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Response of Water Stress and Nitrogen Fertilizer on Fresh Matter Production of Sunflower (*Helianthus annuus* L.)

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Abstract: The response of water stress and nitrogen fertilizer on fresh matter production of sunflower (*Helianthus annuus* L.) was studied in pot experiment. Three nitrogen levels were created by supplying urea at different rates. Sporadic stress was induced by a cycle of 10 day watering and 10 days stress period after 20, 30, 40 and 50 days of sowing. The data of leaf, stem and root showed that water stress and nitrogen fertilizer have highly significant response. The fresh matter production decreased significantly after decreasing urea dose or increasing the water stress period. At all stress levels including control, the highest-value for fresh matter production were recorded at full dose of urea, intermediate at 1/3 and the lowest in 1/8 dose. Stress and fertilizer correlated with each other.

Key words: Fresh matter, water stress, nitrogen fertilizer, sunflower

Introduction

Sunflower being a short duration crop can be fitted well in our present cropping pattern without bringing any major change in our present cropping system. During 1991-92, in Pakistan oil seed crops were grown on 523000 hectares (2 percent of the total cropped area), while the edible oil requirement of the country was 1262 thousand tones and domestic production was only 338 thousand tones which was 30 percent of the total requirement. Pakistan imported edible oils worth Rs. 10025.2 million during 1991-92 (Hatim and Abbasi, 1994).

Sunflower is generally considered drought resistant but the water requirements of this crop are higher than for other crops (Hatim and Abbasi, 1994). Irrigation directly influences the yield of sunflower and practically all the farmers realize its importance. Judicious and timely application of irrigation at critical growth stages of sunflower increases yield considerably. The crop uses only 20-25 percent of its total water needs during theist 30 days. However, the peak demand is during its reproduction. Shortage of water during this period not only reduces seeds yield but also seed oil content. Application of six irrigation is economical for getting higher production (Saeed, 1997). Akhtar *et al.* (1993) determined that water stress at any of the developmental stages of sunflower adversely affect its seed yield. Palmer *et al.* (1996) determined that the availability of nitrate has a strong effect on leaf expansion in sunflower. Ahmad and Ibrar (1998) reported that sunflower/summer legumes intercapping under fainted condition showed similar trends for leaf area and dry matter accumulation. Ali *et al.* (1998) concluded that growth and yield affected significantly by various irrigation regimes in sunflower. Mdo (1999) concluded that sporadic stress and urea fertilizer have highly significant response on leaf area of sunflower. Similarly Bakhsh *et al.* (1999) deduced that yield and yield components of sunflower were significantly affected by irrigation level and six irrigations were found optimum for obtaining good yield of sunflower. So, it has been contemplated in this study to explore the response of water stress and nitrogen fertilizer on fresh matter production, of sunflower (*Helianthus annuus* L.).

Materials and Methods

The experiments was conducted in the net house of Botanical Garden, University of Agriculture, Faisalabad in pots. Sunflower variety " Shams" was used and seeds were obtained from Ayub Agricultural Research Institute, Faisalabad. The seeds were sown in 120 pots and urea as a nitrogen fertilizer was added to each pot. Pots were 23 cm in diameter and 9.5 kg garden soil was added to each pot. Before experiment the soil analysis showed that it was deficient in nitrogen (0.036 percent N) and organic matter (0.73%) with pH 8.0 and saturation percentage of 36 percent. One plant per pot was maintained and urea as a nitrogen fertilizer was applied in three doses which were as follow:

F_1 (Full dose) : 68.77 mg/kg for each pot
F_2 (1/3 dose) : 22.92 mg/kg for each pot
F_3 (1/8 dose) : 8.60 mg/kg for each pot

Four water stress levels and three nitrogen doses as above were studies. The experiment was laid out in completely randomized design (CRD) with eight replications and three treatments. The number of pots per stress treatment were 24 and number of pots per nitrogen dose were 8. Before application of nitrogen fertilizer to all the 120 pots, these were divided into five groups of 24 pots each as follows: Group 1 with all the three nitrogen levels was kept as control and water was applied continuously. In the remaining four groups of each nitrogen level, sporadic drought was induced by a cycle of ten days watering and a ten days stress period at the following stages.

1. Control)..... (S_0)
2. Sporadic drought 20 days after sowing. (S_1)
3. Sporadic drought 30 days after sowing. (S_2)
4. Sporadic drought 40 days after sowing. (S_3)
5. Sporadic drought 50 days after sowing. (S_4)

Data was recorded before flower initiation and mean fresh weight of leaves, stem and root per plant was calculated. The Data was analysed statistically and significant differences were determined by Duncan's Multiple Range Test (Steel and Torrie, 1980).

Results and Discussion

Fresh weight of leaves/plant: The data presented in Table 1 shows highly significant difference among fertilizer means with regard to fresh weight of leaves before flower initiation. Among the three urea levels applied, the maximum significant fresh weight was observed in full urea and maximum significant decrease was recorded in 1/8 urea concentration.

For the stress treatment means, highly significant difference in fresh weight was noted in all treatments. Significantly highest value for fresh weight of leaves was observed in S_0 (stress zero) and significantly maximum decrease was observed in S_1 (stress 20 days after sowing) intermediate values were observed stress treatments stressed 30, 40 and 50 days after sowing.

The interaction between stress and fertilizer statistically differed significantly. When full dose of urea was applied, the maximum fresh weight was observed in S_o and minimum in S_1. In the same way in 1/3 urea, the maximum value was found in S_0 and minimum in S_1. Whereas in 1/8 urea, the maximum value was noted in S_o and minimum was recorded in S_1.

Table 1: Fresh weight of leaves before flower initiation

Water stress level	Fertilizer level			
	F_1	F_2	F_3	Stress means
S_0	22.32	19.54	13.55	18.47 a
S_1	3.43	2.96	2.92	3.10 b
S_2	6.32	5.59	3.68	5.19
S_3	8.79	6.43	4.53	6.58 c
S_4	17.05	13.69	8.65	13.13 d
Fertilizer means	11.58 A	9.64 B	6.67 C	

Any two means sharing the same letter are statistically non-significant. F_1 = Fertilizer Full, F_2 = Fertilizer 1/3, F_3 = Fertilizer 1/8

Table 2: Fresh weight of stem before flower initiation

Water stress level	Fertilizer level			
	F_1	F_2	F_3	Stress means
S_0	50.48	47.86	42.21	46.85 a
S_1	11.79	7.80	7.09	8.89 b
S_2	14.85	12.27	8.54	11.89 c
S_3	17.77	14.03	8.92	13.58 c
S_4	38.53	28.30	15.21	27.35 d
Fertilizer means	26.68 A	22.05 B	16.39 C	

Any two means sharing the same letter are statistically non-significant. F_1 = Fertilizer Full, F_2 = Fertilizer 1/3, F_3 = Fertilizer 1/8

Table 3: Fresh weight of root before flower initiation

Water stress level	Fertilizer level			
	F_1	F_2	F_3	Stress means
S_0	18.25	15.17	13.39	15.60 a
S_1	5.45	3.76	2.54	3.92 d
S_2	6.74	6.30	2.58	5.54 c
S_3	10.00	5.40	3.25	6.22 c
S_4	16.89	13.08	7.06	12.34 b
Fertilizer means	11.47 A	8.74 B	5.96 C	

Any two means sharing the same letter are statistically non-significant. F_1 = Fertilizer Full, F_2 = Fertilizer 1/3, F_3 = Fertilizer 1/8

Similarly et all the sporadic stress levels including control (no stress) highest values were obtained in full dose of urea while intermediate in 1/3 dose and lo-west in 1/8 dose.
It was evident from the results that both sporadic stress and urea doses have highly significant response for fresh weight. When either the sporadic stress period is increased or urea dose is decreased, the fresh weight of leaves was significantly decreased.

Fresh Weight of Stem/Plant : The data presented in Table 2 and indicate that there was highly significant difference among fertilizer means with regard to fresh weight of stem before flower initiation. Maximum significant fresh weight of stem was recorded in full urea dose and maximum significant decrease was observed in 1/8 urea, concentration indicating a highly significant decrease in fresh weight with decrease in stress treatment means. Highest significant value recorded in S_0 (stress zero) and lowest significant value in S_1 stress after 20 days). Intermediate values were recorded in stress treatments stressed 30, 40 and 50 days after sowing. The results indicate that with the successive increase in sporadic stress the fresh weight of stem decreased significantly. The interaction between stress and fertilizer significantly differed. The fresh weight decreased gradually with increase of sporadic stress period among full, 1/3 and 1/8 urea level. When full dose of fertilizer was applied, the maximum fresh weight was noted in S_o while minimum in S_1. In 1/3 urea, the maximum value was found in S_o and minimum in S_1 Whereas in 1/8 urea, the highest value was noted in S_o and lowest was recorded in S_1. Similarly et all the sporadic stress levels including control (no stress) highest values for fresh weight were obtained in full urea dose, intermediate in 1/3 dose and lowest in 1/8 dose. It was evident from the.results that both urea dose and sporadic stress has highly significant response for fresh weight. When either urea dose is decreased or sporadic stress period is increased, the fresh weight was significantly decreased. These results are irfadoordanbe with results observed by Rawson *et al.* (1977) who reported that wafer stress changed the specific weight in wheat.

Fresh weight of root/Plant: Data presented in Table 3 shows highly significant difference in fertilizer means with regard to fresh weight of root before flower initiation. In three urea levels, the maximum significant fresh weight was found in full urea whereas the maximum significant decrease was recorded in 1/8 urea concentration. For the stress treatment means, the difference in fresh weight was highly significant. The maximum significant value for fresh weight was found in S_0 (zero stress) and maximum significant decrease was found in S_1 (stress after 20 days where sporadic stress period was maximum). Intermediate values were noted in stress treatments after 30, 40 and 50 days. It indicate that with gradual increase of sporadic stress the fresh weight of root decreased significantly.
The interaction between stress and fertilizer differed significantly. Gradual decrease was observed in fresh weight of root with the increase of sporadic stress period in full, 113 and 118 urea levels. The maximum value was observed in S_o and minimum value in S_1. Whereas in 1/3 urea, the maximum value was observed in S_0 and minimum in S_1. Whereas in 1/8 urea, the maximum value was found in S_0 and minimum in S_1. The fresh weight, therefore, decrease gradually with the increase of sporadic stress in full ures level. In 1/3 urea level similar findings were observed except S_2 (stress after 30 days) which show higher value for fresh weight than valUes 40 days after stress. Likewise, in 1/8 Urea level, the values decreases with increase of sporadic stress except in S_2. It was evident from the results that both urea and sporadic stress show highly significant response for fresh weight of root. When either the sporadic stress period is increased or urea dose is decreased, the fresh weight was significantly decreased.

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