were harvested after ripening, seeds were air-dried and seed yield, yield components and other morphological traits, were measured.

Statistical analysis

Data were subjected to analysis by SAS software.

RESULTS AND DISCUSSION

Number of leaf and plant height

Based on the results of the variance of analysis (Table 1), it was found that leaf number just for main effect of planting conditions and plant height for both of the main effects were significant and for interaction effects of planting conditions × cultivar in both of the treats, not showed any significant effect. Mean comparison of both treats illustrated that irrigated farming is higher than non-irrigated farming condition, significantly (Figures 1 and 2). SC 301 and BC 582 cultivars with significant difference have lowest plant height and BC 678 and SC 700 cultivars with significant difference have highest plant height (Figure 2). Can say that there is sufficient moisture in irrigated agriculture due to increase the number of leaves and plant height to non-irrigation cultivation. According the research results, drought during the growing season limit plant growth and subsequently can be reduce the number of leaves and plant height (Redden and Hemdge, 1999). The limitation of water during the growing season reduced the morphological traits (Redden and Hemdge, 1999). Ramazan and Dstfal (2004) whit investigate of durum wheat varieties with tolerance to drought stress were expressed under mild

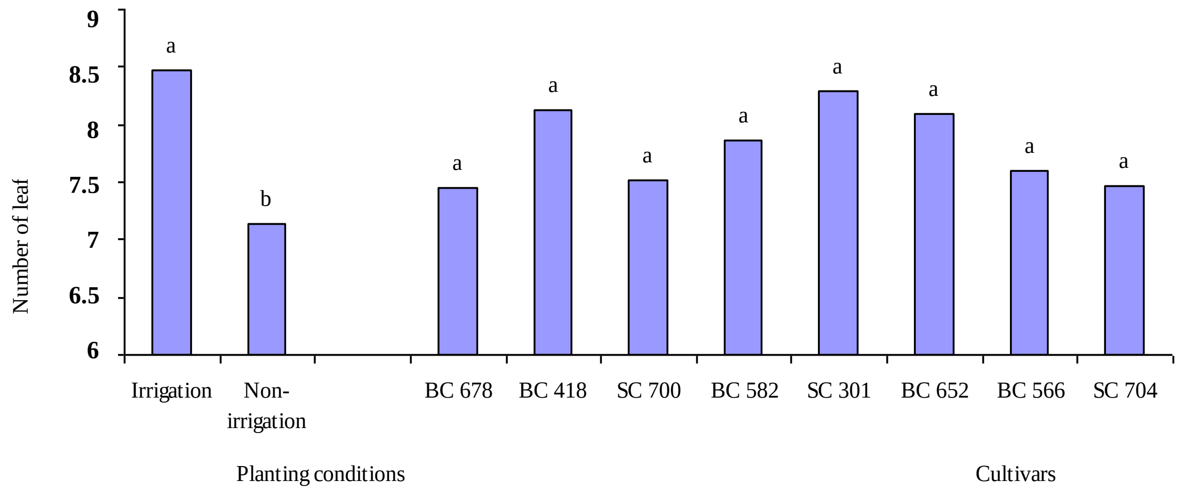

Figure 1. Effect of planting conditions and cultivars on number of leaf.

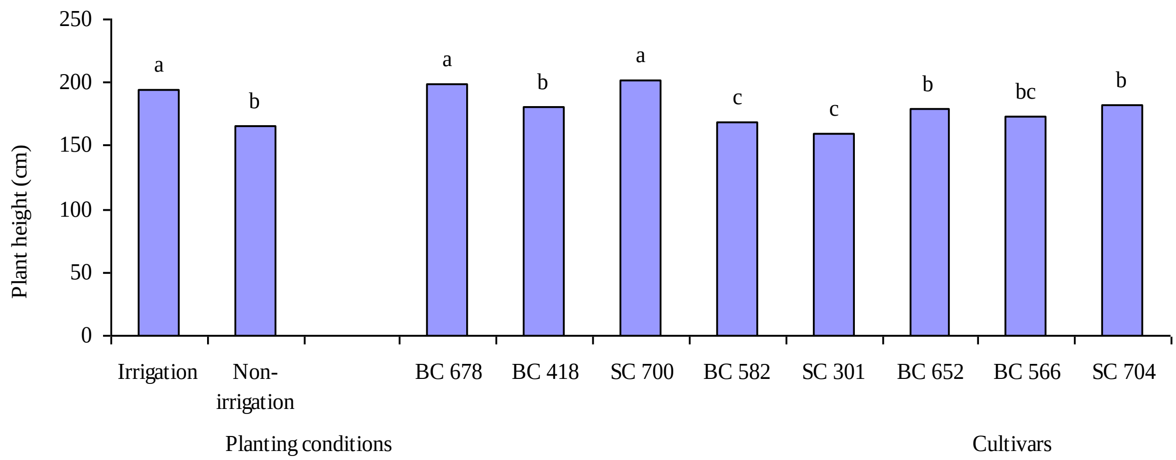

Figure 2. Effect of planting conditions and cultivars on plant height.

drought stress grain weight, grain number per spike, number of spikes per square meter, grain yield, harvest index, biomass and plant height 8.4, 9.9, 6.7, 21.8, 4.7, 16.6 and 3.3% respectively, and under severe stress, 16.3, 22.1, 13.8, 40.7, 12.9, 32.2 and 8.1 percent decrease. A mild drought, reduced water consumption by 25% compared to full irrigation and severe drought decreased 50% compared to the irrigation water is complete.

Ear diameter without the skin, and ear weight per plant

Based on the results of the variance of analysis (Table 1), it was found that ear diameter without the skin for main effect of planting conditions (1%) and cultivars (5%) and ear weight per plant for both of the main effects were significant (1%) and there was no significant effect for interaction effects of planting conditions × cultivar in both of the treats. Mean comparison of both treats illustrated that (Figure 3) irrigated farming is higher than non-irrigated farming condition, significantly. Diameter without the skin was observed that the cultivar for the trait, ear diameter SC 301 and SC 700 in significant difference between the cultivars in the top group has the lowest cultivar BC 418 and BC 678 were divided. SC 700 BC 566 in the top figure and the figure with a significant difference compared to other varieties of maize with the lowest weight per plant (Figure 4). Khayatnezhad et al. (2010a, b) reported that, drought stress reduced significantly the yield of some genotypes and some of them revealed tolerance to drought, which suggested the genetic

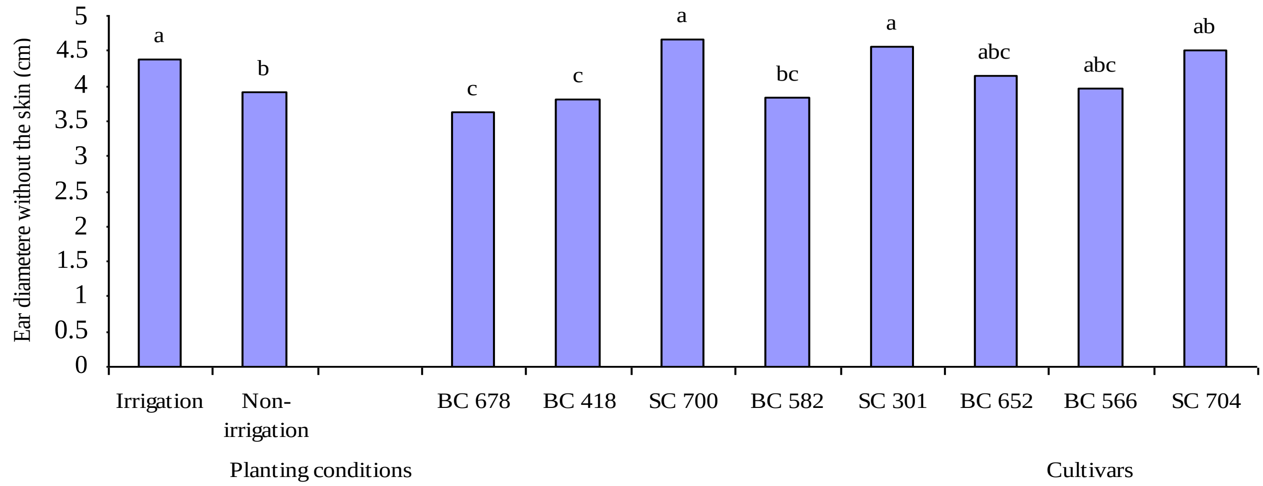

Figure 3. Effect of planting conditions and cultivars on ear diameter without the skin.

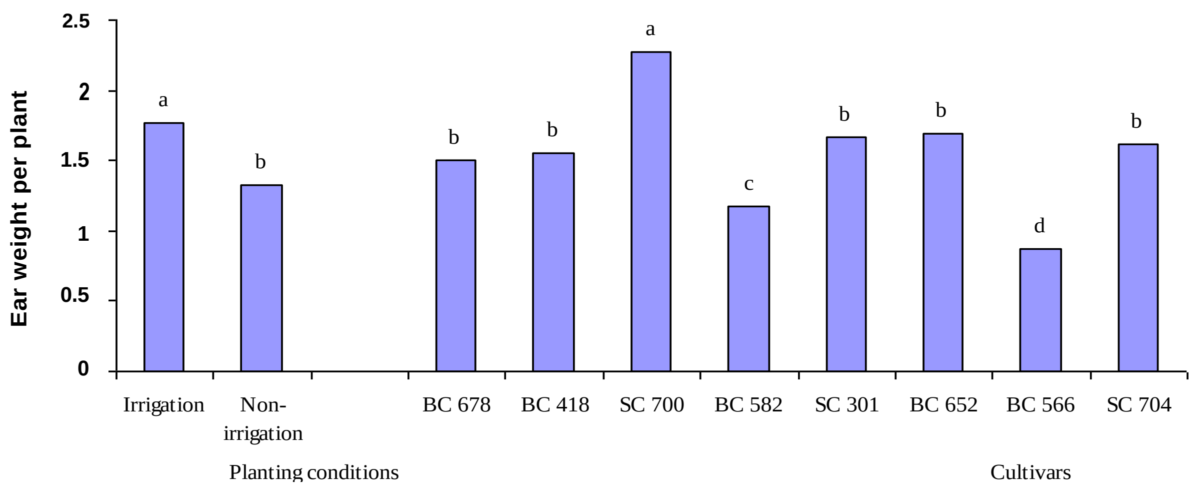

Figure 4. Effect of planting conditions and cultivars on ear weight per plant.

variability for drought tolerance in this material. Therefore, based on this limited sample and environments, testing and selection under non-stress and stress conditions alone may not be the most effective for increasing yield under drought stress. Azadi et al. (2006) reported that with increasing stress intensity, yield and yield components reduced significantly. Also, Akbari Moghaddam et al. (2004) illustrated that, stress reduced grain yield and biomass in the first of growing season and in the end of growing season. Reduction of biomass and yield in the first of growing season was 37% and reduction in yield in the end of the growing season was 116% and reduction in biomass was 36%.

Grain yield

Based on the results of the variance of analysis (Table 1), it was found that grain yield for main effect of planting conditions (1%) and cultivars (1%) were significant and no significant effect was seen for interaction effects of planting conditions × cultivar in both of the treats. Mean comparison of both treats illustrated that (Figure 5) irrigated farming is higher than non-irrigated farming condition, significantly. According the mean comparison, SC 700 cultivar had the highest yield, this cultivar whit compared with the maximum plant height, maximum number of kernels per ear, the ear diameter, ear weight per plant and single grain weight per ear, also won the highest yield. But, BC 566 cultivar had the lowest yield, this cultivar whit compared with the maximum plant height, maximum number of kernels per ear, the ear diameter, ear weight per plant and single grain weight per ear, also won the lowest yield. Bismillah khan et al. (2001) found that, most of the stem diameter and leaf area was obtained from the full irrigation and was

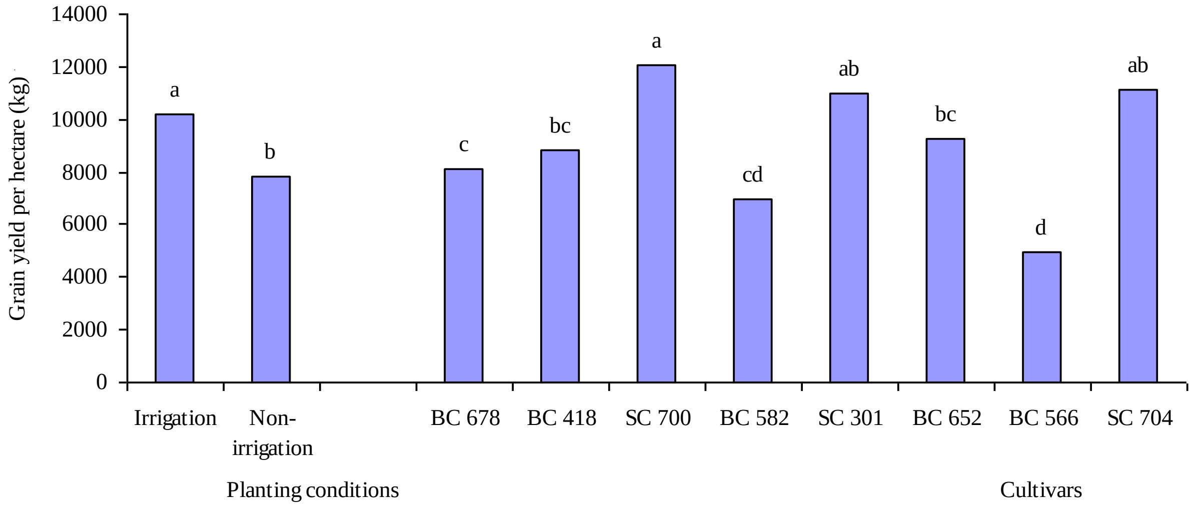

Figure 5. Effect of planting conditions and cultivars on grain yield per hectare.

decreased gradually with increasing stress. They also found that, drought stress decreases the number of grains per ear and thousand grains weight. Ouda et al. (2006) mentioned that the yield of corn cultivars of TWC 310 and TWC 324 under irrigation conditions every one week until the end of the growing season was 7.3 and 6.68 ton/ha, respectively, while the above cultivars under irrigation every two weeks until the end of the growing season have 5.71 and 5.41 tons per ha, respectively. They reported that reducing the amount of irrigation water to 20%, yield of two varieties of the order of 7.22 and 6.68 tons per hectare in irrigated every seven days, and 5.60 and 5.26 tons per hectare in irrigated every two weeks, respectively. In areas under stress, due to high evapotranspiration, the limited water resources and other factors, more attention to study the effects of drought stress on plants and the selection is focused on drought tolerance (Srmdnya, 1993). Leilah and AL-Khateeb (2005) reported that the number of spikes per square meter, 100-grain weight, biological yield and grain weight per spike most has been effective on grain yield. Bahari et al. (2004) showed the traits of seeds per square meter and seeds per spike were the most important role in increasing yield. Water, vegetative growth and yield decreases through reduced leaf area and leaf photosynthesis. This order can lead to a decreased in photosynthesis of plant community, and this decrease is mainly related to stress intensity.

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