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The Simultaneous Effect of Deficit Irrigation, Nitrogen Levels and Seed Priming On Hybrid Sunflower (cv. Azargol) In Varamin

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ABSTRACT

In order to study the simultaneous impact of deficit irrigation, nitrogen levels, and seed priming on grain yield and some morphological traits in hybrid sunflower, cv. Azargol, this experiment was carried out in randomized complete block design with split-split plot arrangement with four replication in the research farm of the Islamic Azad University, Varamin-Pishva branch, Tehran-Iran. Irrigation regimes were allotted to main plots; I_1: perfect irrigation, I_2: no irrigation from budding to flowering, I_3: no irrigation from flowering to grain filling and I_4: no irrigation from budding to grain filling stage. Nitrogen levels (N_1= 0, N_2= 90 and N_3= 180 Kg /ha) and seed priming treatments (Pt1= no pre-treatment, Pt2= soaking seeds in distilled water for 24 hours, and Pt3= soaking seeds in monoethanol amine for 6 hours) were allotted to sub plots and sub-sub-plots, respectively. In this experiment grain yield, oil percentage and harvest index were investigated. The results showed that the highest (5466 Kg/ha) and the lowest (1828 Kg/ha) grain yield were obtained with $I_1N_3Pt_1$ and $I_4N_1Pt_1$ combination, respectively. Deficit irrigation (I_2, I_3 and I_4) decreased the number of seed per head. In the treatment $I_4Pt_{3,}$ Mono ethanol amine lessened the devastative effects of no irrigation on the biological performance of the crops.
KEY WORDS: grain yield, grain oil percentage, harvest index, irrigation, nitrogen, sunflower.

INTRODUCTION

Irrigation is one of the most important limiting factors of the agricultural production in arid and semi arid regions [1]. It can be pointed that competition between other agricultural crops and oil seeds and also limitation of water and soil resources are two factors inhibiting inner production growth of soil seeds. Sunflower is a resistant crop to drought with deep and researcher root system [2-3]. Deficit water and fast reduction of water resources are the most important subjects in the most regions of the world especially in the arid and semi arid areas [4]. Iran is one of arid and semi arid regions of the world and for its various climatic conditions, optimum and scientific use of water and soil to appropriate nutrition and re-investigation in water use amount as a development indicator in the future and also increase the quality and quantity of crop of the sunflower is necessary. The most critical time of water deficit for yield is chiefly result of decrease of fertile seed number in head and oil percentage is affected to water deficit lower than grain yield. Many researches were achieved about effects of water deficit stress and limitation of irrigation on phonologic, morphologic and physiologic traits [3, 5]. The use of nitrogen increases the hundreds seed weight, grain yield, head and stalk diameter, economic and biological yield. Various researches have showed that using nitrogen fertilizer increases the plant growth, dry matter accumulation and grain yield in the sunflower [6]. Pollination and flowering stages are the most sensitive stages to drought about one-hundred-seed weight whereas grain filling is the most sensitive stage to drought about oil percentage [3]. Pretreatment of sunflower seeds with ethanolamine increased seedling tolerance of salt stress during germination. During the germination period, a considerable increase was observed in proline levels (up to 300%) in seedlings subjected to salt stress without pretreatment, whereas in the pretreated group the proline increase was much smaller (20%). Starting from the fourth day of germination, betaine levels in seedlings pretreated with ethanolamine and then with water or salt showed a significant increase compared with untreated controls and salt-exposed seedlings without pretreatment, possibly because ethanolamine promotes betaine biosynthesis [7].

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MATERIALS AND METHODS

This study was carried out in the randomized complete block design with split-split plot arrangement with four replications in the research farm of the Islamic Azad University, Varamin-Pishva branch, Tehran, Iran. Each plot included 7 planting lines (distance between lines was 60 cm), length of each line was 2 m and also distances in-row was 20 cm. The soil of farm was classified in loam-clay. After soil experiment, seeds were planted in two depths of 0-30 cm and 30-60 cm as furrow method and then were irrigated immediately. Protections were achieved accordance routine agronomic methods. All treatments were irrigated three times in order to homozygous germination and the used water was calculated by contour during the growth season. In order to calculation of irrigation depth, were selected soil samples from depths 0-30 and 30-60 cm. the humidity percentage of soil was calculated and then the needed water to reach to field capacity was measured. Also soil was fertilized with nitrogen fertilizer in two times include pre-planting (1/3) and post-thinning (2/3).
Four irrigation levels in this experimental treatment were:

I_1: perfect irrigation
I_2: no irrigation from budding to flowering
I_3: no irrigation from flowering to grain filling
I_4: no irrigation from budding to grain filling stage

As main factor (drought stress in phonological stages of plant) and used nitrogen in three levels:
N_1= 0 kg N/ ha
N_2= 90 kg N/ha
N_3= 180 kg N/ha as marginal factor

Seed provided in three levels:
Pt_1: no pre-treatment
Pt_2: soaking seeds in distilled water for 24 hours
Pt_3: soaking seeds in ethanol amine for 6 hours as sub-sub factor.

Water used and times of irrigation shows in table 1. Calculated traits included grain yield, oil and biological yield, oil percentage, harvest index and water use efficiency. The data obtained from field measurements and laboratory observations were subjected to an analysis of variance using SAS software and Duncan's multiple range test was applied at $P < 0.05$.

RESULTS AND DISCUSSION

Grain yield

It is shown that treatments of irrigation stages and used nitrogen levels had significant difference at $P < 0.01$ and interactive effect between irrigation and seed priming had significant difference at $P < 0.05$ (Table 3).
The highest (4247 kg/ha) and the lowest (2655 kg/ha) grain yield were obtained from perfect irrigation (I_1) and no irrigation (I_4), respectively. Trend of changes showed that I_2 in comparison with I_1 and I_3 to I_1 decreases 5.95% and 17.63 % the grain yield, respectively. I_4 to I_1 (4 times irrigation less than I_4) and decreased used water from 8563 to 5928 m^3/ha resulted to decrease (37.48 %) by grain yield. Treatments of I_2 and I_3 (with equilibrium irrigation times and amount of water) showed significant difference about drought stress due to phonological time difference (Table 1). Obtained results show that irrigation treatments and nitrogen levels had significant difference at $P < 0.01$ but significant difference between irrigation treatments and seed priming was at $P < 0.05$. With regards to increasing of used water, optimum use of environmental conditions and more absorption of nitrogen by plant and increase of photosynthesis, it can be said that grain yield is increased. That subject cab be resulted from precocious biosynthesis of betaine that causing to increased growth in treated transplants by mono ethanol versus untreated transplants. Precocious biosynthesis of betaine can also prevent the decrease of photosynthesis capacity of chlorophyll in treated plants by ethanol amine [7].

Table 1. Water used and times of irrigation in treatments

Treatment	No. of irrigation	Used water (m^3/ha)
I_1	13	8563.492
I_2	11	7246.031
I_3	11	7246.371
I_4	9	5928.571

Table2. Physical and chemical properties of soil

Mn p.p.m	Cu p.p.m	Zn p.p.m	Fe p.p.m	Sand %	Silt %	Clay %	K (ava) p.p.m	P (ava) p.p.m	Total N %	OC %	TNV	pH	EC DS/MS	Experiment
9	1	2	10	50	25	25	400	15	0.2	2	15	6.5	<4	**Optimum range**
7.6	1.06	1.06	2.38	24	46	30	600	40	0.1	1	21.54	7.67	2.86	**depth:0-30cm**
4.2	0.46	0.34	1.28	30	42	28	280	8	0.05	0.46	21.29	7.82	1.59	**Depth:30-60 cm**

Grain oil percentage

The effect of irrigation stages and interactive impact between irrigation and nitrogen levels were significantly different at $P < 0.01$ and $P < 0.05$, respectively. The most oil percentage was obtained by I1 (40.70 %) whereas I4 had the lowest oil percentage (36.65 %). The results indicate that the most decrease in oil percentage was during the ripping stage. Thus no irrigation after flowering had the most effect on decrease of oil percentage but there was no significant difference between I_2 and I_3 about oil percentage on the basis of Duncan's multiple range. Oil percentage was increased (40.7 %) by I_1 (with irrigation in vegetative and generative stages and no limitation in relative humidity). The oil content (true oil percentage) is increased by increasing the grain relative weight in various irrigation treatments. Also limitation of water and drought stress in flower appearance time is implied that cause to decrease of leaf activities and its precocious senescence and also they had final effect on oil percentage decrease [8]. Duration of oil synthesis and oil percentage is increased by addition the length of growth stage. Many researchers believe that grain oil percentage is simultaneously increased by irrigation times [9]. The most (39.78 %) and the lowest (38.43 %) oil percentage were registered by N_1 (0 kg N) and N_3 (180 kg N), respectively. There is no difference between N_2 and N_3. Changes trend of oil percentage was contrast to grain yield, it means by increasing of nitrogen percentage is followed by increase of nitrogen compounds which available materials is decreased to fatty acids synthesis and then photosynthesis materials are devoted to protein composition resulted to low carbohydrates and oil percentage [10]. Simultaneous decrease of oil percentage and increase of nitrogen levels have been reported by many researchers [11-13]. Other researchers have reported that increase of used nitrogen resulted to increase of grain oil yield but decreased the grain oil percentage, simultaneously [14-15]. Some reports showed that increase of nitrogen levels had a negative effect on oil percentage resulted from increasing of proteins in grain [16-18]. Also it have been reported that there is correlation between grain yield and oil percentage with oil yield.

Table3. Variance analysis on measured properties (MS)

s.o.v	df	Grain Yield (kg/ha)	Oil percentage(%)	Harvest Index (%)
R	3	770932.185	6.919	12.059
I	3	17711604.826**	105.777**	131.642**
a	9	177262.864	8.787	3.346
N	2	6226859.981**	28.185*	14.491 ns
I.N	6	588496.574 ns	22.106*	12.636 ns
b	24	1173170.645	7.700	18.568
Pt	2	ns 970554.359	14.175 ns	72.375**
I.Pt	6	1500297.534*	29.766 ns	13.522 ns
N.Pt	4	1549069.359 ns	12.038 ns	132.020**
I.N.Pt	12	713459.237ns	20.167 ns	19.033 ns
c	72	669240.888	17.552	16.908
c.v%	-	22.73	10.77	16.32

Harvest index

Harvest index is an important trait for evaluating of agronomic crops. Table 3 shows that various irrigation stages are significantly different about harvest index. Treatment I_1 and I_4 had the most and the lowest harvest index, respectively. As harvest index is grain yield to total biomass thus no limitation of water during growth period increases the biomass caused to rising of biological yield to economic yield and decrease of harvest index, simultaneously. There were significant difference between I_4 (23.14) and I_1 (27.60) as harvest index. I_1 had the most total dry matter and grain yield and also had high total biomass to grain yield relation resulted to decreasing of harvest index. Table 4 shows the effects of main and interaction double treatments on measured properties. The most (30.40) and the lowest (23.11) harvest index were owned by N_3Pt_1 and N_1Pt_3, respectively. There were positive correlation between harvest index and irrigation. Grain yield and grain yield ingredients are increased by addition of nitrogen but harvest index is deceased. Also there were positive effect of nitrogen fertilizer on the final dry matter, grain yield and no harvest index in sunflower.

Table4. The effects of main and interaction double treatments on measured properties

Factor	Grain yield (kg/ha)	Oil Percentage (%)	Harvest Index (%)
I1	4247A	40.70 A	27.60 A
I2	3994B	39.57 AB	25.69 B
I3	3498C	38.66 B	24.35 C
I4	2655D	36.65 C	23.14 D
N0	3333B	39.78 A	24.96 A
N90	3454B	38.47 B	24.80 A
N180	4009A	38.43 B	25.82 A
Pt1	3645A	38.33 A	26.60 A
Pt2	3439A	38.93 A	24.65 B
Pt3	3712A	39.42 A	24.33 B
I1N0	3858ABC	42.50 A	27.57 AB
I1N90	4070AB	38.87 BCD	26.90 ABC
I1N180	4811A	40.73 ABC	28.33 A
I2N0	3885ABC	41.24 AB	24.63 ABCD
I2N90	3849ABC	38.76 BCD	26.92 ABC
I2N180	4249AB	38.71 BCD	25.50 ABCD
I3N0	2971CDE	38.78 BCD	24.51 ABCD
I3N90	3570BCD	38.11 CD	23.71 BCD
I3N180	3954ABC	39.10 BCD	24.82 ABCD
I4N0	2619DE	36.60 DE	23.12 CD
I4N90	2327E	38.16 CD	21.66 D
I4N180	3021CDE	35.18 E	24.62 ABCD
I1Pt1	4746A	33.60 B	29.96 A
I1Pt2	4145AB	37.82 A	26.90 ABC
I1Pt3	3849BCD	38.53 A	25.94 BCD
I2Pt1	4035ABC	38.87 A	27.30 AB
I2Pt2	3772BCD	37.88 A	23.81 BCD
I2Pt3	4176AB	39.25 A	25.95 BCD
I3Pt1	3308CD	40.56 A	25.39 BCD
I3Pt2	3483BCD	38.82 A	24.59 BCD
I3Pt3	3704BCD	39.32 A	23.07 CD
I4Pt1	2491EF	40.31 A	23.74 BCD
I4Pt2	2356F	41.20 A	23.32 CD
I4Pt3	3119DE	40.58 A	22.35 D
N0Pt1	2985D	38.06 A	25.01 BC
N0Pt2	3355BCD	37.66 A	26.76 B
N0Pt3	3660BC	39.57 A	23.11 C
N90Pt1	3596BCD	39.19 A	24.38 BC
N90Pt2	3220CD	39.59 A	23.67 BC
N90Pt3	3547BCD	40.56 A	26.34 BC
N180Pt1	4354A	37.76 A	30.40 A
N180Pt2	3742BC	39.53 A	23.53 BC
N180Pt3	3930AB	38.13 A	23.53 BC

Conclusion

The obtained results Indicate that simultaneously using of the N3 (180 kg/ha) and I_1 resulted to decreasing of damage on yield in comparison with other treatments in sunflower. Plants produce stressfully specific and non-specific materials in response to stress conditions during short and long terms. Long-term responses are related to intensity and duration of stress. Short-term responses include ROS accumulation, membrane damages due to fatty acids oxidation and release of amino alcohols. Those responses create the resistance to severe stress in plant. Pre-treatment by mono ethanol amine causes to increasing of resistance to stress using cell wall fixation, addition of super oxide dismutase, and glotation metabolism motivation in barely. Investigation of project's results shows that pre-treated sunflower plant by mono ethanol amine decrease the damages but it to be repeated by more researches for better announcement.

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