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Drought and Nitrogen Effects on Sunflower (*Helianthus annuus* L.)

Akbar Ali Meo and Feroza Baig*

Department of Botany, Government Islamia College, Narowal. (Punjab)

*Department of Botany, University of Agriculture, Faisalabad-38040, Pakistan

Abstract

Plant height, head diameter and seed yield were significantly affected both by fertilizer doses and sporadic stress and were positively and significantly correlated with each other. These parameters will significantly decrease when either sporadic stress period is increased or urea dose is decreased.

Introduction

Sunflower (*Helianthus annuus* L.) is one of the most important annual crops grown for edible oil. It was introduced in the early sixties in Pakistan but its acreage and yield remained stagnant until 1980/81 when both area and production started to increase in the Punjab and Pakistan (Aslam and Akhtar 1988). Sunflower being a short duration crop can be fitted well in our present cropping pattern (Akhtar *et al.*, 1993). The area under sunflower is increasing rapidly in the Rice and Cotton based farming system. Rainfed area accounts for about 24 per cent of the total cultivated area of the country (Pakistan at a glance, 1987). Steer *et al.* (1986) conduct an experiment on sunflower (*Helianthus annuus* L.) and concluded that dry matter and N contents per plant increase in applied N and decreased with increase in population density. 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 area expansion in sunflower. Ahmad and Ibrar (1998) reported that sunflower summer legumes intercropping under rainfed condition showed similar trends for leaf area and dry matter accumulation. Present study was designed to find out influence of Urea and drought on plant height, head diameter and seed yield of sunflower. (*Helianthus annuus* L.).

Materials and Methods

The effect of urea and drought on sunflower was evaluated in the net house of Botanical Garden, University of Agriculture, Faisalabad. The experiment was conducted in pots with sunflower variety shams. The seeds were sown in pots with 9½ kg soil and the size of each pot was 23 cm in diameter. One plant per pot was maintained. A solution of urea as nitrogen fertilizer was prepared and three urea doses were applied in the following ratio.

1. Full dose (normal) = 1.41 g for each pot.
2. 1/3 dose = 0.46 g for each pot.
3. 1/8 dose = 0.17 g for each pot.

Before application of urea, 120 pots were divided into the following five equal groups. Group I having all the three

nitrogen levels was kept as control in which water was applied continuously. In rest of the four groups of each nitrogen levels sporadic drought was induced by a cycle of ten days watering and a ten days stress period (i) sporadic drought was started after 20 days of sowing (S₁). (ii) sporadic drought was started after 30 days of sowing (S₂). (iii) sporadic drought was started after 40 days of sowing (S₃). (iv) sporadic drought was started after 50 days of sowing (S₄). Data on plant height, head diameter and yield were recorded at the time of maturity and mean of five plants was calculated. Data were statistically analysed by using Duncan's Multiple Range Test (Steel and Torries, 1980).

Results and Discussion

Plant Height: The maximum significant plant height (84.30 cm) was observed at full dose of urea and maximum significant decrease (55.12 cm) under 1/8 urea dose (Table 1). Maximum plant height (94.71 cm) was observed in S₀ (zero stress) and maximum decrease (53.93 cm) was observed in S₁ (stress 20 days after sowing). Followed by the plants stressed 30, 40 and 50 days after sowing. When full dose of urea was applied, maximum value for plant height (114.60 cm) was observed in S₀ (zero stress) and minimum (66.20 cm) in S₁ (stress after 20 days of sowing). In 1/3 urea, the maximum value (88.70 cm) was found in S₀ and minimum (56.62 cm) in S₁. In the same way in 1/8 urea the maximum value (80.80 cm) was observed in S₀ and lowest (38.98 cm) in S₁. It is evident that both fertilizer doses and sporadic stress have highly significant response for plant height. When either sporadic stress period increased or urea dose is decreased the plant height will significantly decrease. these findings are in agreement with Lahiri (1978), and Agha *et al.* (1978), Yousaf *et al.* (1988) and Bakhsh *et al.* (1999).

Head Diameter: The maximum significant head diameter (6.84 cm) was noted in full dose of urea and maximum significant decrease (5.45 cm) in 1/8 urea dose (Table 1). Maximum significant value for diameter (8.25 cm) was observed in S₀ (zero stress) and maximum significant

Meo and Baig: Plant height, head diameter, yield, drought, nitrogen

Table 1: Effect of water stress on plant height (cm) at maturity

Urea	Levels of water stress					Mean ± SE or SD
	S ₀	S ₁	S ₂	S ₃	S ₄	
Full dose (Control)	114.60	66.20	71.20	80.28	89.20	84.29 ± 1.24a
1/3 dose	88.70	56.62	62.82	62.90	76.68	69.54 ± 1.24b
1/8 dose	80.82	38.98	46.02	51.06	58.74	55.12 ± 1.24c
Mean ± SE	94.71a ± 1.60	53.93b ± 1.60	60.01c ± 1.60	64.75d ± 1.60	74.87e ± 1.60	
F. Value for fertilizer means	=					138.01**
F. Value for stress treatments means	=					99.16**
F. Value for interaction means	=					1.75 N.S.

N.S. = Non significant, ** = Highly significant
Any two means shearing the same letter are statistically non-significant.

Table 2: Effect of water stress on difference levels of urea applied on head diameter (cm) at maturity

Urea	Levels of water stress					Mean ± SE
	S ₀	S ₁	S ₂	S ₃	S ₄	
Full dose (Control)	8.98	3.84	6.22	7.10	8.04	6.84 ± 0.17a
1/3 dose	7.92	3.34	5.34	6.42	7.42	6.09 ± 0.17b
1/8 dose	7.86	2.54	3.80	5.75	7.30	5.45 ± 0.17c
Mean ± SE	8.25 ± 0.22a	3.24 ± 0.22b	5.12 ± 0.22c	6.42 ± 0.22d	7.59 ± 0.22e	
F. Value for fertilizer means	=					16.20*
F. Value for stress treatments means	=					81.134**
F. Value for interaction means	=					0.90 N.S.

N.S. = Non significant, * = significant, ** = Highly significant
Any two means shearing the same letter are statistically non-significant.

Table 3: Effect of water stress on different levels of urea on yield (dry weight) at maturity

Urea	Levels of water stress					Mean ± SE
	S ₀	S ₁	S ₂	S ₃	S ₄	
Full dose (Control)	8.60	3.73	4.87	5.40	6.88	5.89 ± 0.15a
1/3 dose	7.66	2.58	3.13	3.61	4.67	4.33 ± 0.15b
1/8 dose	6.82	1.95	2.87	2.95	4.50	3.82 ± 0.15c
Mean ± SE	7.69 ± 0.19a	2.75 ± 0.19b	3.62 ± 0.19c	3.99 ± 0.19d	5.35 ± 0.19e	
F. Value for fertilizer means	=					51.30**
F. Value for stress treatments means	=					97.52**
F. Value for interaction means	=					1.50 N.S.

N.S. = Non significant, ** = Highly significant
Any two means shearing the same letter are statistically non-significant.

decrease (3.24 cm) in S₁ (stress after 20 days). Intermediate values were recorded among plants stressed 30, 40 and 50 days after sowing. In full dose of urea, the maximum value (8.98 cm) was recorded in S₀ (zero stress) and minimum (3.84 cm) in S₁ (stress 20 days after sowing). In 1/3 urea, the maximum value (7.92 cm) was noted in S₀ and minimum (3.34 cm) in S₁. In 1/8 urea dose, the maximum value (7.86 cm) was noted S₀ and minimum (2.54 cm) in S₁. It is concluded that stress and urea dose showed significant response for head diameter. When either the sporadic stress period is increased or urea dose is

decreased, the head diameter will significantly decreased. These results are in conformity with Verghese *et al.* (1976), Tripathi and Kalra (1981), Ali *et al.* (1998) and Bakhsh *et al.* (1999).

Yield: The maximum seed yield (5.89 g) was recorded at full dose and maximum significant decrease (3.82 g) in 1/8 dose of urea (Table 3), showing a highly significant decrease in dry weight of seeds with decrease in urea concentration. Maximum yield (7.69 g) was observed in S₀ (zero stress) and maximum decrease (2.75 g) was observed

in S_1 (stress 20 days after sowing).

Intermediate values were recorded among treatment stress after 30, 40 and 50 days of sowing. When full dose of urea was applied, maximum value for yield (8.60 g) was observed in S_0 (zero stress) and minimum (3.73 g) in S_1 (stress 20 days after sowing). In 1/3 urea, the maximum value (7.66 g) was recorded in S_0 and minimum (2.58 g) in S_1 . Similarly in 1/8 urea dose, the highest value (6.82 g) was observed in S_0 and lowest (1.95 g) in S_1 . These results are in agreement with Khalil *et al.* (1998), Saeed *et al.* (1998), Malik and Wright (1998) and Bakhsh *et al.* (1999).

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