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Evaluation of Different Amount of Super Absorbent A200 on Draught tolerance in Three Varieties of Corn

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ABSTRACT

This investigation has been done to evaluate the impact of different irrigation regimes (irrigation after 70, 110 and 150 mm evaporation from evaporating basin) and super absorbent (application and non application) on growth and yield of corn cultivars (704, Iranian maxima and overseas maxima) in three replication. Based on the results, irrigation after 110 mm evaporation from evaporating basin stem diameter, crop biomass, 100-grains weight, stem dry weight and leaf dry weight decreased. Irrigation after 150 mm evaporation from evaporating basin husk dry weight by 42 percent, the number of grains per cob row by 39/2 percent, the number of grains per cob by 38/8 percent, grain yield by 46/1 percent, biomass by 44/6 %, 100 grain weight by 13/8%, stem dry weight by 37/9% and leaf dry weight by 40 percent decreased. Application of super absorbent had not a significant effect on most traits in irrigation regimes of irrigation after 70 and 110 mm evaporation from evaporating basin. Application of super absorbent in irrigation regimes of irrigation after 150 mm evaporation from evaporating basin grain number per row, grain number in cob, biomass and yield by 41.1, 41.5, 29.1 and 38 percent increased, respectively. Even though the application of super absorbent in irrigation regimes of irrigation after 150 mm evaporation from evaporating basin had not prevent yield due to water shortage, it considerably the loss caused by water shortage on maize grain yield decreased. In most traits such as corn yield and yield components, there were no significant differences between cultivars. In general, based on region whether condition, it seems we can plan corn with irrigation regimes of irrigation after 110 mm evaporation from evaporating basin without any decrease in grain yield. Also, the use of super absorbent in high water shortage can decrease drought loss. Result showed that by irrigation after 70 and 150 evaporation from basin A and maximum and minimum grain yield 985 and 550g. Achier. The result showed that maximum 100 grain weight was 26.2 and minimum 100 grain weight was 13.8% decreased.

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INTRODUCTION

Corn (*Zea mays*) is a monocotyledonous and allogamy plant [30], in the New World, which has probably been a domestication of Mexico [25]. After World War II, the average yield of corn increased from 2.2 to 6 tons per hectare. Today, 22 to 25 percent of the world's agricultural land is cultivated with corn [10].This plant has a high genetic diversity which is associated with biological variety [30].Water shortage highly reduces the yield of corn. This crop is sensitive to drought [12]. Drought is the most limiting factor worldwide for corn production [6]. This crop is very sensitive during growth stages and very vulnerable to dry soil during flowering and grain filling stages [24].

Moisture absorbent can be a useful tool in increasing the water holding capacity of the soil and thus improve soil physical properties. For example, Pumice, which is moisture absorbent, can be used to improve soil physical properties [16]. Although the use of super absorbents have been less used in recent years due to the overuse of chemical fertilizers, the use of super absorbent as been resurfaced again in agriculture because of the use of biofertilizers [31]. Super absorbents are hydrophilic polymeric compounds that absorb water into their structure and thus transfer it to the roots of plants during the growth period [13]. Researchers' reported that 171-to-402-percent increase in water holding capacity by the use of super absorbents in coarse grained soils [28].

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By the use of super absorbent, the initial moisture in the soil after irrigation is high. This makes the irrigation water to be stored in the soil after irrigation and thus not to be wasted and to be absoberd by the roots under a controlled mechanism [11]. Robiul Islam *et al* [27] reported that highest yield by application 200 kg/ha super absorbents. The components of the grain yield, by application super absorbents. Cob length and cob diameter by use of super absorbents increased. Moslemi *et al* [22] have studied the effect of super absorbent polymer and crop growth bacteria on grain yield and grain components under drought conditions. The results of this research showed that water shortage grain yield, biological yield, grain number per row, number of grains per cob and the harvest index decreased, but water shortage had not affect on stem dry weight and leaf dry weight. The use of super absorbents and inoculating seeds with bacteria biological yield and grain yield under drought conditions and full irrigation increased. Therefore, the aim of this research was Evaluation of Different Amount of Super Absorbent A200 on Draught tolerance in Three Varieties of Corn. Khodadadi Dehkordi *et al*. (2013) investigated the effect of dehydration and superabsorbent a-200 on the growth factors of corn [33]. The results of their studies show that dehydration has a negative impact on leaf area index, plant growth speed, and the amount of pure assimilation of corn [34]. Studying super absorbents, Dragicevic *et al*. (2011) reported that increase in humidity storage and food storage of soil leads to increase in plant growth [4]. Also, Khodadadi Dehkordi *et al*. (2013) reported that superabsorbent a-200 acts by absorbing and storing water and nutrients in gel form and dewatering and watering cycle based on plant needs [33].

MATERIALS AND METHODS

This experiment was conducted in 2014 year in the field of Malekan Islamic Azad University. Experimental was split plot based on randomized-complete-block design in 3 replications and 18 treatments. Treatment was: First factor: it includes three levels of irrigation (irrigation after 70, 110 and 150 mm evaporation from evaporating basin), second factor includes treatment of the super absorbent (application and non-application of the super absorbent) and the third factor includes three maize cultivars (704, Iranian maxima, overseas maxima). Application different level irrigation was after crop establishment after solidification of the maize plants is initiated in the field. The use of super absorbent was done before planting by mixing super absorbent with soil by 4kg. Each plot consisted of 4 rows with a length of 4 meters and a distance of 75 cm, 20 cm distance between crops, a distance of 50 cm between the treatments and 1 meter between two replicates. After mapping the land, there started the preparation of the land for planting and making beds. In May, maize seeds were planted with a distance of 20 cm. on the beds with a-60-centimeter distance from each other, in a depth of 4 cm. In order to ensure the germinating, there were used two seeds. The first irrigation was done a day after planting. All phosphorus and potassium fertilizer and one third of the nitrogen fertilizer before planting were used, and the remaining of the nitrogen was used in strips at the 8-leaf stage of corn. After physiologic ripeness, harvesting was started and after omitting the sidelines of any plot, 5 cobs from the middle rows from a 0.5-meter-distance were collected from the margins, dissociating any plot, and then were transformed to the lab for the measurements. Before statistical analysis, data normality test was conducted and then a statistical analysis of data obtained from the measured traits was using the MSTAT-C software. For comparison of the means, we used the Duncan test at the 5% level probability. Excel software for drawing the graphs was used.

RESULTS AND DISCUSSION

Number of leaves:

According to the results of this study, water shortage had a significant effect on the total number of corn leaves (Table 1). The results of the comparison of the means of leaves under the influence of irrigation levels, there was no significant difference between the two irrigation levels of 70 and 110 mm of evaporation from the evaporating basin in terms of the number of corn leaves. In the irrigation level after 150 mm of evaporation from the evaporating basin, the number of green leaves in the corn crop was 6/3, whereas the number of green leaves in the lowest level of irrigation after the investigation, i.e. irrigation level after 70 mm of evaporation from the evaporating basin was 8/4. Considering the results of this study, the number of leaves in the irrigation treatment after 150 mm of evaporation from the evaporating basin was 25 percent lower than the irrigation level after 70 mm of evaporation from the evaporating basin (Fig 1). Researchers have reported that the water shortage tension can have an impact on the reduction of leaf level by making changes in the production of new leaves. Water shortage also speeds up the aging of leaves and hence reduces the number of leaves [3]. Boomsma and Vyn [2] reported that drought speeds up aging. Therefore, by speeding up the aging of leaves, particularly in lower leaves, drought reduces the number of leaves active in photosynthesis. In this experiment, too, drought speeds up the drought of the lower leaves of the crop.

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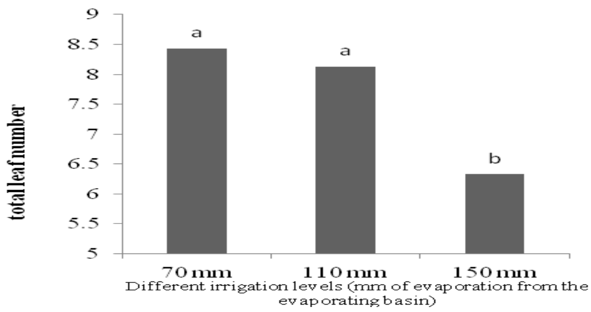

Fig. 1: Comparison of the mean of the number of corn leaves under the influence of different irrigation levels

Stem diameter:

Considering the results of the comparison of the means of stem diameter under the influence of irrigation levels and application of super absorbent, the longest corn stem diameter was found to be in irrigation level of 70 mm of evaporation from the evaporating basin without the use of super absorbent. The application of super absorbent in the irrigation level of 70 mm of evaporation from the evaporating basin the stem diameter by 8 percent reduced. Notwithstanding, in higher irrigation levels, there was no significant difference between the treatment using super absorbent and those not using it. Under the circumstances of not using super absorbent, water shortage the stem diameter reduced. With the further exacerbation of water shortage, the stem diameter was further reduced. The highest reduction in the stem diameter was seen in the irrigation level of 150 mm of evaporation from the evaporating basin which was 28 percent lower than that of the control. The irrigation level after 110 mm of evaporation from the evaporating basin also reduced the corn stalk diameter by 12 percent in comparison with the irrigation level of 70 mm of evaporation from the evaporating basin (Fig 2). The lengthening of stem diameter is a result of the activities of cambium meristems between vascular bundles and strip meristems inside parenchymal spaces [28]. Zweifel *et al* [32] reported that with the decrease of water stored in stems, the diameter growth of stems reduces. Matsumoto-Kitanoa *et al* [17] stated that the cambium activity of crops is in response to environmental factors such as temperature and water shortage changed. Hormones, particularly cytokines and auxins had a significant role in the regulation of cambium activities in response to environmental factors. The amount of these hormones reduces under the influence of drought conditions, and, as a result, the cambium activities are reduced, too.

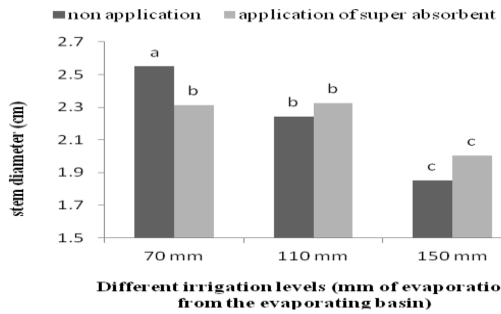

Fig. 2: Comparison of the mean of stalk diameter under the influence of irrigation levels and super absorbent application

Considering the results of this study, in the irrigation level after 70 mm of evaporation from the evaporating basin, the cultivar 704 of corn has a greater stem diameter than other cultivars, but there had not significant difference between the two cultivar of Iranian maxima and overseas maxima in the irrigation level of 70 mm of evaporation from the evaporating basin. In the irrigation level after 110 mm of evaporation from the evaporating basin, only the overseas maxima cultivar had a greater stem diameter in comparison with the Iranian maxima, but none of the studied cultivars were different from cultivar 704 in terms of stem diameter. Irrigation level of 150 mm of evaporation from the evaporating basin, no significant difference was observed between the studied cultivars in terms of stem diameter. It seems that in cultivar 704, there is greater reduction in stem diameter in response to water shortage (Fig 3). Investigations have showed that different plant cultivars have different responses to water shortage conditions. The cultivars which have the highest degree of a trait in one condition can have a different response if the conditions change [29]. In this study, in cultivar 704, both irritation levels of after 100 and 150 mm of evaporation from the evaporating basin had a smaller stem length in comparison with the irrigation level after 70 mm of evaporation from the evaporating basin. In cultivar 704 of corn, in the irrigation period of 110 and 150 mm of evaporation from the evaporating basin, the corn stem diameter was respectively 18.5 and 29.6 percent smaller in comparison with the level of 70 mm of evaporation from the evaporating basin. In the two type of Iranian and overseas maxima, not significant relationship was detected between the two irrigation levels of 70 and 110 mm of evaporation from the evaporating basin in terms of corn stem diameter, while a significant different was observed in the higher irrigation level. In the two Iranian and overseas maxima, the stem diameter in the irrigation level of 150 mm of evaporation from the evaporating basin was 1.9 and 1.8, respectively, which, in comparison with the irrigation level of 70 mm of evaporation from the evaporating basin, was 13.6 and 18.1 percent higher, respectively.

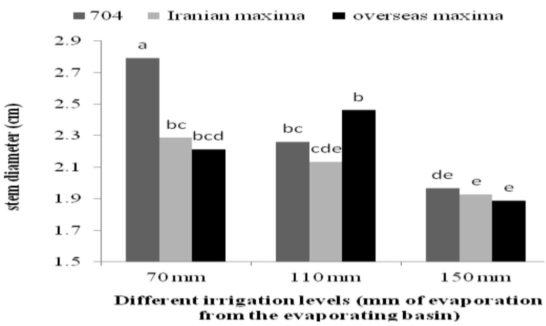

Fig. 3: Comparison of means of stalk diameter under the influence of irrigation levels in corn varieties

Dry leaf weight:

Considering the results obtained from the comparison of the means of leaf dry weight under the influence of different irrigation levels, the highest dry leaf weight was found to be 20.06 g. in the irrigation level after 70 mm of evaporation from the evaporating basin. Increase in the intervals between irrigations reduces the dry weight of corn leaves. The highest decrease in irrigation level happened after 150 mm of evaporation from the evaporating basin. In the irrigation level of 150 mm of evaporation from the evaporating basin, the leaf dry weight was 12.54 g., which was 40 percent lower than in the irrigation level of 70 mm of evaporation from the evaporating basin. Besides, the irrigation level of 110 mm of evaporation from the evaporating basin decreased the dry weight of corn leaves by 18.3 in comparison with the irrigation level of 70 percent of evaporation from the evaporating basin (Fig 4). Gupta and Kaur reported that the accumulation of dry material in different parts of plans decreases with the decrease in photo synthesis under the influence of dryness. Mohammadian *et al* [20] stated that the growth of leaves diminishes under dryness conditions, and, therefore, few carbohydrates are conveyed to the leaves. Besides, the increase in the aging speed of leaves under dryness conditions can too be a reason for the decrease in the dry weight of leaves [31].

In view of the results of this investigation in cultivar 704 and the Iranian maxima cultivar, application of super absorbent had no effect on the dry weight of corn leaves, whereas the application of super absorbent in the overseas maxima cultivar increased the dry weight of corn leaves by 30.2 percent (Fig 5). Similar investigation by other researchers, too, demonstrated that depending on the traits; different cultivars of plants have different responses to the application of super absorbent. Shisanya [29] demonstrated that different cultivars of dry weight of corn have different responses to the application of super absorbent.

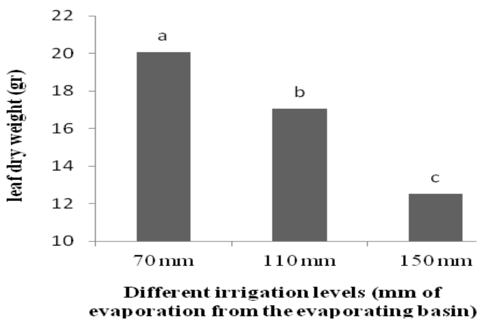

Fig. 4: Comparison of the mean of dry weight of corn leaves under the influence of irrigation levels

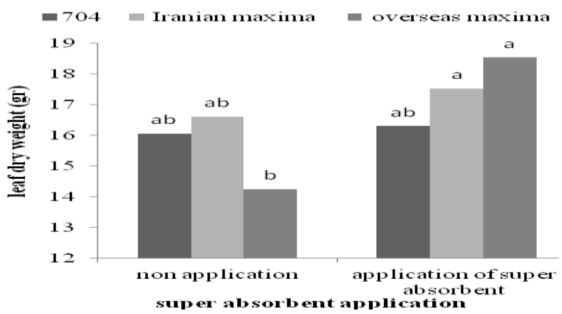

Fig. 5: Comparison of mean of leaf dry weight under the influence of application of super absorbent in different cultivars

Stem dry weight:

Analysis of variance of the investigated traits showed that revealed that the cultivar and application of super absorbent had no significant effect on stem dry weight, but shortage of water did have a significant effect on this trait (Table 1). Comparison of the means of corn stem dry weight under the influence of different irrigations demonstrated that water shortage significantly reduced corn stem dry weight; with the exacerbation on water shortage, the corn stem dry weight would further decrease. Therefore, the highest amount of decrease in the stem dry weight with 37/9 percent compared with irrigation level after 70 mm of evaporation from the evaporating basin in the irrigation level treatment after 150 mm evaporation from the evaporating basin was determined. The treatment of irrigation level after 110 mm evaporation from the evaporating basin reduced the stem dry weight by 18.3 mm compared with the irrigation level after 70 mm evaporation from the evaporating basin (Fig 6). The amount of carbohydrates soluble in the stems increases under the influence of dryness [18]. Therefore, under dryness conditions, it is not the shortage of carbohydrates which decreases stem growth. Parida *et al* [23] reported that under the conditions of dryness of synthesis of lipids, structural proteins and carbohydrates decrease. As a result, carbohydrate conveyed to the stems is not consumed, and, under dryness conditions, they are accumulated and therefore, the next conveyance of carbohydrates from the source to the stems is reduced [7]. Consequently, the stem dry weight decreases. Also, Hong and Yun [8] reported that dryness reduces stem biomass. And, Hu *et al*, [9] reported that dryness reduces the absorption of minerals and nutrients, which in turn impedes the growth the organs of the plant.

Husk dry weight:

Based on result obtained from this evaluation in irrigation regime of irrigation after 70 mm evaporation from evaporating basin, application of super absorbent was shown to have no effect on husk dry weight; however, in irrigation regimes of irrigation in 110 and 150 mm evaporation from evaporating basin, application of super absorbent caused significant increase in husk dry weight. In irrigation levels of irrigation in 110 and 150 mm evaporation from evaporating basin, application of super absorbent increased husk dry weight 26.9% and 20%, respectively. In irrigation regime of irrigation after 110 mm evaporation from evaporating basin, highest husk dry husk was obtained, this was 17.9 g. When no super absorbent was used and irrigation regime shifted from 70 to 110 mm evaporation from evaporating basin, no changes was evident in husk dry weight, while after a shift from 70 to 150 mm evaporation from evaporating basin husk dry weight increased by 42.7% (fig 7). Moslemi *et al* [22] reported that super absorbent maintains moist in soil to be used by plants in case of water shortage and in this way prevents growth delay.

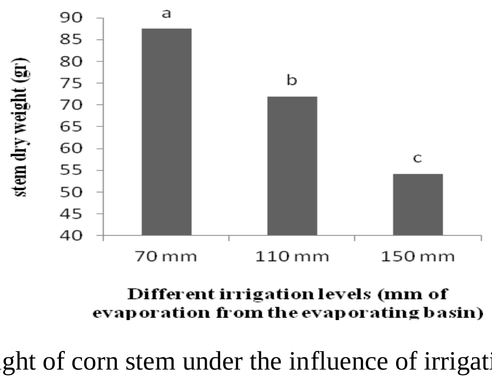

Fig. 6: Comparison of the dry weight of corn stem under the influence of irrigation levels

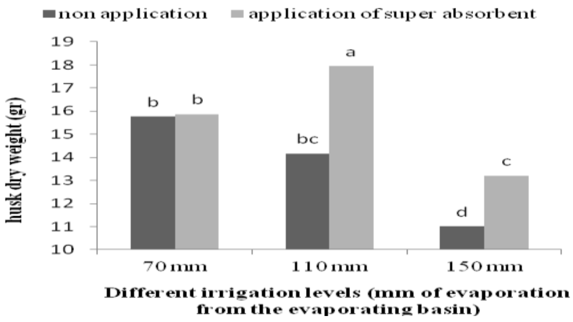

Fig. 7: Comparison of husk dry weight under the influence of regimes of irrigation and application of super absorbent

Number of grain per row of cob:

In this study, no significant difference was observed between the traits of number of grain per row of cob, but water shortage and application of super absorbent had significant effects on number of grain per row of cob (table 1). Comparison of averages of grain row per cob under the influence of irrigation regimes and application of super absorbent showed that shift of irrigation regime after 70 to 110 mm evaporation from evaporating basin had no effect on number of grain per row of cob but by increasing irrigation regime after 70 to 150 mm evaporation from evaporating basin, number of grain per row of cob decreased significantly. In irrigation regime of 150 mm evaporation from evaporating basin, number of grain per row of cob was 17.3, which was 39.2% less than that in irrigation regime after 70 mm evaporation from evaporating basin (figure 8). So, water shortage decreased number of grain per row of cob. Moser *et al* [21] concluded that drought before pollination decreased number of grain per row of cob. According to the results obtained in the present investigation, application of super absorbent had no effect on number of grain per row of maize in irrigation regimes of 70 and 110 mm evaporation from evaporating basin, whereas it had significant influence on number of grain per row of cob in 150 mm evaporation from evaporating basin. In irrigation regime after 150 mm evaporation from evaporating basin plus the application of super absorbent, number of grain per row of cob was 24.3 which are 41.1% more than when no super absorbent existed. Therefore, application of super absorbent revealed no significant decrease in number of grain per row of cob in case of water shortage. Kouhestani *et al* [14] attempted to investigate the effect of application of super absorbent hydrogels on for decrease of negative effects of dryness stress on grain maize yield and yield components. Dryness stress of grain yield decreased yield components and biological yield. On the contrary, super absorbent hydrogels, especially at 300 kg/hectare level improved these parameters. Super absorbent hydrogels caused an improvement in number of grain per cob only under dryness stress condition. However, biological yield improved each grain weight and number of grain row under both stress and anti- stress conditions. So, it can be speculated that application of super absorbent hydrogels improves grain maize yield and its component yield under stress conditions through increasing preserving capacity of water, decreasing removal of nutritious materials, quick optimal growth of stem, and better ventilation of soil.

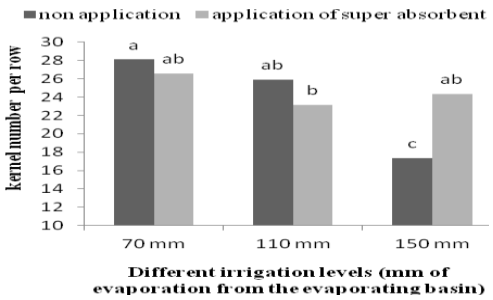

Fig. 8: Comparison of number of grain per row of cob under the influence of regimes of irrigation and application of super absorbent

Number of grains per cob:

With regard to the obtained results from the comparison of average numbers of grain per cob under the influence of regimes of irrigation and application of super absorbent, shifting irrigation regime from 70 to 110 mm evaporation from evaporating basin, no change was seen in number of grain per cob, but shifting irrigation regime from 70 to 110 mm evaporation from evaporating basin led to a significant decrease in number of grain per cob. In irrigation regime after 150 mm evaporation from evaporating basin, number of grain per cob was

277, which was more than by 38.8%. Therefore, water shortage caused significant decrease in number of grain per cob (figure 9). Drought before pollinations decreased grain yield due to decrease in number of grain. Two theories have been proposed for this decrease. Firstly, biological and nutritious reasons lead to a decrease in number of under dry conditions. In this sense, researchers have reported that delay in silk formation can be a reason of decrease in number of grain per cob. Anyway, when drying plants are pollinated artificially by totally irrigated plants, seeds are formed but still do not improve, even if dryness have been removed before pollination. Researcher, in this regard, have suggested that during the drying process when controlling carbohydrates metabolism, decrease in assimilates leads to characterization of carbohydrates toward maize and, finally, no formation of grains. Secondary, hormonal or chemical reasons for the induction of infertility. Researchers have indicated that Abscise acid increases infertility in wheat. Research has also shown that dryness increases production of this phytohormone [1]. Asch *et al* [1] expressed that long term drought cause a 60% decrease in number of grain. In this investigation, application of super absorbent had no significant influence in irrigation regimes 70 and 150 mm evaporation from evaporating basin, though in irrigation regime of 150 mm evaporation from evaporating basin, it caused a 41.5 increase in number of grain. Investigations have shown that super absorbents can decrease the effect of water shortage and lead to plant growth and yield in dry and semi-dry regions [5]. Undoubtedly, influence of super absorbent is more evident in water shortage conditions. Because, in water shortage conditions, super absorbent acts as a source of moisture in a land where water is not enough. In conclusion, in water shortage conditions, super absorbent can cause a higher increase in growth and yield of maize.

100 grains weight:

According to results of ANOVA of traits in this study, super absorbent yield and cultivar had no effect on maize grain, but water shortage had significant influence on its 100 grain weight (table 1). Under the influence of irrigation regimes, comparison of average 100 grain weight of maize showed that after shifting irrigation regime from 70 to 110 and 140 mm evaporation from evaporating basin decrease 100 grain weight. Increasing water shortage caused more decrease in 100 grain weight. So, fewest 100 grain weight of maize was 23 for irrigation regime after 150 mm evaporation from evaporating basin, which was 13.8% less than that after 70 mm evaporation from evaporating basin. Irrigation regime after 110 mm evaporation from evaporating basin caused a 6.7% decrease in 100 grain weight in comparison to that after 70 mm evaporation from evaporating basin (figure 8). Moser *et al* [21] also reported that drought decrease 1000 grain weight in maize. Similarly, Plavsic *et al* [26] announced that drought decreases 1000 grain weight, too.

Biomass:

Comparison of average biomass of maize plant under the influence of irrigation regimes and application of super absorbent showed that shifting irrigation regimes from 70 mm evaporation from evaporating basin to 110 and 150 mm evaporation from evaporating basin decreased biomass of maize significantly. By increasing irrigation regime, more decrease was observed in biomass. So, most decreases were seen in irrigation regime after 150 mm evaporation from evaporating basin. In this cure, biomass was 161 in maize plant, which was 44.6% less than that amount after 70 mm evaporation from evaporating basin. Irrigation regime after 110 mm evaporation from evaporating basin led to 18.2% decrease in biomass of maize plant, in comparison to irrigation regime after 70 mm evaporation from evaporating basin (figure 12). Researchers reported that limitation of some sources such as water, through decrease of photosynthesis, led to limitation of that source and that container. In this way, accumulation of dry material decreases in different parts of the plant [15]. In this investigation, in irrigation regimes of 70 and 100 mm evaporation from evaporating basin, application of super absorbent did not have any influence on plant biomass, whereas in irrigation regime after 150 mm evaporation from evaporating basin application of super absorbent once increased biomass of maize plant by 29.1%. In Moazen Ghamsari *et al* [19] it was shown that using polymers of super absorbent increased maize dry material.

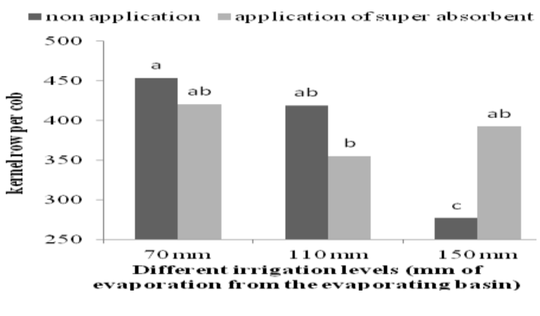

Fig. 9: Comparison of number of grain in cob under the influence of regimes of irrigation and application of super absorbent

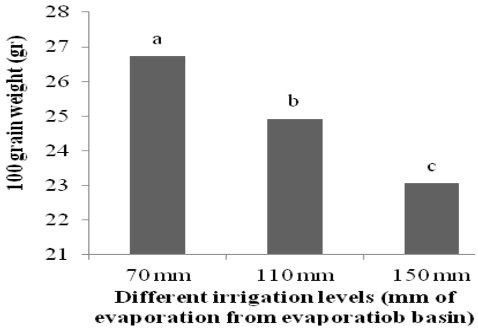

Fig. 10: Comparison of 100 grain weight under the influence of regimes of irrigation

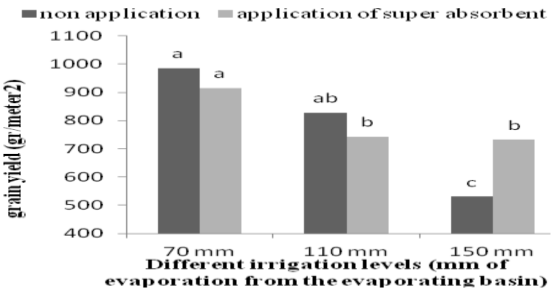

Fig. 11: Comparison of grain yield under the influence of regimes of irrigation and application of super absorbent

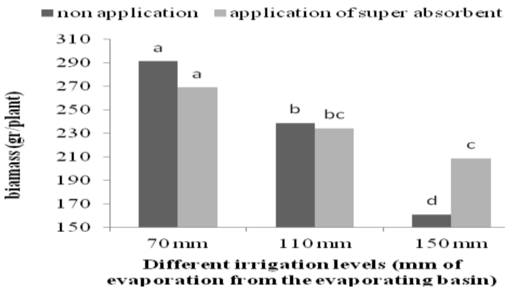

Fig. 12: Comparison of plant biomass under the influence of regimes of irrigation and application of super absorbent

Table 1: ANOVA for traits of corn under investigating

Grain yield	100 grain weight	Number of pedal	Stem diameter	Stem dry weight	Leaf dry weight	Husk dry weight	Plant biomass	Number of row of cob	Number of grain in row of cob	Number of grain in cob	df	S.O.V
4745350.278*	0.286	0.913	0.067	695.588	16.352	4.245	544.08	0.479	39.310*	13908.56	2	replication
45877355.810**	60.778**	23.286**	1.210**	5014.346**	258.052**	87.763**	41018.100**	0.337	190.596**	46974.101**	2	Regime of irrigation
504950	1.366	0.59	0.011	209.055	6.335	1.999	419.693	0.204	5.326	2023.338	4	Main error
342782.3	0.882	0.329	0	17.943	44.331*	55.407**	655.056	0.955	10.968	533.952	1	Super absorbent
11674150.900*	2.372	1.602	0.194*	765.131	3.918	15.535*	5916.968**	0.953	127.558**	41330.467**	2	Irrigation regimes * super absorbent
6923420	0.583	0.038	0.237*	74.293	3.837	3.136	2510.127	0.134	39.705	13087.3	2	cultivar
2073963	2.766	1.616	0.266**	114.589	6.209	4.78	968.26	0.802	11.016	3014.681	4	Irrigation regime * cultivar
715252.5	0.601	0.636	0.015	49.638	21.315*	2.124	214.058	0.131	5.477	2441.03	2	Super absorbent * cultivar
2426481	0.548	0.226	0.073	100.525	7.337	1.321	624.976	1.295	22.225	6587.27	4	Irrigation regimes *Super absorbent * cultivar
2528781	1.928	0.857	0.044	250.871	6.312	3.771	839.818	0.532	17.805	4729.363	30	Peripheral error
20.16	5.58	12.14	9.52	22.24	15.18	13.25	12.39	4.58	17.4	17.8		Coefficient of change (%)

*and**: significant at 1% and 5% of interval confidence, respectively

Grain Yield:

In this evaluation, no significant difference was evident in cultivars in terms of yield. However, water shortage and super absorbent had significant influence on maize grain yield (table 1). Comparison of averages of grain yields under the influence of irrigation regimes and application of super absorbent indicated that shifting irrigation regime from 70 mm evaporation from evaporating basin to 110 mm evaporation from evaporating basin had no effect on grain yield, but significant decrease was shown when irrigation regime shifted from 70 mm evaporation from evaporating basin to 150 mm evaporation from evaporating basin. In irrigation regime after 150 mm evaporation from evaporating basin, maize yield was 5.3 tons/hectare, which was 46.1% less than irrigation regime after 70 mm evaporation from evaporating basin, i.e. 9.8 tons/hectare (highest amount of yield among cures)(figure 8). Maize was sensitive to water shortage to a great extent [24]. For maize, water shortage leads to a decrease in yield [24]. In an investigation carried out by Boomsma and Vyn [2], intense drought led to decrease of grain yield by 70%. Researches have shown that dry pollination can have the greatest effect on plant yield. In majority of researches in the literature, dryness before pollination affects both number of grain and 1000 grain weight. Index of harvest for maize in moderate climates has been reported to be more than 0.5. Index of harvest can be decrease with decrease of water in soil [21]. In the present study, for irrigation regimes of 70 and 110 mm evaporation from evaporating basin, application of super absorbent had no effect on maize grain yield; however, in irrigation regime of 150 mm evaporation from evaporating basin, grain yield was increased by 38% due to the application of super absorbent. Therefore, although application of super absorbent inhibited grain yield, it reduced the effect of water shortage on grain yield. Super absorbents increase moisture and nutrition preservation in soil and, in this way, lead to an increase in plant growth and grain yield in water shortage conditions [4]. In an investigation carried out by Moazen Ghamsari *et al* [19] it was revealed that use of super absorbent polymers increases maize dry material. In a similar study, Robiul Islam *et al* [27] observed that utmost grain yield was reached for maize at 200 kg/hectare of super absorbent. Moslemi *et al* [22] evaluated the effect of super absorbent polymer and bacteria that increase plant growth on grain yield and components in water shortage conditions. Findings of this study showed that water shortage of grain yield decreased biological yield, number of grain per row of cob, number of grain in cob, and index of harvest, but leaf and stem dry weights were not affected by water shortage. Application of super absorbent and insemination with bacteria increased grain yield and biological yield under water shortage and full irrigation conditions. Simultaneous application of super absorbent and fertilizers showed more increase than isolated application of each.

Conclusions:

In this investigation, shifting irrigation regime from 70 mm evaporation from evaporating basin to 110 and 150 mm evaporation from evaporating basin indicated significant decrease in biomass of maize plants. Highest decrease was shown to occur in irrigation regime after 150 mm evaporation from evaporating basin. In this cure, biomass was 161 gram/plant, which was 44.6% less than that in irrigation regime after 70 mm evaporation from evaporating basin. Irrigation regime after 110 mm evaporation from evaporating basin decreased plant biomass of maize plants by 18.2%, in comparison to irrigation regime after 70 mm evaporation from evaporating basin. Shifting irrigating regime from 70 mm evaporation from evaporating basin to 100 mm evaporation from evaporating basin had no influence on maize grain yield, while shifting irrigation regime from 7o mm evaporation from evaporating basin to 150 mm evaporation from evaporating basin denoted a significant decrease in maize grain yield. In irrigation regime after 150 mm evaporation from evaporating basin, maize grain yield was 5.3 tons/hectare, which was 46.1% less than irrigation regime after 70 mm evaporation from evaporating basin, i.e. 9.8 tons/hectare (highest amount of yield among cures). As concluding remarks, maize can be planted after 110 mm evaporation from evaporating basin, without significant decrease in its grain yield. Furthermore, in water shortage conditions, application of super absorbent can decrease the effect of water shortage loss on maize grain yield significantly.

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REFERENCES

[1] Asch, F., M.N. Andersen, C.R. Jensen and V.O. Mogensen, 2001. Ovary abscisic acid concentration does not induce kernel abortion in field-grown maize subjected to drought. European Journal of Agronomy, 15: 119-129.
[2] Boomsma, C.R. and T.J. Vyn, 2008. Maize drought tolerance: Potential improvements through arbuscularmycorrhizal symbiosis. Field Crops Research, 108: 14-31.
[3] Brevedan, R.E. and D.B. Egli, 2003. Short periods of water stress during seed filling, leaf senescence and yield of soybean. Crop Sci, 43: 2083-2088.
[4] Dragicevic, V., M. Simic, S. Sredojevic, B. Kresovic, B. Saponjic and Z. Jovanovic, 2011. The effect of super-hydro-grow polymer on soil moisture, nitrogen status and maize growth. Fresenius Environmental Bulletin, 20: 1013-1019.
[5] FazeliRostampour, M., M. Yarnia, R. FarokhzadehKhoee, M.J. Seghatoleslami and G.R. Moosavi, 2013. Physiological Response of Forage Sorghum to Polymer under Water Deficit Conditions. Agronomy Journal, 105(4): 951-959.

[6] Feng, D., F. Feng-ling, N. Na and L. Wan-chen, 2009. Differential Gene Expression in Response to Drought Stress in Maize Seedling. Agricultural Sciences in China, 8(7): 767-776.
[7] Gupta, A.K. and N. Kaur, 2005. Sugar signalling and gene expression in relation to carbohydrate metabolism under abiotic stresses in plants. J. Biosci, 30(5): 101-000.
[8] Hong, W. and J. Ji-yun, 2007. Effects of zinc deficiency and drought on plant growth and metabolism of reactive oxygen species in maize (*Zea mays* L.). Agricultural Sciences in China, 6(8): 988-995.
[9] Hu, L., Z. Wang, H. Du and B. Huang, 2010. Differential accumulation of dehydrins in response to water stress for hybrid and common bermudagrass genotypes differing in drought tolerance. Journal of Plant Physiology, 167: 103-109.
[10] Jakab, Z., 2005. The effect of nutrient supply on the yield and quality of maize hybrids. 6th International Multidisciplinary conference. Mezőtúr. pp: 158.
[11] Jalilian, J. and O. Mohsennia, 2013. Effects of superabsorbent and irrigation regime on seedling growth characteristics of barley (*Hordeumvulgare* L.). CercetăriAgronomice in Moldova, 11: 11-19.
[12] Kanga, Y., M. Chena, and S. Wana, 2010. Effects of drip irrigation with saline water on waxy maize (*Zea mays* L. var. ceratinaKulesh) in North China Plain. Agricultural Water Management, 110: 46-51.
[13] Koudela, M., F. Hnilička, L. Svozilová, J. Martinková, 2011. Cauliflower qualities in two irrigation levels with the using of hydrophilic agent. *Hort. Sci*, 38: 81-85.
[14] Kouhestani, S. Askari, N. and K. Maghsoudi, 2009. Investigation of the effect of super absorbent hydrogels on grain maize yield (*Zea mays* L.) under the influence of dryness stress. Iranian Water Researches, 78-5: 71
[15] Madani, A., A. Shirani-Rad, A. Pazoki, G. Nourmohammadi, R. Zarghami, A. Mokhtassi-Bidgoli, 2010. The impact of source or sink limitations on yield formation of winter wheat (*Triticumaestivum* L.) due to post-anthesis water and nitrogen deficiencies. Plant Soil Environ, 56(5): 218-227.
[16] Malekian, A., K. ShahbaziHomonlo, G. DidehbazMoghanolo, Mona Dastoori, 2012. Evaluation of appropriate technique to improve soil characteristics and crop production. International Journal of Food, Agriculture and Veterinary Sciences, 2: 26-31.
[17] Matsumoto-Kitanoa, M., T. Kusumotoa, P. Tarkowskib, K. Kinoshita-Tsujimura, K. Vaclavíkova, K. Miyawaki and T. Kakimotoa, 2008. Cytokinins are central regulators of cambial activity. *PNAS*, 105: 20027-20031.
[18] Méndez, A.M., D. Castillo, A. delPozo, I. Matus, R. Morcuende, 2011. Differences in stem soluble carbohydrate contents among recombinant chromosome substitution lines (RCSLs) of barley under drought in a mediterranean–type environment. *Agronomy Research,* 9 (Special Issue II): 433-438.
[19] MoazenGhamsari, B., E. Akbari, G. Zohourian and B. Nikniyaee, 2009. Evaluation of corn growth indexes performance under the influence of different rats of superabsorbent super AB a 200 in drought stress conditions. Farm Plants Sciences, 40(3): 102-111.
[20] Mohammadian, R., M. Moghaddam, H. Rahimian, S.Y. Sadeghian, 2005. Effect of early season drought stress on growth characteristics of sugar beet genotypes. Turk J Agric For, 29: 357-368.
[21] Moser, S.B., B. Feil, S. Jampatong and P. Stamp, 2006. Effects of pre-anthesis drought, nitrogen fertilizer rate, and variety on grain yield, yield components, and harvest index of tropical maize. Agricultural Water Management, 81: 41-58.
[22] Moslemi, Z., D. Habibi, A. Asgharzadeh, M. Reza Ardakani, A. Mohammadi and A. Sakari, 2012. Effects of super absorbent polymer and plant growth promoting rhizobacteria on yield and yield components of maize under drought stress and normal conditions. American-Eurasian J. Agric. & Environ. Sci, 12(3): 358-364.
[23] Parida, A.K., V.S. Dagaonkar, M.S. Phalak, G.V. Umalkar, L.P. Aurangabadkar, 2007. Alterations in photosynthetic pigments, protein and osmotic components in cotton genotypes subjected to short-term drought stress followed by recovery. Plant Biotechnol Rep, 1: 37-48.
[24] Ping, B., S. Fang-Gong, G. Ti-Da, S. Zhao-Hui, L. Yin-Yan and Z. Guang-Sheng, 2006. Effect of soil drought stress on leaf water status, membrane permeability and enzymatic antioxidant system of maizet. *Pedosphere*, 16(3): 326-332.
[25] Piperno, D.R. and K.V. Flannery, 2001. The earliest archaeological maize (*Zea mays* L.) from highland Mexico: New accelerator mass spectrometry dates and their implications. *PNAS*, 98(4): 2101-2103.
[26] Plavsic, H., 2006. Influence off irrigation and nitrogen on yield and yield components of maize. Agriculture: Scientific and Professional Review, 12: 70-71.
[27] Robiul Islam, M., XuzhangXue, Sishuai Mao, Xingbao Zhao, A. EgrinyaEneji and Yuegao Hu, 2011. Superabsorbent polymers (SAP) enhance efficient and eco-friendly production of corn (*Zea mays* L.) in drought affected areas of northern China. African Journal of Biotechnology, 10(24): 4887-4894.
[28] FazeliRostampour, M., M. Yarnia, and R. Farokhzadeh Khoee, 2012. Effect of polymer and irrigation regimes on dry matter yield and several physiological traits of forage sorghum. African Journal of Biotechnology, 11(48): 10834-10840.

[29] Shisanya, C.A., 2005. Yield and nitrogen fixation response by drought tolerant tepary bean (*Phaseolusacutifolius* A. Gray var. latifolius) in sole and maize intercrop systems in semi-arid southeast Kenya. Journal of Food Technology, 3: 300-307.
[30] Zare, A., R. Shahhosseini, H. Ali Bahrami, M. Ghovahi, A.R. Askary Kelestanie, 2013. Evaluation the effect of nitroxin and super absorbent on yield components of chickpea in dry farm. International Journal of Agronomy and Plant Production, 4(8): 2033-2038.
[31] Zhang, J., 2004. Risk assessment of drought disaster in the maize-growing region of Songliao Plain, China, Agriculture. Ecosystems and Environment., 102: 133-153.
[32] Zweifel, R., H. Item and R. Häsler, 2000. Stem radius changes and their relation to stored water in stems of young Norway spruce trees. Trees. 15: 50-57.
[33] Khodadadi Dehkordi, D., H.A. Kashkuli, A. Naderi, S.A. Shamsnia, 2013. Evaluation of Superabsorbent super AB A 200 on three corn growth factors affected by drought stress in the spring summer weather conditions in Khouzestan province. Advances in Environmental Biology, 7(6): 1064-1073.
[34] Dragicevic, V., M. Simic, S. Sredojevic, B. Kresovic, B. Saponjic and Z. jovanovic, 2011. The effect of super-hydro-grow plymer on soil moisture, nitrogen status and maize growth. Fresenius Enveronmental Bullein, 20: 1013- 1019.