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Effect of Different Water Stress Levels on Yield and Oil Content of Sunflower (*Helianthus annuus* L.) Cultivars

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Abstract: A decreasing trend in head diameter, number of achenes per head, hundred achene weight and achene yield per plant to as observed as the level of water stress increased from 100 percent to 25 percent of field capacity. Seed oil content was very sensitive to even mild water stress but showed stability under increasing stress conditions. FH-1 responded better at high level of water stress in respect of all the parameters studied except for hundred achene weight, where FH-3 showed better response.

Key words: Water stress, sunflower cultivars, yield, oil content

Introduction

The production of oilseed crops in Pakistan is much less than the national demand. During 1997, Pakistan imported edible oils worth Rs. 30601 millions (Anonymous, 1997). Sunflower being a short duration crop can be fitted well in our cropping pattern (Akhtar *et al.,* 1993). The area under sunflower is increasing rapidly in the rice and cotton based farming system (Meo and Baig, 1999) but the hostile weather conditions during the sunflower growing season, adversely affect its vegetative as well as reproductive growth in addition to deteriorating the quality of its oil content (Jones, 1984). The water requirements of sunflower are higher than for other crops and water stress symptoms do not appear as quickly and recognizably as in other cultivated crops (Nazir, 1994).

Materials and Methods

The experiment was conducted in the net house of Botanical Garden, University of Agriculture, Faisalabad under natural conditions during the year, 1998. The studies were carried out in pots lined with polythene bags and filled with 8 kg of sun dried soil having 22.8 percent saturation percentage. The seeds of sunflower varieties (FH-1, FH-3 and FH-28) were taken from Oilseed Department, Ayub Agricultural Research Institute, Faisalabad. Six seeds of each variety were sown in each pot and after complete germination, thinning was done to maintain three plants in each pot. The levels of water stress were adjusted in accordance with the field capacity of the soil and following treatments with six replications for each were used throughout the experiment:

T_0	=	100% of field capacity	904 mL (control)
T_1	=	75% of field capacity	678 mL
T_2	=	50% of field capacity	452 mL
T_3	=	25% of field capacity	226 mL

Seed oil content was determined by Soxhelt apparatus at Ayub Agriculture Research Institute, Faisalabad. The seeds were dried in an oven for 30-40 minutes at 90°C. The oven dried seed samples were ground with an ordinary kitchen grinder to powder form. The ground samples were again dried for about 15 minutes and then immediately transferred to a desicator. Two gram of each ground sample was taken and tied into tiny packets of oven dried filter paper sheets. These packets were then transferred into the tube of Soxhelt apparatus for 2-6 hours or till the colour of the solvent cleared. These packets were then dried in an oven and loss in weight was calculated. The loss in weight is the oil present in the sample which was calculated in terms of percentage of oil. The data were statistically analyzed using analysis of variance (ANOVA) and Duncan's Multiple Range Test was used to delineate mean differences (Steel and Torrie, 1980).

Results and Discussion

The data presented in Table 1 revealed that different water stress levels significantly affected the yield components. Under full irrigation, head diameter was maximum in FH-1. Head diameter showed decreasing trend as the level of water stress increased. Minimum head diameter was recorded in FH-3 under high moisture stress. These results are in agreement with Hussain *et al.* (1994). Maximum number of achenes per head were recorded under control and minimum under high level of water stress. Among the varieties, FH-3 responded better at medium water stress level while FH-1 performed better at high *water* stress level. Reduction in number of achenes per head in response to water stress was also reported by Bakhsh *et al.* (1999). The hundred achene weight was maximum under control and minimum under high level of water stress. A decreasing trend in hundred achene weight was noted with increasing the level of water stress. However, 100-achene weight showed stability under mild water stress. Maximum 100-achene weight was noted in FH-28 under non-stress conditions and maximum decrease was noted under severe stress in the same variety. Jana *et al.* (1982) and Ali *et al.* (1998) had also reported similar results. Among the varieties, FH-3 showed better response at high level of water stress. Achene yield per plant also decreased with increasing the level of water stress. Maximum achene yield per plant was recorded under control and minimum under high level of water stress. Varietal means were at par regarding the achene yield per plant. The decrease in achene yield per plant in response to water stress was also reported by Hedge (1988) and Meo and Baig (1999). Water stress also decreased the oil content in all the varieties as the stress increased from 100 percent field capacity to 25% field capacity. The maximum oil content were recorded under 100% field capacity and minimum under stress level at 25% of field capacity. Among the varieties, FH-1 performed better at high level of water stress than the others. These results are in agreement with the findings of Ravishankar *et al.* (1990). In sunflower, achene yield is the

Table 1: Effect of different water stress levels on yield components, yield and oil content of sunflower cultivars

Varieties	FH-1				FH-3				FH-28			
	T_0	T_1	T_2	T_3	T_0	T_1	T_2	T_3	T_0	T_1	T_2	T_3
Head diameter (cm)	6.64a	5.94c	5.34e	3.44g	6.40b	5.64d	5.50d	3.24i	6.28b	5.52d	4.681	3.3gh
No. of achenes/head	170.00ab	146.00c	113.00.	90.00g	183.20a	160.00bc	118.2abc	88.009	166.00abc	144.00c	106.60f	71.8h
100-achenes/heed (g)	2.66bc	2.60c	1.86de	1.30h	2.86b	2.87bc	1 .71def	1.61efg	3.22a	3.O2ab	1.97d1	1.4gh
Actions yield/plant (g)	3.88a	2.86de	1.659	0.82h	3.89a	3.32c	1.80f	0.81h	3.78b	2.90d	1.78f	0.61
Oil content (%)	37.77a	34.98bcde	34.59cde	34.25defg	36.41abc	34.68bcde	34.41cdef	34.13defg	34.92bcd	32.69efg	33.44fg	31.9g

Means sharing this same letter are statistically non-significant at 5% level of probability

ultimate product of many physiological processes occurring throughout the development of the plant till it dies. Achene yield per plant depends on the number of achenes per head, head diameter, achene size and achene weight etc. Furthermore, achenes with maximum amount of oil content are considered better.

From all the above results, it can be inferred that with increasing the levels of water stress simultaneously showed decreasing trend in respect of different parameters studied. At severe water stress level, FH-1 performed better in respect of number of achenes per head and oil content. However, FH-3 showed better response in respect of hundred achene weight at high level of water stress.

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