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Effects of Planting Date and Irrigation Management on Sunflower Yield and Yield Components

[1]Fatemeh Taheri Asbag, [2]Abdollah Hasanzadeh Gorttapeh, [1]Amir Fayaz-Moghadam,
[1]Maryam Saber-Rezaie, [1]Farideh Feghnabi, [1]Mosa Eizadkhah, [1]Sharara Jahannavard,
[3]Simin Parvizi and [4]Somyeh Naghi Moghadam-Pour
[1] College of Agriculture, Urmia University, West Azerbijan, Iran
[2]Agricultural and Natural Resources Research Center of West Azerbijan, Urmia, Iran
[3]Tabriz Young Researchers Club, Tabriz Islamic Azad University, East Azerbijan, Iran
[4]Tabriz Islamic Azad University, East Azerbijan, Iran

Abstract: Sunflower is one of the most cultivated oil crops in the world. In Iranian environments, where water deficit frequently occurs, early sowing and irrigation are used to overcome environmental constraints due to water scarcity. Since, in the literature, the data on the effect of these agronomic techniques on sunflower seed yield and yield component are essential and contrasting, the aim of this study was to evaluate the effect of the sowing time and the water regime on seed yield and yield component in Iranian environment. For this aim, one standard hybrid (Euroflor) sown in spring at the 3 different dates were cultivated in Western Iranian under 5 water regimes, viz I_1, IW/CPE (irrigation water: cumulative pan evaporation) ratio 0.6. I_2, at 25 days after sowing + flower-bud initiation; I_3, at 25 days after sowing + complete flowering; I_4, at 25 days after sowing + seed filling; I_5, at 25 days after sowing + complete flowering + seed filling in 2007. Yield and its main component were positively affected by irrigation and by the earlier sowing date. At early sowing date the yield and yield components showed notable increase. The increase in these parameters observed also in supplementary irrigation.

Key words: *Helianthus annus* L., sowing date, irrigation, water stress, yield

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is an important oil crop word wide and in the topics, its cultivation is becoming widespread. Sunflower combines high yield with great adaptation capacity, the characteristically high photosynthetic capacity and harvest index makes this crop viable for contrasting environments (Agele *et al*., 2007). In 1998, the seed world production was about 28.5 million tons and as edible vegetable oil, only soybean (*Glycine max* L. Merr.) and rapeseed canola (*Brassica napus* L. *and Brassica campestris* L.) oil production exceeded that of sunflower. Due to the sunflower ability to tolerate short periods of water deficit the potential exists for it to become an important crop, also in sub-arid environments and wherever, available irrigation water is limited. In such environments, early sowing allows the crop to benefit from late winter rainfall and can be given only as supplementary irrigation to sustain yield (Flagella *et al*., 2002). Among the various agronomic practices, sowing time and irrigation management have greater influence on growth and yield of crop. The effect of sowing date and irrigation has been extensively studied on seed yield of standard genotypes of sunflower (Flagella *et al*., 2002).

Numerous studies have shown that yield and yield component in sunflower is reduced when normal spring sowing dates are delayed in both temperature (Abelardo *et al*., 2002) and subtropical (Bange *et al*., 1998) environments. The observed lower yields associated with late planting have been variously hypothesized as due to warmer temperatures during the growth period, which promotes excessive early stem growth and reduce time to flowering and to Cooler temperatures and reduced incident radiation photosynthesis, which affects the dynamics of grain filling (Flagella *et al*., 2002; Bange *et al*., 1998).

Water stress is considered one of the most important factors limiting plant performance and yield world wide. Effects of water stress on a plant including growth, leaf photosynthesis and yield have been studied extensively (Ribas-Carbo *et al*., 2005; Iqbal *et al*., 2005).

Corresponding Author: Abdollah Hasanzadeh Gorttapeh, Agricultural and Natural Resources Research Center of West Azerbijan, Urmia, Iran

With delayed sowing, development is hastened because the crops encounter higher temperatures during the vegetable growth. Shortening of the growing. Cycle decrease the amount of radiation intercepted during the growing season and thus total dry matter at harvest (Barros *et al*., 2004).

Flagella *et al*. (2002) reported that a delay of the sowing date significantly reduced grain yield of sunflower due to a decrease in the number of seed m^{-2} and in seed weight.

With most plants the maintenance of growth and function depends on maintaining relatively high water content in the protoplasm. This is because many important physiological processes such as leaf enlargement, stomata opening and photosynthesis are directly affected by a reduction in leaf water potential. In crop plants, water deficits have been shown to decrease both growth and yield (Barros *et al*., 2004).

The aim of this study was to evaluate the influence of irrigation and three sowing dates on seed yield and yield component of sunflower grown in a sub-arid environment. That in order to get deeper insight into the effects of the main agronomic techniques adopted in a Mediterranean climate on seed yield and quality of sunflower.

MATERIALS AND METHODS

This study was conducted in 2006 at a farm of Agricultural researches center located in west Iran, Urmia, 37°43'E, 45°2'N) on a flat silt loam clay soil having 0.12% total nitrogen contented (Kjeldhal method), 12.5 ppm assumable phosphorus (Olsen Method, P_2O_5), 800 exchangeable potassium (Ammonium acetate Method, K_2O), 1.20% organic matter (Walchy-Black method). Seeds of sunflower genotype (Euroflor) were obtained from the company of oil seeds of Urmia.

Experiment was laid out in a split-plot design with 3 replications. There were 3 planting dates in main plot, viz 5 and 20 May, 5 June and 5 irrigations schedules in subplots, viz I_1, IW/CPE (irrigation water:cumulative pan evaporation) ratio 0.6. I_2, at 25 days after sowing+ flower-bud initiation; I_3, at 25 days after sowing+ complete flowering; I_4, at 25 days after sowing+ seed filling; I_5, at 25 days after sowing+ complete flowering+ seed filling. A pre-sowing irrigation of 100 mm was applied to ensure good germination of the crop and post-sowing irrigation each of 60 mm depth were given as per treatment. The quantity of water was measured with the help of 15 cm throat Parshall flume fixed in the irrigation channel.

Plants were sown in rows planted 0.6 m apart, with the seeds placed 0.25 m apart along the row. The crop of 5th and 20th May and 5th June, was harvested on 22nd August, 6th and 21st September, respectively. Seed yield and 100 achene weight was recorded.

Analysis of variance of the data from each attribute was computed using the SAS computer program (version 9). The Duncan's new multiple range tests at 5% level of probability was used to test among mean values (Iqbal *et al*., 2005).

RESULTS AND DISCUSSION

Seed yield: Both yield and yield component showed significant differences in relation to the sowing date and the water regime (Table 1). The more favorable irrigation regime in 2007 resulted in a better yield performance (Table 1). Due to a higher number of seeds/head and 1000 achene weight, the early sowing date (5 May) resulted highest seed yield (2.906 ton ha^{-1}) (Table 1).

Irrigation exhibited a highly significant positive effect on seed yield and this was greater than the early sowing date effect. The highest seed yield was obtained from I_1 irrigation treatment (3.373 ton ha^{-1}) (Table 1), due to an increase of both 1000 seed weight and the number of achene/head.

Yield components: Combine analysis of variance showed that the effect of sowing date on 1000 achene weight and seed number per head was significant (Table 1). But about the 1000 achene weight the means of all sowing dates treatment followed by the same letter (Table 1). However the highest 1000 achene weight obtained from D_1 (56.10 g) (Table 1). Analysis showed that D_1 resulted highest seed number per head (1608) (Table 1).

The highest seed number per head obtained from I_1 irrigation treatment (1984) (Table 1). It resulted in 33.66% seed number increase due to increase the head diameter. I_1 irrigation treatment resulted highest 1000 achene weight (59.22 g), however the mean of I_1, I_3, I_4 and I_5 irrigation treatments about this factor followed by the same letter (Table 1).

Influence of sowing date on seed yield and yield component: Concerning the effect of the sowing time, we observed a yield increase in the early sowing with respect to the later one. Our results are agreement with those already reported for standard genotype sown in spring in Western Iran. In fact anticipating sowing time from May-March (Barros *et al*., 2004) caused a marked yield increase. This behavior might be as crib able to the best soil water content in the early stage of plant development. Seed yield is strongly influenced by the water use of the crop during the later crop stages and thus by the precipitation during these stages. On the other hand, no effect was found on yield by anticipating sowing date from July to June, when sunflower was cult ivated as catch crop, in Southern Italy. That was probably due to the contribution of autumn rainfall at the seed filling stage, in the case of the late sowing (Barros *et al*., 2004).

Table 1: Effect of sowing date and water regime on the mean values of seed yield

	Sowing date*			Water regime**				
Seed yield	D_1	D_2	D_3	I_1	I_2	I_3	I_4	I_5
Achene yield (t ha^{-1})	2.9^a	2.5^b	2.8^a	3.3^a	2.1^d	2.4^c	2.7^b	2.9^b
1000 achene weight (g)	56.1^a	53.5^a	52.4^a	63.2^a	59.2^{ab}	54.3^{bc}	59.3^c	41.9^d
Achene/head (number)	1608^a	1399^b	1716^a	1948^a	1182^c	1494^b	1508^b	1702^b

Values in a row followed by the same letter are not significantly, according to Duncan's test at $p<0.05$; * D_1, D_2 and D_3, 5th and 20th May, 5th June, respectively; ** I_1, I_2, I_3, I_4 and I_5, IW/CPE (irrigation water: cumulative pan evaporation) ratio 0.6. at 25 days after sowing flower-bud initiation; 25 days after sowing + complete flowering; 25 days after sowing+ seed filling; 25 days after sowing + complete flowering + seed filling, respectively

Furthermore, Flagella *et al*. (2002) and Barros *et al*. (2004) found that large differences among seeding dates in the various years resulted primarily from the effect of precipitation amount and distribution during the growing season. Different planting dates caused flowering and seed development to occur during periods of widely different temperatures, radiation and day length.

So, a correct decision on the planting date should be based in a thorough understanding of the environmental factors influencing sunflower growth, development, yield and quality.

Influence of the water management on seed yield and yield component: This is a well established fact that yields of crop plants in drying soil reduce even in tolerant lines of that crop species. A similar trend in yield decline was observed during the present investigation, the yield per plant and yield component were reduced due to water stress treatments (Flagella *et al*., 2002).

The decrease in yield and yield component in different sunflower genotypes has also been reported by many workers (Iqbal *et al*., 2005). These workers clearly indicated that sunflower drought tolerant lines showed less reduction in yield plants in respect of susceptible lines (Agele *et al*., 2007).

The highly positive effect of irrigation on seed yield confirms the key role of supplementary irrigation at critical growth stages, particularly sensitive to water stress (Flagella *et al*., 2002). In particular, workers reported that supplementary irrigation at the critical stages gave similar yield as with the periodic replenishment of evapotranspiration calculated on the basis of metrological approach. Also, Flagella *et al*. (2002) reported that both yield parameters and the oil fatty acid composition showed significant differences in relation to the water regime, the year, sowing date and genotype. The more favorable rainfall regime in 1996 resulted in a better yield performance, due to a higher number of seeds per head and 1000 achene weight.

CONCLUSION

In conclusion, in Iranian environment, supplementary irrigation and early sowing resulted in a notable rise in seed yield.

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