

Effect of Water Stress on the Growth, Yield and Oil Content of Sunflower

¹B.R.Kazi, ²F.C.Oad, ²G.H. Jamro, ²L.A. Jamali and ²N.L. Oad
¹Arid Zone Research Institute, PARC, Umerkot, Pakistan
²Sindh Agriculture University Tandojam, Pakistan

Abstract: Experiments were conducted at Latif Experimental Farm, Sindh Agriculture University, Tandojam, Pakistan, to study the effect of water stress (different irrigation frequencies) on growth, yield and oil content of sunflower variety Hysun-33. The experiment was laid out in randomized complete block design with five water stress treatments replicated four times having plot size of 15 square meters. The results revealed highly significant differences for all the growth, yield and oil content characters. Water stress treatments comparison describes that four regular irrigations with 10-days interval upto physiological maturity and first irrigation after 40-days of sowing produced significantly tall plants, thickened stems, early flowering and maturity, big sized heads bearing maximum seeds, higher seed index, and yield, and oil content, followed by three irrigations at the interval of 15 days and first irrigation after 45 days of sowing.

Key Words: Sunflower, Water Stress, Yield, Oil Content

Introduction

Sunflower *Helianthus annuus* L. is an important oil seed crop of the world as well as in Pakistan. It can be cultivated successfully after cotton as well as rice tracts of Sindh and also can be grown as spring and autumn crop under irrigated as well as in daubari and rainfed conditions. It has gained a significant importance due to its nutritive value as its oil is equal to that of olive oil. The area, production and yield per unit area of sunflower is increasing tremendously with passage of time and among various factors responsible for the low yields, the water requirement of the crop is most important because water have the direct relationship with the yield of crop as reported by Karam (1978), that increase in the irrigations intervals reduced seed yield, plant height, head diameter, seed index, seed oil content and also increased the percentage of unfilled seeds. Reddy *et al.* (1995) reported that low yielding genotypes showed the least percentage reduction in leaf area per plant, seed yield and total dry matter production due to moisture stress. Anwar (1995) observed that all the yield moisture components were affected by the number of irrigations. As the number of irrigations increased, the days to maturity, head diameter, plant height, 1000 seed weight and stalk yields increased. With the exception seed oil content. Rodriguez Garcia *et al.* (1996) reported that leaf area index, dry matter accumulation, seed yield and oil content were strongly affected by water stress. Osman and Talha (1979) reported that irrigation after every 13 or 15-days resulted significantly higher seed index, oil yield and other parameters. Anderson (1980) reported that highest seed yield was associated with total water supply, soil water and rainfall during growth period. (Andhale and Kalbhor, 1980) observed that yield traits were significantly increased with the increase in irrigation scheduled from 0-6 irrigations during the growth period and consumptive use of irrigation water improved by increasing the number of irrigations from 3-6. Pirjoi and Savulescu (1980) reported that

supplementary irrigations at flowering and seed development stages significantly increased plant height, head diameter and seed yield as compared to drought stressed (un-irrigated) plots. (Jones, 1982) observed that seasonal precipitation had the greatest effect on seed yield and WUE. Unger (1982) reported that seed yield were highest with full irrigation than no irrigation and adequate irrigations but yield differences between full irrigation and adequate irrigation treatments were not always significant and also WUE was higher with limited irrigations. Jana *et al.* (1983) reported that all the growth and yield traits and seed oil content with irrigations and WUE were highest with two irrigations at flowering and seed development stages. El-Naggar (1991) reported that sunflower crop was irrigated at 7, 14 or 21 days intervals, the plant growth and seed yield were improved by all irrigation treatments and were best with irrigation at every 14-days interval. Rawson and Turner (1983) reported that crop sown under irrigated conditions, the late varieties gave higher yield than early maturing varieties. Further, Marc and Palmer (1976) reported that when water stress was imposed from 10-20 days after sowing, the number of leaves produced by the primary stem of sunflower and the initiation of inflorescence was delayed by four days which in turn reduced the head size and seed yield. Rollier and Pierre (1976) reported that due to draught stress for 1-6 weeks after beginning of flowering, the head diameter, and its weight were adversely affected. Rollier (1976) observed that sunflower is able to use soil water reserves to an extent depending on root system. Water stress during all stages of growth decreased yield and other crop characters. Nicholes *et al.* (1977) reported that after 5 weeks drought the head diameter and seed yield of crop decreased significantly. Keeping in view the adverse effects of water stress, the experiment was conducted to evaluate the appropriate irrigation level for obtaining target yields of sunflower crop.

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Materials and Methods

Field experiments were conducted to determine the effect of water stress on the growth, yield and oil content of sunflower variety Hysun-33 at Latif Experimental Farm, Sindh Agriculture University, Tandojam. The experimental soil was clay loam having pH 7.5, OM% 0.56, nitrogen 0.045%, available P 7ppm, available K 265 ppm. The experimental design was Randomized Complete Block Design and replicated four times. The water stress/ treatment details are as under.

T1 = One irrigation (after 45 days of sowing)

T2 = One irrigation (after 60 days of sowing)

T3 = Two irrigations (1st irrigation after 45-days of sowing and 2nd irrigation after 60-days of sowing).

T4 = Three irrigations(1st irrigation after 45-days of sowing, 2nd irrigation after 60-days and 3rd irrigation after 75-days of sowing).

T5 = Four irrigations (1st irrigation after 40-days of sowing, 2nd irrigation after 50-days, 3rd irrigation after 60-days of sowing and 4th irrigation 70-days after sowing).

All the agronomical practices were carried out uniformly in all the treatments and data was statistically analyzed following the procedures of Gomez and Gomez (1984).

Results and Discussion

Results revealed that all the growth, yield contributing and oil content of seed were highly significantly affected by water stress (irrigation frequencies). Further results demonstrated that maximum plant height 115.25 cm, stem thickness 2.57 cm, days to flowering (90%) 98.25, days to maturity (90%), head diameter 16.01 cm,

number of seeds per head 771.25, seed index (g) 49.25, seed yield 1.397 kg per plot and oil content (%) 41.81 were recorded under four regular irrigations given after 40-days of sowing followed by three irrigations with 15-days interval and first irrigation given after 45-days of sowing.

Furthermore, data showed that all the growth, yield contributing traits and oil content percentage were significantly minimum with one irrigation, given after 45-days of sowing as followed by one irrigation given after 60-days of sowing, whereas the difference between both the treatments were non significant. Similarly the yield performance of T4 (three irrigations) and T5 (four irrigations) were non significant and the coefficient of variation per plot were ranges from 1.71-8.54% which indicated that the soil under experiment was homogenous and somewhat normal in fertility.

The present result have supported with the findings of Karam (1978), who reported that increase in the irrigation intervals reduced seed yield, plant height, head diameter, seed index, seed oil content and also increased the percentage of unfilled seeds. Furthermore the results are in agreement with Anderson (1980); Unger, (1982); Jana et al. (1983); Quattar et al. (1992), El-Naggar (1991); Reddy et al. (1995) and Jadhav; and Jadhav (1996). It can be concluded that sunflower variety Hysun-33 required regular four irrigations with 10-days interval and 1st irrigation may be given after 40-days for producing optimum growth, highest seed yield and oil content percentage under prevailing agro climatic conditions further delay in irrigation interval reduces the yield of the crop. It is concluded that four regular irrigations with 10-days intervals will be appropriate irrigation frequency for getting better performance of sunflower under agro climatic conditions.

Table 1: Mean Performance of Growth, Yield Contributing Components and Oil Content Percentage of Seed as Affected by Water Stress

Plant Characters	Treatments / Irrigation frequencies				
	(T1) (45-days)	(T2) (60-days)	(T3) (45 & 60 days)	(T4) (45,60 and 75-days)	(T5) (40,50,60 & 70-days)
Plant height (cm)	94.00 c	99.00 bc	105.75 b	104.00 b	115.25 a
Stem thickness (cm)	1.63 d	1.90 c	1.95 c	2.20 b	2.58 a
Days to 90%flowering	98.25 a	95.75 ab	94.00 a	94.50 b	93.25 b
Days to 90%maturity	117.25 a	115.50 ab	115.00 b	115.50 ab	113.00 c
Head diameter (cm)	10.65 b	11.63 b	11.64 b	10.95 b	16.01 a
Seeds per head	610.50 b	627.50 b	655.25 b	670.50 b	771.25 a
Seed index (g)	42.00 d	42.35 cd	43.88 bc	44.59 b	49.25 a
Yield per plot (kg)	0.68 c	0.69 c	0.93 b	1.38 a	1.40 a
Oil content (%)	34.80 c	35.49 c	23.23 c	39.67 b	41.81 a
	S.E.	Cdi	Cdii	CV %	
Plant height (cm)	1.795	5.238	7.159	3.42	
Stem thickness (cm)	0.052	0.155	0.212	5.10	
Days to flowering (90%)	0.815	2.413	-	1.71	
Days to maturity (90%)	0.609	1.802	2.464	1.06	
Head diameter (cm)	0.520	1.539	-	8.54	
Seeds number /head	20.958	62.040	84.800	6.28	
Seed index (g)	0.438	1.299	1.775	1.98	
Yield per plot (kg)	0.011	0.046	0.063	2.26	
Oil content (%)	0.354	1.049	1.433	1.88	

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