



Asian Journal of Plant Sciences

ISSN 1682-3974

science
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Response of Sunflower at Various Stages to Earthing up Operation

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Abstract: Total four experiments were conducted in the different ecological zones of the province i.e. Southern, Northern and Central zones in order to find out the suitable time of earthing up for obtaining maximum yield of sunflower crop in NWFP. The average data of four locations revealed that sunflower gave highest yield if the earthing up is completed before bud formation. However, seed yield is decreased when earthing up is delayed. It is, therefore, recommended that earthing up before bud formation is necessary for obtaining higher returns from sunflower with respect to seed yield.

Key words: Sunflower, yield, bud formation

Introduction

Sunflower (*Helianthus annuus* L) is the second important source of edible oil in the world after soybean (Usman *et al.*, 1980). It contains 40% oil and 20% protein. Its oil cake is utilized for poultry feed, as cooking oil, salad oil, making soap, drugs, fertilizers etc. It contains 60-70% polyunsaturated fatty acid (Usman *et al.*, 1980a). Sunflower was introduced during 1960 and its cultivation in NWFP was started in 1972-73 with total areas of 17 areas. Its cultivation gradually increased due to favorable climate and soil condition for successful cultivation of sunflower twice a year in the province. Every year, Govt of Pakistan spent a lot of foreign exchange on the import of edible oil, therefore it is a need of day to increase per ha yield to achieve self-sufficiency in edible oils (Usman and Khan, 2001).

Cheema *et al.* (1984) conducted trial on earthing up of sunflower during spring 1973-74 and concluded that earthing up at bud formation stage gave 10.71 percent more yields as compared to control. Cobia and Zimmer (1975) recommended that sunflower crop give more yield, resistant to lodging when the earthing up is completed before flowering. Vranceanu and Stoeneșu (1972) completed the earthing up of sunflower in time but they found more lodging effect in open pollinated variety "Record" as compared to single hybrids. Roath and Miller (1982) reported significant effect on the environment on seed set in sunflower. Usman *et al.* (1980) found that earthing up should be done at the stage when the plants reached to 65 cm tall to prevent lodging. In Russia 80 percent of the total requirements is met from this crop. Similarly USA, Canada, South Africa, Romania, Iran and Turkey are now raising sunflower on commercial basis (Sharif and Khan, 1979). As little information was available regarding the effect of earthing up on the yield of sunflower, therefore, an experiment was laid out during spring sowing 1996 and 1997 to find out the suitable time of earthing up for maximum yield from sunflower crop in NWFP.

Materials and Methods

Four experiments were conducted in different ecological zones of the province i.e., ARI, D. I. Khan, ARI, Tarnab and on the farmers field at Chakdara, (Dir) under irrigated condition during spring season 1996 and 1997. Hybrid ARITAR-93 was planted on RCB design with four replications. Fertilizer at the rate of 2.5 bags DAP and 5 bags urea ha⁻¹ (138:58: kg NP) were used in the trial. All the phosphatic and half doze of urea fertilizers were applied before sowing, while the remaining dose of urea was applied before flowering i.e at the stage of earthing up. Planting was done with hand hoe. Row to row spacing was 75 cm, however plant to plant space was 20-25 cm.

Four treatments consisting of flat sowing (control), earthing up before bud formation stage, earthing up at bud formation and earthing up at flowering stage were used in the trial. For replications, each treatment covered plot size of 5 x 3 m². The management practices were kept constant for all the plots from sowing to harvesting. The data were recorded on various parameters like days to flowering, head diameter (cm), lodging %, days to maturity, plant population and grain yield (gm). The mean data of each family were subjected to the analysis of technique (Steel and Torrie, 1980).

Results and Discussion

Data in Table 1 shows that T₄ (earthing up at flowering stage) took more days to flower initiation and also mature in 109 days. Maximum lodging

Table 1: Effect of earthing up operation on the seed yield and other characteristics of sunflower at ARI, D.I. Khan during spring-96

Treatments	DTFI	DTFC	HD (cm)	DTM	Lodg (%)	Pl. P ha ⁻¹ (000)	G.Yld (kg ha ⁻¹)
T ₁ : Control (Flat sowing)	59	70	12	105	5.0	49	665
T ₂ : Earthing up Before bud Formation	61	73	16	110	2.0	49	1143
T ₃ : Earthing up at Bud formation	61	75	20	110	3.0	50	1120
T ₄ : Earthing up at Flowering	62	75	20	109	3.0	51	887
LSD at 5%	1.33	2.03	--	0.93	--	NS	
LSD at 1%	1.91	2.92	--	1.34	--	N.S	

Table 2: Effect of earthing up operation on the seed yield and other characteristics of sunflower at ARI, D.I. Khan during spring 1997

Treatments	DTFI	HD(cm)	Lodg (%)	DTM	Pl.P ha ⁻¹ (000)	G.Yld (kg ha ⁻¹)
T ₁ : Control (Flat sowing)	65.00	13	5	95	48	683
T ₂ : Earthing up before bud Formation	66.00	16	3	95	47	1200
T ₃ : Earthing up at bud Formation	68.00	19	4	95	49	1150
T ₄ : Earthing up at Flowering	60.00	16	4	95	48	950
LSD at 5%	1.85	2.27	NS	NS	150	
LSD at 1%	2.66	3.26	NS	NS	213	

Table 3: Effect of earthing up operation on the seed yield and other characteristics of sunflower at ARI, Tarnab, Peshawar during spring, 1997

Treatments	DTFI	DTFC	Lodg (%)	DTM	PH (cm)	HD (cm)	Pl.P ha ⁻¹ (000)	G.Yld (kg ha ⁻¹)
T ₁ : Control (Flat)	65	78	10	108	158	17	48	1013
T ₂ : Earthing up before Bud formation	70	84	R	112	171	18	47	1943
T ₃ : Earthing up at bud Formation	68	81	3	112	169	19	46	1893
T ₄ : Earthing up at Flowering	66	76	6	110	167	18	47	1775
LSD 5%	1.21	2.3	0.32	2.02	2.3	1.68	NS	118.00

Table 4: Effect of earthing up operation on the seed yield and other characteristics of sunflower at Chakdara (Dir) during spring, 1997

Treatments	DTFI	DTFC	Lodg (%)	DTM	PH (cm)	HD (cm)	Pl.P ha ⁻¹ (000)	G.Yld (kg ha ⁻¹)
T ₁ : Control (Flat)	75	88	12	118	165	16	48	1385
T ₂ : Earthing up before Bud formation	83	96	R	123	183	19	49	2147
T ₃ : Earthing up at bud Formation	80	92	4	125	185	20	49	2011
T ₄ : Earthing up at Flowering	76	90	5	119	170	17	48	1613
LSD 5%	0.76	3.2	0.2	3.10	3.03	0.92	NS	101.68

Table 5: Seed yield and days to maturity combined over four locations.

Treatments	ARI, D.I. Khan				ARI, Tarnab		Chikdra (Dir)		Average	
	Spring-1996		Spring-1997		Spring -997		Spring-1997			
	DTM	S.Yld.	DT M	S.Yld.	DTM	S.Yld	DTM	S.Yld.	DTM	S.Yld
T1: Control (Flat sowing)	105	665	95	683	108	1013	118	1385	106	936
T2: Earthing up before bud Formation	110	1143	95	1200	112	1943	123	2147	110	1608
T3: Earthing up at bud Formation	110	1120	95	1150	112	1893	125	2011	110	1543
T4: Earthing up at Flowering	109	887	95	950	110	1755	119	1613	108	1301
DTFI	Days to flowers initiation.			DTFC	Days to flower completion			S.Yld (Kg ha ⁻¹)		Seed yield
Lodg. %	Lodging percentage.			DTM	Days to maturity					
PH (cm)	Plant height			HD (cm)	Head diameter					
Pl.P. ha ⁻¹	Plant population per hectare			G.Yld.(Kg ha ⁻¹)	Grain yield					

obtained from T₁, T₂ gave the highest grain yield of 1143 kg ha⁻¹, followed by T₃ giving 1120 kg ha⁻¹. It is concluded that earthing up before bud formation can minimize the lodging and gave more yields however, seed yield is decreased when earthing up is delayed. Similar results were reported by Robinson (1973) and Put (1967).

Data presented in Table 2 revealed that except lodging %age, all other characters were found significant, maximum lodging were found in T₁, while best head diameter size were found in T₃. Highest grain yield was obtained from T₂ i.e. 1200 kg ha⁻¹, however, the lowest yield was obtained by T₁ i.e. 683 kg ha⁻¹. It is concluded that earthing up gave more yield and resistant to lodging if it is completed before bud formation. These findings are supported by the Chemma *et al.* (1984), who concluded that earthing up gave more yields as compared to flat sowing. Similar results obtained from the trials conducted at ARI, Tarnab, Peshawar (Table 3) and Chakdara (Dir) (Table 4).

Combined locations: In the combined locations data in Table 5 shows that the crop is matured early in T₁, followed by T₄, however T₂ and T₃ matured in 110 days. Similarly, the highest yield of 1608 kg ha⁻¹ was obtained by T₂, followed by T₃, however the lowest yield of 936 kg ha⁻¹ was obtained from T₁, followed by T₄.

It was concluded from the results and discussion of all the four locations that sunflower crop is resistant to lodging, give more yield when the earthing up is completed before bud formation, however, seed yield is decreased when earthing up is delayed. It is, therefore, recommended that earthing up before bud formation of sunflower crop is necessary for the growers to get maximum yield in NWFP.

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