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STUDY OF SAFFLOWER CULTIVARS YIELD AND YIELD COMPONENTS UNDER DIFFERENT SUPPLEMENTARY IRRIGATION CONDITIONS

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Abstract

Safflower is an adapted plant with our country conditions. In order to study of safflower cultivars yield and yield components under different supplementary irrigation conditions an experiment was conducted in khorasan. The experimental design was split plot based on Randomized Complete Block Design with four replications. Factors were included five levels of irrigation, i.e., no irrigation, irrigation at rosette stage, flowering stage, seed filling stage and irrigation in flowering+ seed filling as the main factors , and sub factors were cultivars in three levels. Results showed that the effect of supplementary irrigation on HI, seed number per main head, seed number per branch, 1000 kernel weight and seed yield was significant.

Key words: *Carthamus tinctorius, water stress, seed yields, harvest index.*

INTRODUCTION

Safflower (*Carthamus tinctorius* L.) is member of Asteraceae family with having vertical root type that can penetrate to soils a depth of two to three meters (Bagheri and Sam-Daliri, 2011). Safflower is one of the oldest crops, traditionally, grown for its seeds, which is used as edible oil and as birdseed and used for coloring and flavoring foods and for making red and yellow dyes, especially before cheaper aniline dyes became available, and in medicines (Zohary and Hopf, 2000). This plant is considered as a drought and salinity-tolerant crop (Gecgel et al., 2007; Ozturk et al., 2008; Majidi et al., 2011), able to extract water at soil moisture contents that are not available to the majority of crops (Weiss, 2000). The deep root and the many fine laterals, allow safflower to survive in periods of moisture shortage also limit.

Kar et al. (2007) observed that under water deficit condition, supplemental irrigation during reproductive phases had a significant effect on increasing seed yield.

Damage caused by water shortages, reduced production due to delays or failure of plant establishment, weakening or loss of established plants, the plants prone to pests and diseases, changes in the plant biochemical and physiological metabolism and decrease crops quality.

Lovelli et al. (2007) showed that the harvest index in safflower did not significantly change in 5 irrigation regimes with a restoration of 100%, 75%, 50%, 25%, and 0% of the maximum crop evapotranspiration, but seed yield declined sharply when drought was severe (Lovelli et al., 2007).

Supplemental irrigation in order to improve and stabilize production, small amounts of water are added to crops which are essentially rainfed, during periods which rain cannot provide sufficient moisture for normal development of plants (Oweis, 1997). Supplemental irrigation also had a significant effect on grain yield. Therefore, while applying one irrigation, only 392 kg ha^{-1} of grain yield was obtained, and yield was enhanced by 48% when two irrigations were applied over the single irrigation. With three irrigations, 1258 kg ha^{-1} of grain yield was obtained, 220% higher than for a single irrigation. Omidi Tabrizi (2006) evaluated safflower genotypes under 3 different environmental conditions, in Karaj, Isfahan, and Darab in Iran, and indicated significant differences among genotypes in seed and oil yield.

MATERIALS AND METHODS

The experimental design was split plot based on Randomized Complete Block Design with four replications. Factors were included five levels of irrigation, i.e., no irrigation, irrigation at rosette stage, flowering stage, seed filling stage and irrigation in flowering+ seed filling as the main factors, and sub factors were cultivars in three levels (promising line 411,Sina and Syrian). Leaves, stems and pods were separately taken from three plants of each plot and plant growth parameters such as plant height, number of leaves, main branches, secondary braches, main heads, secondary heads, seed per head, 1,000 seeds weight, fresh and dry weight were recorded. All data from the experiment were subjected to analysis of variance (ANOVA) using SAS 9.1 package, the means compared with Duncan's test and all graphs were drowning using Excel.

RESULTS AND DISCUSSIONS

Results of analysis of variance indicated that the main effect of supplementary irrigation on HI was significant ($P<0.05$). Based on results the I_3 and I_5 treatments with 23.35% and 27.74% of HI were showed the highest amount of HI respectively. Although I_2 showed the highest amount of biomass but I_3 and I_5 were showed the highest amount of HI and it seems supplementary irrigation in flowering stage had the highest effect on economical yield by increasing productive growth. Omidi et al. (2006) reported that he found a significant positive correlation between biological yield and seed yield of safflower on his experiment. Patel and Patel (1993) reported that, the stage to flowering and grain filling as a critical stage of safflower growth stages to irrigation. Results also indicated that the highest biomass was obtained in promising line 411 with 2.03 kg/m^2. Promising line 411 had the highest plant height, and could produce more biomass than the other two cultivars.

Results showed the effect of supplementary irrigation on number of seeds per main head was significant ($P<0.05$) (Table 1) and the highest number of seeds were produced in treatment I_3, and in treatment I_1 the lowest number of seeds per main head was obtained. As the number of head per plant and the number of seeds per head of safflower are the important factors that effect on yield of this plant, I_3 by producing more seeds per head to compare with other treatments ranked as a superior treatment.

Based on results 1000 seed weight significantly differed between irrigation treatments ($P<0.05$) and treatment of I_3 by amount of 43.70 (gr) of 1000 seed weight had the highest weight while irrigation treatment I_1 produced the lowest one (38.04 gr) (Table 1). Analysis of variance showed that variety was significantly ($P<0.05$) affected 1000 seed weight and the highest 1000 seed weight was recorded in Sina (Table 1) by amount of 44.44 and it was not observed any significant differences between this cultivar to compare with promising line 411 by 1000 seed weight of 41.74 gr (Table 2).

The effect of supplementary irrigation on traits: stand establishment, days to stem elongation, flowering and end of flowering and plant height, biomass, number of total heads, number of branches, and number of hollow seeds and number of main branch were not affected by water stress.

Results of analysis of variance showed that supplementary irrigation significantly affected yield of safflower cultivars. Results of main effects indicated that treatment of I_3 with production of 423.43 kg/ha seeds. Interaction effects of supplementary irrigation and cultivars also significant and based on results Syrin in treatment I_3 by production of 512.18 kg/ha seed, ranked as the highest cultivar and Sina in treatment number one with production of 249.37 was the lowest cultivar and irrigation treatment.

Mean comparison results of main effects showed the superiority of irrigation at flowering stage in compare with the other treatments and the highest yield was obtained in flowering stage in promising line 411 with 423.43 kg/ha.

CONCLUSIONS

In this study we found that complementary irrigation in flowering stage had the highest effect on economical yield by increasing productive growth and increased HI significantly, seed number per main head, seed

number per branch and 1000 seed weight also increased by supplementary irrigation. Since irrigation at flowering stage increased yield in water limitation conditions, irrigation is one of great importance factors to improving yield and also promising line 411was classified as a superior cultivar.

Table 1. Mean Comparison the main effects of safflower cultivars and irrigation in Khorasan

S.O.V	Treatments	Seed/Main Head	Seed/Secondary Head	1000 Seed Weight(gr)	Seed Weight of Secondary Head	Yield
Supplementary Irrigation	I_1	17.97b	21.95b	34.04b	062b	292.46b
	I_2	20.80ab	25.75b	40.72ab	0.81ab	363.71ab
	I_3	24.53a	40.03a	43.70a	0.90ab	423.43a
	I_4	21.32ab	34.88a	40.65ab	1.03a	352.59ab
	I_5	22.12ab	36.15a	42.35a	1.08a	388.92a
Variety	C_1	22.21a	32.38a	41.74a	1.03a	389.63a
	C_2	21.35a	30.78a	37.10b	0.74b	352.12a
	C_3	20.48a	32.10a	44.44a	0.89ab	350.92a

*Values followed by similar upper case letters in a column are not significantly different at p <0.05

Table 2. Mean Comparison the interaction effects of safflower cultivars and irrigation in Khorasan

Irrigation levels	Cultivars	Seed/Main Head	Seed/Secondary Head	1000 Seed Weight(gr)	Yield (kg/ha)
I_1	C_1	17.20b	22.665fg	40.91abcd	324.00bcd
	C_2	21.40ab	26.30cdefg	32.41e	249.37d
	C_3	23.80ab	28.30bcdefg	44.35ab	304.00bcd
I_2	C_1	14.40b	25.25defg	38.56bcde	426.88ab
	C_2	17.40b	16.90g	36.90cde	341.26bcd
	C_3	18.10b	23.70efg	43.15abc	322.99bcd
I_3	C_1	26.85a	38.75abc	44.75ab	361.43bcd
	C_2	22.20ab	37.75abc	40.34abcd	396.68abc
	C_3	24.55ab	31.95bcdef	46.03a	512.18a
I_4	C_1	25.10ab	44.20a	42.00abcd	429.68ab
	C_2	17.70b	35.65abcde	35.88de	369.21bcd
	C_3	21.15ab	40.25ab	44.08abc	258.88cd
I_5	C_1	19.50ab	31.05bcdef	42.49abcd	406.15ab
	C_2	23.40ab	37.30abcd	39.96abcd	404.08ab
	C_3	23.45ab	36.30abcd	44.59ab	356.54bcd

*Values followed by similar upper case letters in a column are not significantly different at p <0.05

REFERENCES

Bagheri H., Sam-Daliri M., 2011. Effect of water stress on agronomic traits of spring safflower cultivars (*Carthamus Tinctorius*). Australian Journal of Basic and Applied Sciences, 5(12): 2621-2624.

Gecgel U., Demirci M., Esendal E., 2007. Seed yield, oil content and fatty acids composition of safflower (*Carthamus tinctorius* L.) varieties sown in spring and winter. International Journal of Natural and Engineering Sciences, 1: 11-15.

Kar G., Kumar A., Martha M., 2007. Water use efficiency and crop coefficients of dry season oilseed crops. Agricultural Water Management, 87: 73-82.

Lovelli S., Perniola M., Ferrara A., Tommaso T.D., 2007. Yield response factor to water (ky) and water use efficiency of *Carthamus tinctorius* L. and *Solanum melongena* L. Agricultural Water Management, 92: 73-80.

Majidi M.M., Tavakoli V., Mirlohi A., Sabzalian M.R., 2011. Wild safflower species (*Carthamus oxyacanthus* Bieb.): A possible source of drought tolerance for arid environments. Aust. J. Crop Sci. 5: 1055-1063.

Omidi Tabrizi A.H., 2006. Stability and adaptability estimates of some safflower cultivars and lines in different environmental conditions. J Agric Sci Technol., 8: 141-151.

Oweis T., 1997. Supplemental Irrigation: A highly efficient water use Practice. International Center for Agricultural Research in the Dry Areas (ICARDA). Aleppo, Syria.

Ozturk E., Ozer H., Polet T., 2008. Growth and yield of safflower genotypes grown under irrigated and non-irrigated conditions in a highland environment. Plant Soil Environ. 54(10): 453-460.

Patel N.C., Patel Z.G., 1993. Performance of safflower under different irrigation scheduling in south Gujarat. Annals of Agriculture Research, 41(1): 109-110.

Weiss EA., 2000. Oilseed Crops. Blackwell Publishing Limited, London,UK.

Zohary D., Hopf M., 2000. Domestication of plants in the Old World, 3rd edition. Oxford University Press, p. 211.