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Evaluation of Drought Stress Effects on Yield Components on Some Plants

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Abstract Drought stress is one of the most important environ-mental factors in reduction of growth, development and production of plants. It can be said that it is one of the most devastating environmental stresses. Iran, with an annual rainfall of 240 mm, is classified as one of those dry regions. According to geographical location and topographic conditions, Iran has always been faced with drought over the last centuries, about 10 percent of the Iran's areas have more than 500 mm of rainfall over the years and the rest have to be watered for the plants growth. Water shortage is a critical problem limiting maize growth through impact on anatomical, morphological, physiological and biochemical processes. The severity of drought damage depends on stress duration and crop growth stage.

Keywords Corn, Sun flower, Yield

Introduction

Drought stress is one of the most important environ-mental factors in reduction of growth, development and production of plants. It can be said that it is one of the most devastating environmental stresses. Iran, with an annual rainfall of 240 mm, is classified as one of those dry regions [1]. According to geographical location and topographic conditions, Iran has always been faced with drought over the last centuries, about 10 percent of the Iran's areas have more than 500 mm of rainfall over the years and the rest have to be watered for the plants growth [2]. According to Hayat and Ali (2004), Moisture stress is a limiting factor for crop growth in arid and semi-arid regions due to low and uncertainty precipitation [3]. Water stress due to drought is probably the most significant abiotic factor limiting plant and also crop growth and development [4]. Maize (Zea mays L.) is one of most important crop that plays a great role in human nutrition (20-25%) [5]. Water shortage is a critical problem limiting maize growth through impact on anatomical, morphological, physiological and biochemical processes. The severity of drought damage depends on stress duration and crop growth stage [6]. Drought occurs when moisture around the roots is so reduced that a plant is not able to absorb enough water, or in other words with transpiration of water absorption [7]. Drought stress is physiologically related, because induced osmotic stress and most of the metabolic responses of the affected plants are similar to some extent [8]. In a study on corn and sorghum grain, under drought stress conditions it shown that high levels of nitrate lowered grain quality [9]. Sunflower (*Helianthus annuus* L.) is an important oilseed crop of the family composite originated in southern Asia and is known to have been cultivated in China, India, Egypt and Iran [10]. The oil content of safflower seed ranged between 35 to 50% that consists of about 90% unsaturated fatty acids, placing it as one of the best oils for popular consumption [11]. Sunflower, with a world production of grain and oil of over 28.5×106 and 10.5×106 Mg, respectively, and grown around 22.6×106 ha with a seed yield of 1.3 Mg/ha, is one of the most common grown oilseed species [12]. Sunflower seeds contain a high amount of oil (40 to 50%) which is an important source of polyunsaturated fatty acid (linoleic acid) of potential health benefits [13-15]. This crop adapted to relatively low rainfall areas receiving winter and spring rainfall with a low humidity during flowering and maturation [16]. Water shortage and the increasing competition for water resources between agriculture and other sectors compel the adoption of irrigation strategies in semi-arid Mediterranean regions, which may allow saving irrigation water and still maintain satisfactory levels of production [17]. The growth, development and spatial distribution of plants are severely restricted by a variety of environmental stresses. Among different problems faced by crop plants, water stress is considered to be the most critical one [18-20]. Shortage of water, the most important component of life, limits plant growth and crop productivity, particularly in arid regions more than any other abiotic environmental factor [18]. Water deficit effects have been extensively studied on several crops such as maize [21], sorghum [22-24], sugar beet and hot pepper [25] etc. Reduced precipitation together with the higher evapotranspiration is expected to subject natural and agricultural vegetation to a greater risk of drought in those areas [26]. Water is essential at every stage of plant growth and agricultural productivity is solely dependent upon water and it is essential at every stage of plant growth, from seed germination to plant maturation [27]. Drought stress is one of the most important abiotic stress factors which are generally accompanied by heat stress in dry season [28]. Due to water deficits, the physiology of crop is disturbed which causes a large number of changes in morphology and anatomy of plant. Drought stress is a major limiting factor for plant growth and development worldwide and, in Iran, too. Sunflower is a well adapted to drought crop, essentially because of the powerful water uptake due to its efficient root system [29]. However, it has been found that both quantity and distribution of water has a significant impact on seed yield and seed quality in sunflower [30-31]. Intensity of yield reduction by drought stress depends on the growth stage of crop, the severity of the drought and tolerance of genotype. Petcu et al, (2001) showed that grain yield of sunflower hybrids was affected by drought stress with the low status treatment yielding 10-13% less than the control treatment [32]. It was reported that a trend in yield decline and reduce of yield components due to water stress treatments. Razi and Asad, (1998) indicated that drought stress at flowering stage was observed to be a limiting factor for seed filling, so significant reduction of unfilled seeds was observed as a result of irrigation missing [33]. Decreasing water supply either temporarily or permanently affects morphological and physiological and even biochemical processes in plants adversely [22-24]. D'Andria et al. (1995) reported that, the ability of sunflower to extract water from deeper soil layers "when water stressed during the early vegetative phase causes stimulation of deeper root system" and a tolerance of short periods of water deficit, are useful traits of sunflower for producing acceptable yields in dry land farming [34]. On the other hand, some evidences have indicated that water stress deficit causes considerable decrease in yield and oil content of sunflower [35]. Although a lot of literature is available about water stress effects on sunflower [36-38], information regarding the effect of normally irrigated and water deficit environment on seed yield, yield component, seed oil and protein content is scanty.

Material and methods

This article is review and the aims of influence of salt stress on some characteristics of crop plants. The experiment 1 was conducted [39]. In this experiment the experimental design was split plot using randomized complete block design with three replications. Treatment was consisted of irrigation in 4 levels, S0: complete irrigation, S1: halted irrigation at squaring, S2: halted irrigation at 50% flowering, S3: halted irrigation at grain filling as main plot; and cultivars in 3 levels, V1: Zaria, V2: Alstar, V3: Azargol as sub factor. Before planting, 200 kg/ha P (as triple super phosphate) and 150 kg/ha K (as potassium sulfate) was added to the respective treatments, while 150 kg/ha N as urea was applied in two doses; half at planting and the remaining half at 55 days after planting. Sunflower was planted manually in March 2004. Experiment plots were designed with 50 cm row to row distance and 20 cm between plants. Seeds were sown 5 cm deep. Weeds were removed by hand. After planting, irrigation was applied as required during the growing season. Data collected (obtained by combining the four center rows at each experiment unit) included: plant height, seed number of head, 1000 grain weight, yield grain, oil yield and oil percent. Seed oil content was determined using soxhlet apparatus and diethyl ether as a solvent. The data were analyzed using MSTATC software; mean comparison was done using Duncan multiple comparison at 5% probability [39].

The experiment 2 was conducted by Dehkhoda et al., 2013. The experiment was a split plot in a randomized complete block design with three replications [40]. Class A pan was used to determine the level of irrigation water from evaporation irrigation treatments were transcribed. as main plots in 3 levels: 80 mm irrigation based on evaporation (conventional irrigation), irrigation based on of 130 mm evaporation from pan evaporation, irrigation based on 180 mm evaporation from pan evaporation and sunflower cultivars as subplots in five levels including Farrokhi, Azargol, Hysun 33 and Euroflor and G-543 cultivars. Each plot consisted of four lines and the time of doing stress was started after the establishment of the plant and from 6 leaves in experimental plots. Row spacing of 60 cm and plants spacing of row 20 cm was considered, so plant density was 83,333 plants per hectare. The stage of complete maturity was considered when the back of the petals are brown and leaves were dry, 6 plants successive were selected from the middle row of four per plot. Then number of seeds was counted and their weight was measured. In order to determine the seed yield and HI in maturity stage examples was removed from the exit of stems from second to forth rows and by removing a half feet long from the beginning and end of row as a peripheral effect. The heads were separated and dried in the open air. After drying, grain weight of treatments and kernel percentage with seed yield and other traits were determined. Oil percentage of samples from complete seeds of each plot was evaluated in the laboratory using sox let petroleum ether solvent. Data were analyzed by means of statistic analysis and averages were compared with Duncan's multiple range tests in probability level of five percent if the effect of experimental treatment was significant. All the data were analyzed on the basis of the experimental design, using MSTATC and Excel softwares [40].

The experiment 3 was conducted by Mohammadai et al., (2012) [41]. In this experiment an experiment was conducted on the basis of split plot layout with completely randomized block design with 3 replications. Main plot were irrigation treatments Including: 70 (for control), 90 (moderate water stress), 110 and 130 mm (severe water stress) from evaporation pan evaporation class A, and sub plots were cultivarsm (Sc 704 , Sc 604 and Sc 301). This research was conducted in 2010-2011, at research farm of farming building of Islamic Azad University Khorasgan (Isfahan) Branch located in Khatun abad village (latitude 32o /40' N and Longitude 51o /48' E). Soil texture was silty clay. Long term average precipitation was 120 mm. The soil preparation consisted of mouldboard ploughing (25-30 cm) followed by discing and smoothing with a land leveler. On the basis of soil analysis, 120 kg ha-1 from triple superphosphate and 100 kg ha-1 KSo4, in planting time were used. Nitrogen as urea (46.6% N) was applied equivalent 300 kg ha-1. It was added into three equal portions, the first part was applied in planting time and the second part was applied in 2-4 leaf stage, and third part in 6 leaf stage. Other normal agronomic practices for maize production were followed. In each plot, 4 lines were used, the planting lines number 1 and 4 and also 0.5 meter from start and end of lines were omitted and the length of each line was 5 meter. Number of rows in ear, number of seeds per row, 1000 seed weight (g), seed yield (kg ha-1), biological yield (kg ha-1) and harvest index (%),was measured. Mstat-C software and mean comparison with Duncan, s test in 5% probability was used [41].

Results and Discussion

In the experiment 1 was conducted by Mobasser and Tavassoli (2013), the results showed that plant height affected by irrigation treatments ($P < 1\%$), so that the maximum and minimum plant height respectively was achieved from complete irrigation treatment with mean 117.833 cm and irrigation treatments in stage of halted irrigation at squaring with 104.750 cm (Table 1) [39]. Water stress causes deceleration of cell enlargement and thus reduces stem length by inhibiting inter nodal elongation and also checks the tillering capacity of plants. Adequate irrigation lead to increase of plant height in sunflower. Interaction effect of irrigation treatments and cultivars in plant height was significant ($P < 5\%$). Maximum and minimum plant height was achieved from treatments of S0V1 and S1V2 with mean 136 cm and 95 cm respectively (Table 2). The results of variance analysis showed that effect of treatments of irrigation and cultivars was significant on seed number per head ($P < 1\%$). The highest number of seeds obtained from treatment of complete irrigation. The lowest seed number per head was seen from treatment of stress in flowering stage (Table 1). Among cultivars treatments the maximum number of seeds obtained from Zarya cultivar and the lowest was achieved from Allstar cultivar (Table 2) [39]. Interaction effect of irrigation and cultivars treatments not significant on seed number per head in the 5% probability level. According to results of variance analysis effect of treatments of irrigation and cultivars was significant on 1000 grain weight ($P < 1\%$). The highest 1000 grain weight (56.583 g) obtained from treatment of complete irrigation and the lowest amount of oil yield (41.242 g) was seen from treatment of stress in flowering stage (Table 1).

Table 1: Effect of irrigation and sulphur levels on factor measured

Treatments	Plant height (cm)	Seed number of head	1000 grain weight (g)	Yield grain (ton/ha)	Oil yield (kg/ha)	Oil percent (%)
Irrigation						
S_0	125.083 a	847.500 a	56.853 a	4.700 a	1.980 a	41.980 a
S_1	104.750 c	708.833 c	45.633 bc	3.245 c	1.256 c	38.650 b
S_2	116.750 b	796.917 b	41.242 c	3.267 c	1.207 c	36.970 b
S_3	117.833 b	856.833 a	48.567 b	4.127 b	1.547 b	38.020 b
Cultivar						
V_1	124.813 a	856.688 a	40.525 c	3.456 b	1.350 b	38.950 a
V_2	100.938 a	750.625 b	49.700 b	3.754 b	1.450 b	38.440 a
V_3	122.563 a	800.250 ab	53.794 a	4.293 a	1.712 a	39.310 a

Means followed by similar letters in each column are not significantly different at the 5% level of probability

The decrease of vegetative growth in condition of water shortage lead to decrease of photosynthesis materials production in plant and finally decrease of 1000 grain weight. Among cultivars treatments the most 1000 grain weight obtained from Azargol cultivar (53.794 g) and the lowest amount of it was achieved from Zarya cultivar (40.525 g) (Table 3). The interaction effect between irrigation and cultivar treatments was significant (P < 5%). Maximum and minimum 1000 grain weight was achieved from treatments of S0V3 and S2V1with average 66.175 g and 42.275 g respectively (Table 4). The results of variance analysis showed that effect of treatments of irrigation and cultivars was significant on grain yield (P < 1%), so that the highest grain yield from treatment of complete irrigation with an average 4700 kg and the lowest grian yield was seen in treatment of halted irrigation at squaring with yield average 3245 kg. D `Andria et al., (1995) during the two-year study found that the most sensitive life stage of sunflower irrigation is time of squaring, and can improve the yield of this plant (Table 1).

Table 2: Mean comparison of interaction effects of factors measured

Treatments	Plant height (cm)	1000 grain weight (g)	Yield grain (ton/ha)	Oil yield (kg/ha)
S_0V_1	136.00 abc	42.00 d	3.87 bcd	6.60 bcd
S_0V_2	100.75 de	61.57 a	4.47 b	1.84 b
S_0V_3	126.75 abc	66.17 a	5.57 a	2.49 a
S_1V_1	114.75 abcde	42.27 d	2.84 f	1.10 d
S_1V_2	95.50 e	45.47 cd	3.46 cdef	1.33 cd
S_1V_3	104.00 cde	49.15 bc	3.42 cdef	1.33 cd
S_2V_1	126.50 a	33.57 e	3.04 ef	1.09 d
S_2V_2	96.25 bcde	43.92 cd	3.08 def	1.51 cd
S_2V_3	127.50 ab	46.22 cd	3.67 bcdef	1.37 bcd
S_3V_1	132.00 abcd	44.25 cd	4.05 bc	1.59 bcd
S_3V_2	100.25 e	47.82 cd	3.99 bc	1.47 bcd
S_3V_3	126.00 ab	53.62 b	4.32 b	1.65 bc

Means followed by similar letters in each column are not significantly different at the 5% level of probability

Concluded that sunflower seed yield was the most sensitive to water stress after anthesis. He also emphasized the need of irrigation management under limited water supply, especially during the reproductive period. Among cultivars treatments the highest grain yield obtained from cultivar of Azargol with average 4300 kg and the lowest yield about 3450 kg was achieved from cultivar of Zarya (Table 1). This matter can be by reason of higher resistance of Azargol cultivar to water deficit and having a high leaf surface duration reproductive stage. The interaction of irrigation and cultivars on grain yield was significant (P < 5%), so that the highest and lowest grain yield was achieved from treatments of S0V3 (5750 kg) and S1V1 (2846 kg) respectively (Table 2) [39].

In the experiment 2 was conducted by Dehkhoda et al., 2013. Effect of irrigation regimes and cultivar on 1000 kernel weight of sunflower was significant in 1 % probability level (Table 3). The highest 1000 kernel weight was obtained by control treatment which was significantly different with other treatments. The lowest 1000 kernel weight was irrigation treatment by ET180 which was also significantly different from the other treatments (Table 4). The highest grain weight was obtained by Azargol cultivar and the lowest grain weight was obtained by Euroflor (Table 4). The interaction effect of stress × cultivar was significant on 1000 kernel weight per 1 % probability level (Table 3). The highest 1000 kernel weight was by control treatment (conventional irrigation) coupled with Azargol cultivar and the lowest 1000 kernel weight was by the cultivar of G-543 in combination with irrigation regime on of ET180. The results indicate that increasing severity of drought stress decreased seed weight. It seems that decreasing seed weight under drought stress is because of reduction of grain filling period and premature aging. In fact drought stress reduced seed weight and seed number by reducing leaf area. Perhaps drought stress had negative effect on the current and further transport of the photosynthesis materials. Finally the transmitted material to grain decreases and this has led to shrinkage and weight loss of grains [40].

Table 3: Analysis variance of field traits [40]

SOV	df	Mean square: 1000 kernel weight	Grain yield	Biological yield	Harvest index	Oil percent	Oil yield
Replication	2	3.735	184144.66	552185.8	1.896	0.272	17135.8
Stress	2	714.15**	21056595.1**	2909826926.7**	11.058	141.9**	4405356.5**
Ea	4	6.705	132311.66	1569430.6	2.266	1.224	22737.7
Cultivar	4	149.405**	1367347.8**	49581452.9**	3.719*	20.48**	227309.3**
Stress* Cultivar	8	41.029**	277601.9	12416433.7	2.828	3.68	38580.9
Eb	24	12.097	297321.4	11437853.1	1.229	1.051	54494.9

* and ** are significant at 5 and 1 % probability levels, respectively

Effect of irrigation levels and cultivar on grain yield of sunflower cultivars was significant at the one percent level (Table 3). The highest yield was obtained by control treatment that significantly different with other treatments. The lowest grain yield was irrigation treatments by 180 mm evaporation from pan evaporation that was also significantly different from the other treatments (Table 4). The highest seed yield was obtained by Farokhi cultivar and the lowest yield was obtained by the G-543 cultivar (Table 4). So results indicate that reducing plant water needs to be less than 100% significantly reduced grain yield which this response is indicative the effect of drought stress on grain yield. Reducing seed yield in condition of limited irrigation can be contributed to effect of water defect due to lack of water which is along with acceleration of aging and reduction of filling period of grain, the signals sent from roots to leaves and induced stomata and finally reduction of the proportion of net photosynthesis. It seems that a balanced intake of water during various developmental stages of flowering and grading improved grain yield of sunflower. Because during this stage the most important yield components (seed number in head and seed weight) is formed [40].

Table 4: The means of single effects of treatments on all traits [40]

Treatment	1000 kernel weight (g)	Grain yield ($Kg.ha^{-1}$)	Biological yield ($Kg.ha^{-1}$)	HI (%)	Oil percent (%)	Oil yield ($Kg.ha^{-1}$)
Irrigation levels						
Control(Normal)	54.12 a	4930 a	33863 a	15.59 a	40.14 b	1979 a
ET_{130}	47.22 b	3963 b	25339 b	14.68 ab	41.38 a	1635 b
ET_{180}	40.32 c	2573 c	18310 c	13.98 b	35.54 c	917 c
Cultivar						
Farokhi	48.89 b	4133 a	27204 a	15.33 ab	40.54 a	1693 a
Azargol	52.52 a	4022 a	25676 a	15.56 a	38.17 b	1545 ab
Hysun 33	48.16 b	3961 a	27783 a	14.25 b	39.53 a	1597 ab
Euroflor	40.55 c	3844 a	26648 a	14.31 b	36.83 c	1435 bc
G-543	41.98 c	3150 b	21875 b	14.29 b	40.03 a	1280 c

Means in each column ,followed by at least one similar letter are not significantly different level-using Duncan's Multiple Range Test

Effect of irrigation regimes on biological yield of sunflower in 1% probability level was significant (Table 3). The highest yield was obtained by control treatments were significantly different with other treatments. The lowest biological yield was obtained by ET180 that was also significantly different from the other treatments (Table 4). The effect of different sunflower cultivar on biological yield in probability level of 1% was significant (Table 4). The highest biological yield was obtained by Hysun 33 cultivar that has not significant difference with other Azargol, Euroflor and Farokhi cultivars. The lowest biological yield was obtained by Hysun 33 cultivar that has not significant differences (Table 4). The results indicate that the increase could be due to an increase in biomass, leaf area index and crop growth rate is increasing can be more light and dry matter production. Effect of irrigation regimes on sunflower oil percentage was significant at the one percent level (Table 3). Most of the oil percentage was obtained by irrigation treatment at ET130 that was significantly different with the other treatments. The lowest percentage of oil was obtained by irrigation of ET180 treatment that was also significantly different from the other treatments (Table 4). Effect of sunflower seed oil content was significant at the one percent level (Table 3). The highest oil content was obtained by the graceful figure of the G-543 and Haysvn 33 other varieties were not significantly different. The lowest oil content was obtained by Euroflor with other varieties showed significant differences (Table 4). Effect of different cultivar of sunflower on oil percentage in one percent probability was significant (Table 3). The highest oil percentage was obtained by Farokhi cultivar that was not significantly different with G-543 and Haysun 33. The lowest oil percentage was obtained by Euroflor which had significant difference with other varieties (Table 4). Decrease of oil percentage in control treatment is because increase of water consumption increases excessive vegetative growth and delayed maturation of immature seed in the time of harvest also reduction of the percentage of oil in the severe stress treatment is because of impaired grain filling, which increases the skin of sunflower seeds [40]. The experiment 3 was conducted by Mohammadai et al., (2012) [41]. Irrigation treatment had significant influence on number of seeds per row, 1000 seed weight, seed yield, biological yield and harvest index (Table 5). Several studies have shown that seed yield and yield components of maize, was markedly affected by irrigation treatments. Effect of cultivar was significant on number of rows in ear, number of seeds per row, 1000 seed weight, seed yield, biological yield and harvest index (Table 5). The highest of NRE was achieved with control, but had no significant differences between other treatments. The lowest NRE related to 130 mm levels of evaporation. Sc 704 cultivar has highest NRE but had no significant differences with Sc 604.

Table 5: Analysis of variance for experimental characteristics of corn [41]

S.O.V.	d.f	No. of rows/ear	No.of seeds/row	1000seed weight	Seed yield	Biological yield	HI
Replication	2	13.19	5.91	128.15	245975.7	901920.52	55.46**
Irrigation	3	7.80	161.28*	15027.6**	48505490.6**	174742355.7**	16.88**
Error (a)	6	3.36	13.107	508.23	162827.3	609368. 6	0.43
Cultivar	2	4.95*	200.3**	1239.40*	6046435.1**	13737452. 6**	28.39**
Irrigation ×Cultivar	6	3.29	43.16**	657. 45	880885.9*	2999682. 5*	0.38
Error (b)	16	1.36	6.04	255.98	253981.6	1090150.5	3.87

* and ** Significant at P=0.05 and P=0.01 level, respectively in F-test.

Table 6: Mean comparison for No. of rows/ ear, No. of seeds per row, 1000-seed weight (g), seed yield (kg ha^{-1}), biological yield (kg ha^{-1}), HI (%)

Treatment	No. of rows/ear	No.of seeds/row	1000-seed weight	Seed yield	Biological yield	HI
Irrigation (mm) (I)						
70 (I1)	17.73^{a}	28.58^{a}	368.27^{a}	8716.2^{a}	17349.3^{a}	50.21^{a}
90 (I2)	16.48^{a}	26.96^{ab}	325.48^{b}	8004.8^{b}	16206.4^{b}	49.28^{b}
110 (I3)	15.80^{a}	23.05^{bc}	292.17^{c}	5027.3^{c}	10379.0^{c}	48.42^{c}
130 (I4)	15.72^{a}	19.11^{c}	275.74^{c}	3884.2^{d}	8289.1^{d}	46.99^{d}
Cultivar (C)						
Sc 704 (C1)	16.92^{a}	28.87^{a}	327.00^{a}	7020.1^{a}	13854.7^{a}	50.38^{a}
Sc 604 (C2)	16.67^{ab}	23.58^{b}	311.17^{b}	6572.5^{b}	13472.8^{a}	48.46^{b}
Sc 301 (C3)	15.70^{b}	20.83^{c}	308.05^{b}	5629.5^{c}	11840.3^{b}	47.34^{b}
Irrigation × Cultivar (I×C)						
I 1C1	18.63^{ab}	38.80^{a}	370.9^{a}	9746.7^{a}	18790.8^{a}	51.87^{a}
I 1C2	19.17^{a}	25.77^{cd}	358.7^{a}	8644.6^{bc}	17400.7^{abc}	49.70^{abc}
I 1C3	15.43^{c}	21.23^{de}	375.3^{a}	7758.7^{c}	15860.5^{cd}	49.10^{abcd}
I 2C1	16.47^{bc}	31.23^{b}	347.9^{ab}	9086.0^{ab}	17930.7^{ab}	50.67^{ab}
I 2C2	16.93^{bc}	27.63^{bc}	305.7^{cd}	8168.1^{c}	16500.6^{bc}	49.43^{abcd}
I 2C3	16.10^{c}	21.97^{de}	322.8^{bc}	6761.7^{d}	14180.4^{d}	47.73^{bcd}
I 3C1	16.07^{c}	24.13^{cd}	300.3^{cd}	5554.5^{e}	11120.1^{e}	50.03^{abc}
I 3C2	15.37^{c}	23.03^{cd}	$292.^{bcd}$	5020.0^{ef}	10380.0^{e}	48.40^{abcd}
I 3C3	16.00^{c}	22.07^{de}	283.7^{d}	4508.5^{fg}	9638.6^{e}	46.90^{bcd}
I 4C1	16.53^{bc}	21.30^{de}	289.0^{d}	3695.6^{gh}	7580.5^{f}	48.93^{abcd}
I 4C2	15.30^{c}	17.93^{e}	287.7^{d}	4458.4^{fg}	9610.6^{e}	46.33^{cd}
I 4C3	15.37^{c}	18.13^{e}	250.5^{e}	3491.4^{h}	7678.6^{f}	45.70^{d}

Common letters within each column do not differ significantly.

The lowest NRE related to Sc 301 (Table 6). The highest of NSR was achieved with control, but had no significant differences with 90 mm. The lowest NSR related to 130 mm levels of evaporation but had no significant differences with 110 mm. Sc 704 cultivar has highest NSR with significant differences from other cultivars and the lowest of NSR related to Sc 301 (Table 6).

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