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Interaction Effects of Water Stress and Nitrogen Fertilizer on Node Number and Root Length of Sunflower (*Helianthus annuus* L.)

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Abstract: The interaction effects of water stress and nitrogen fertilizer on sunflower variety "Shmas" were studied in pot cultivation. Urea as nitrogen fertilizer was applied and water stress was sporadically induced by a cycle of 10 day watering and 10 day stress period after 20, 30, 40 and 50 days of sowing. Node number and Root length were significantly affected by the interactive effect of water stress and nitrogen fertilizer dose. These two parameter will significantly decrease when either sporadic stress period is increased or urea dose is decreased. The nitrogen applied in three dose had effectively balanced the adverse effects of four sporadic stress periods.

Key words: Node number, root length, nitrogen fertilizer, water stress, sunflower

Introduction

Water stress is one of the most serious condition that effects crop productivity. Deficiency of water modifies plant water relationship by lowering tissue water potential (Akhtar *et al*., 1993). Water deficits that occur during the crop growth period influence its various physiological processes associated with growth, development and economic yield (Begg and Turner, 1976; Pandey *et al.,* 1984a,b). Such effects of water deficit depend on the degree of water stress and stage of crop development at which stress occur (Pandey *et al.,* 1984a,b). Moisture stress at any growth stage reduces crop yield. Similar observations were recorded in a study by Malik and Ahmad (1993) who found that moisture stress reduced grain yield. They were of the view that moisture stress at tillering and grain development stages badly affected the crop and resulted in poor harvest. Palmer *et al.* (1996) have reported that the availability of nitrate had a strong effect on leaf expansion in sunflower. Saeed *et al.* (1998) have concluded that water stress caused substantial reduction in seed yield and total plant biomass production of soybean compared with control. However, magnitude of such reduction varied with time and duration of water stress. Meo (1999) determined that sporadic stress and urea fertilizer have highly significant response on leaf area of sunflower. Meo and Baig (1999) deduced that parameters like plant height, head diameter and seed yield were significantly affected by fertilizer doses and sporadic stress in sunflower. A reduction in leaf area index of soybean in response to water stress has also been reported by Chinchilla *et al.* (1988). Ghani *et al.* (1999) have observed that interactive effect of nitrogen and water stress on yield and biomass had highly significant response in wheat. Meo *et al.* (2000) indicated that the response of water stress and nitrogen fertilizer on fresh matter production of sunflower (*Helianthus annuus* L.) was highly significant. Judicious use of fertilizer is considered one of the most important factor which could increase sunflower yield on per unit area bases. Among nutrients applied nitrogen is one of the most essential element for plant growth. Fertilization for the adequate nutrition of all crop play a major role in efficient use of water (Tisdale *et al.,* 1985). The central idea was that fertilizer application time could be one approach to minimize the adverse effects of water stress occured at different growth stages. With a view to test the aforesaid idea, the present study was undertaken to identify the interaction effects of water stress and nitrogen fertilizer on node number and root length of sunflower (*Helianthus annuus* L.).

Materials and Methods

The trial was carried out in the net house of Botanical Garden, University of Agricultural, Faisalabad. The entire experiment was conducted in 120 pots. The seeds were sown in pots having 9.5 kg garden soil. The size of each pot was 23 cm in diameters. One plants per pot was maintained. Urea as a nitrogen fertilizer was applied in solution form in three doses in the following ratio:

Full dose (Normal)	=	1.41 g for each pot
1/3 rd dose (Normal)	=	0. 46 g for each pot
1/8 th. dose (Normal)	=	0.17 g for each pot

Three urea doses and four water stress levels were created. Completely Randomized Design (CRD) was applied with eight replications and three treatments. The number of pots per stress treatment was 24 whereas the number of pots per urea dose was 8. Before application of urea fertilizer, 120 pots were divided into five groups of 24 pots each as follows. Group I having all the three nitrogen levels was kept as control in which water was applied continuously. In rest of the four group of each nitrogen levels sporadic drought was applied by a cycle of ten-day watering and ten-day stress period at the following stages:

Control.....(S_0)
Sporadic drought was started 20 days after sowing (S_1)
// // // // 30 // // // (S_2)
// // // // 40 // // // (S_3)
// // // // 50 // // // (S_4)

The data for number of node and root length per plant was calculated and analysed statistically by using Duncan's Multiple Range Test (Steel and Torrie, 1980).

Result and Discussion

Number of Nods/Plant: The data given in Table 1 revealed that the number of nodes just before flower initiation significantly differed in fertilizer means. The Maximum significant node number was found at full dose of urea and maximum significant decrease in node number was found at $1/8^{th}$ urea dose. The stress treatment means differed significantly. The maximum significant value was observed in S_0 and maximum significant decrease was found in S. Intermediate values were recorded in stress treatments stressed 30, 40 and 50 days after sowing. Stress and fertilizer

interaction differed non-significantly.

In full dose of urea, the number of nodes was maximum in So and minimum in S_1. In 1/3rd urea, the maximum value was observed in S_o and minimum in S_1. The same pattern was observed in 1/8th urea. It is evident that both fertilizer doses and sporadic stress level have highly significant response for node number. When either sporadic stress period is increased or urea dose is decreased, the number of nodes will decrease significantly. These results are in agreement with Buttrose (1974), Memzel *et al.* (1996) and Meo *et al.* (1989). The reduction in growth is due to

Table 1: Number of Nodes before flower initiation

	Fertilizer Level			
Water stress level	F_1	F_2	F_3	Mean
S_o	23.33	22.67	21.00	22.44a
S_1	17.67	14.33	13.66	15.22b
S_2	20.00	18.67	14.00	17.56ab
S_3	21.33	19.00	14.00	18.11ab
S_4	22.67	20.67	18.00	20.44a
Mean	21.00A	19.06A	16.136	

Any two means sharing the same letter differ non-significantly.
F_1 = Fertilizer full, F_2 = Fertilizer 1/3, F_3 = Fertilizer 1/8

Table 2: Length of root at maturity

	Fertilizer level			
Water stress level	F_1	F_2	F_3	Mean
S_0	15.16	9.88	9.72	11.59a
S_1	8.90	7.02	6.00	7.30c
S_2	9.62	7.22	7.12	7.99b
S_3	10.02	8.66	8.02	8.90b
5_4	10.58	8.72	8.18	9.16b
Mean	10.86A	8.306	7.808	

Any two means sharing the same latter differ non-significantly.
F_1 = Fertilizer full, F_2 = Fertilizer 1/3, F_3 = Fertilizer 1/8

reduction in turgor potential (Ashraf *et al.,* 1994).

Length of Root/Plant: Table 2 shows that length of root at maturity was highly significantly differed among fertilizer means. The maximum significant root length was recorded at full dose of urea and maximum significant decrease was observed at 1/8th urea dose. The stress treatment means differed significantly. Maximum significant value was found in S_o and maximum significant decrease in S_1. Intermediate values were recorded in stress treatments stressed after 30, 40 and 50 days. The interaction between fertilizer and stress means non-significantly differed. In full dose of urea, the maximum root length was noted in S_o and minimum in S_1. In 1/3rd urea, the maximum value was observed in S_o and minimum in S_1. Similarly in 1/8th urea dose, the highest value was recorded in S_o and lowest in S_1. Therefore, at all sporadic stress levels including control, the highest values for root length were found at full urea dose. When it was applied as 1/3rd dose, the values were intermediate and lowest at 1/8th urea dose. These results are in conformity with Carceller and Fraschina (1986).

References

Akhtar, M., M. Zubair, M. Saeed and R. Ahmad, 1993. Effect of planting geometry and water stress on seed yield and quality of spring planted sunflower (*Helianthus annuus* L.). Pak. J. Agric. Sci., 30: 73-76.

Ashraf, M.Y., A.R. Azmi, A.H. Khan and S.S.M. Naqvi, 1994. Water relations in different wheat (*Triticum aestivum* L.) genotypes under water deficits. Acta Physiol. Plant., 16: 231-241.

Begg, J.E. and N.C. Turner, 1976. Crop water deficits. Adv. Agron., 28: 161-217.

Buttrose, M.S., 1974. Fruitfulness in grapevines: Effects of water stress. Vitis, 12: 299-305.

Carceller, M. and A. Fraschina, 1986. Distribution of some nitrogen compounds in seedlings of maize and sunflower in relation to water stress. Bot. Gazette, 147: 98-101.

Chinchilla, R.G., S.P. Carrillo, O.O. Agudelo and H. Rojas, 1988. Evaluation of soybean (*Glycine max* L.) cultivars with different growth habits according to irrigation level. Acta Agron., 38: 7-22.

Ghani, A., A.N. Ahmed and A.A. Meo, 1999. Interactive effect of water stress and nitrogen on yield and biomass of wheat (*Triticum aestivum* L.). Pak. J. Biol. Sci., 2: 840-842.

Malik, M.A. and S. Ahmad, 1993. Moisture stress and fertilizer management interaction studies on yield of two wheat varieties under irrigated conditions. Pak. J. Agric. Eng. Vet. Sci., 9: 16-19.

Memzel, C.M., D.R. Simpson and A.J. Dowling, 1996. Water relation to passion fruit: Effect of moisture stress on growth, flowering reorient uptake. Sci. Hortic., 29: 239-249.

Meo, A.A. and F. Baig, 1999. Drought and nitrogen effects on sunflower (*Helianthus annuus* L.). Pak. J. Biol. Sci., 2: 846-848.

Meo, A.A., 1999. Influence of fertilizer and water stress on leaf area of sunflower (*Helianthus annuus* L.). Pak. J. Agric. Sci., 36: 60-62.

Meo, A.A., F. Baig and M.A. Khan, 2000. Response of water stress and nitrogen fertilizer on fresh matter production of sunflower (*Helianthus annuus* L.). Pak. J. Biol. Sci., 3: 491-492.

Meo, A.A., F. Baig, Z.U.D. Khan and W. Naseem, 1989. Effect of sporadic drought in relation to three levels of nitrogen fertilizer on growth of sunflower. J. Pure Applied Sci., 18: 73-78.

Palmer, S.J., D.M. Brridge, A.J.S. MacDonald and W.J. Davies, 1996. Control of leaf expansion of sunflower (*Helianthus annuus* L.) by nitrogen nutrition. J. Exp. Bot., 47: 359-368.

Pandey, R.K., W.A.T. Herrera and J.W. Pendleton, 1984a. Drought response of grain legumes under irrigation gradient: I. Yield and yield components. Agron. J., 76: 549-553.

Pandey, R.K., W.A.T. Herrera, A.N. Villegas and J.W. Pendleton, 1984b. Drought response of grain legumes under irrigation gradient: III. Plant growth. Agron. J., 76: 557-560.

Saeed, M., N.H. Qureshi, A. Jabber and T. Mahmood, 1998. Effect of water stress on different agronomic traits of diverse soybean cultivars. Pak. J. Agric. Sci., 35: 65-69.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statistics: A Biometrical Approach. 2nd Edn., McGraw Hill Book Co., New York, USA., ISBN-13: 9780070609266, Pages: 633.

Tisdale, S.L., W.L. Nelson and J.D. Beaton, 1985. Soil Fertility and Fertilizers. 4th Edn., MacMillan Publisher, New York, USA., ISBN-13: 9780029467602, pp: 607.