

IMPACT OF IRRIGATION ON SUNFLOWER (*Helianthus annuus L.*) PRODUCTIVITY

Dhillon A. Singh, *Punjab Agricultural University, Department of Plant Breeding,
Ludhiana - 141 004, India*
Fax: +91- 161- 400945; e-mail: asdhillon@pau.chd.nic.in

Sidhu M. Singh, *Punjab Agricultural University, Department of Agronomy
Ludhiana - 141 004, India*

Summary

The impact of moisture stress at different stages of sunflower growth was investigated to identify the critical irrigation stages during spring 1993 to 1995. The soil was loamy sand with pH 8.0, low in organic carbon and medium in phosphorus and potash. There were nine treatments, replicated four times and tested in a random block design ~~RBD~~. First irrigation was applied at 30 days after sowing. Irrigation stress was given at 4- 6 leaf, star, bud, 50 per cent flowering, soft dough and hard dough stages. These treatments were compared with three standard practices i.e. no stress, irrigation at 75 mm evaporation and as per standard cultural practices. Highest mean seed yield (2167 kg/ha) was obtained with standard irrigation schedule i.e. seven irrigations which was statistically at par ~~-~~ with six irrigations given at different stages. This treatment was significantly superior than rest of the treatments. Irrigation missed at soft dough stage of seed caused severe reduction in seed yield by 25 per cent. It was closely followed by irrigation missed at 50 per cent flowering and at hard dough stage of seeds which caused 21 per cent reduction in seed yield. At these three stages of moisture stress, oil content, oil yield (kg/ha) and water use efficiency were substantially reduced. Similar results were discernible in head diameter and test weight which were significantly affected by irrigation stress during reproductive ~~ly~~ stages. However stem girth and plant height were not much influenced. To conclude, 50 per cent flowering, soft and hard dough stages are very critical and the crop should not be allowed to suffer for want of moisture at these stages.

Introduction

Sunflower (*Helianthus annuus* L.) has emerged as a most potential oilseed crop in Indian agriculture. The area under sunflower crop in India is spreading rapidly not only in the southern states but also in the northern states like Punjab, Haryana, Uttar Pradesh etc. It is a potential source of quality edible oil. There are several favourable points like short growth period coupled with photo-insensitivity enabling the cultivation of crop throughout the year and wide adaptability to different agro-climatic conditions and soil types. The most favourable season for growing this crop in Punjab is spring season. The crop is most prone to moisture stress leading to a substantially drop in the productivity (Ravishankar *et al.*, 1991). In the light of the above, a field experiment was conducted to identify the critical growth stage, which are most sensitive to water deficit during spring season. Effect of water deficit on seed yield, its components and oil content was also investigated.

Material and Methods

The experiment was carried out in spring seasons during 1993 to 1995 at Research Farm, Punjab Agricultural University, Ludhiana, Punjab, India. The soil was loamy with pH 8.0 low in available nitrogen, medium in phosphorus and potash. During all the three crop seasons, sowing of the crop was done in the last week of January while harvesting was carried out in the first week of June. There were nine treatments, replicated thrice and ~~tested-arranged~~ in ~~a RBD-random block design~~. First irrigation was given at about 30 days after sowing. Moisture stress (7.5 cm) was given at 4-6 leaves, star, bud, 50 per cent flowering, soft dough and hard dough stages. These treatments at all the stages were compared with three practices i.e. no moisture stress, irrigation at 75 mm evaporation and as per recommended package of practices, Punjab Agricultural University, Ludhiana. A detail of irrigations given at various growth stages is given in ~~T~~able 1. It may be noted that six irrigations were given at all the growth stages and seven according to ~~the~~ recommended package of practices. At 75-mm evaporation, during 1993 and 1994, six irrigations were applied but during 1995 due to rains during the early growth stage (Table 2), first irrigation and hence subsequent four irrigations were delayed and in all five irrigations were sufficient during the whole crop season. At different stages of sunflower growth, ~~;~~ data were recorded for seed yield, its contributing factors and water use efficiency. Oil content was estimated using wide line NMR (Newport Analyser MK III A). Data were statistically analysed using normal procedures.

Results and Discussion

It is evident from the data that sunflower crop requires 6 to 7 irrigations to realise maximum seed yield (Table 3). Highest mean seed yield (2167 kg/ha) was obtained with recommended irrigation schedule i.e. seven irrigations which was statistically at par with six irrigations given at all the stages. These treatments were significantly superior to rest of the treatments. Earlier studies by Singh (1990) and Dhillon ~~ET-and Labanaal~~ (1990) on the irrigation requirement of spring sunflower has also shown that 6 to 9 irrigations were optimum for obtaining maximum seed yield. Moisture stress at soft dough grain stage resulted in drastic reduction of seed yield by 25 per cent. It was closely followed by moisture stress at

50 per cent flowering and at hard dough stage which caused 21 per cent reduction in seed yield. At these three stages of moisture stress, water use efficiency, percentage mean oil content and oil yield (kg/ha) were substantially reduced.

It was further observed that head diameter and 100 seed weight were significantly reduced by moisture stress during different stages as compared with three standard practices (Table 4). Plant height was also significantly reduced when moisture stress was given at 4-6 leaves and star stages. Further stem girth was significantly reduced at 4-6 leaves, star, bud and 50 per cent flowering stages.

>From the present study, it may be concluded that 50 per cent flowering, soft and hard dough stages are very critical and the spring crop of sunflower should not be allowed to suffer for want of moisture at these stages.

References

- Dhillon, A.S. and Labana, K.S.** 1990. Status of agronomic research on sunflower, constraints and future strategy of non-traditional areas. Proceedings of "Special Group Meeting of Agronomists", 17- 18 May, 1990, Hyderabad, pp 1-17."
- Ravishankar, K.V., Ma Shankar, R., Ravishankar, H.M., Udaya Kumar, M and Prasad, T.G.** 1991. Development of dough tolerant sunflower for semi-arid tracts of India. *Helia* 14: 77-86.
- Singh Nathu,** 1990. Effect of irrigation and nitrogen application on spring sunflower. Annual Research Report. Dept. Agronomy, PAU, Ludhiana 1990-91.

Table 1. Details of irrigation at all growth stages , 75 mm evaporation and recommended package of practices on spring sunflower during 1993 to 1995

Number of irrigations		Irrigation applied (days after sowing)											
		At all growth stages			At 75 mm evaporation			At recommended package of practices					
		1993	1994	1995	1993	1994	1995	1993	1994	1995	1993	1994	1995
I	4-6 leaves	29	31	32	38	44	53	1 March	27 Feb	28 Feb	29	31	32
II	Star	54	57	54	64	61	75	21 March	20 March	20 March	49	52	52
III	Bud	70	72	71	81	75	93	9 April	7 April	9 April	66	70	70
IV	50% flowering	82	85	83	89	88	103	21 April	18 April	21 April	77	81	82
V	Soft dough	95	99	97	95	96	101	2 May	29 April	2 May	87	92	93
VI	Hard dough	107	111	108	102	104	-	11 May	9 May	12 May	97	102	103
VII	-	-	-	-	-	-	-	21 May	18 May	21 May	109	111	112

Table 2. Rainfall data recorded during crop season at Ludhiana

Month	Rainfall (mm)			Number of rainy days		
	1993	1994	1995	1993	1994	1995
February	16.4	35.3	51.1	3	4	3
March	30.1	0.0	20.0	3	0	1
April	16.1	9.1	17.1	2	2	2
May	15.8	0.0	0.0	3	0	0
Total	78.4	44.4	88.2	11	6	6

Table 4. Effect of moisture stress on seed yield attributing characters in spring sunflower crop during 1993 to 1995

Sr. No.	Treatment	Plant height (cm)	Stem girth (cm)	Head diameter (cm)	100-seed weight (gm)
1.	Irrigations at all growth stages	148.9	7.1	13.7	6.5
2.	Moisture stress at 4-6 leaves	134.6	6.6	12.5	5.8
3.	Star	135.4	6.5	12.5	6.1
4.	Bud stage	145.9	6.6	12.3	5.7
5.	50% flowering	148.7	6.8	12.2	4.7
6.	Soft dough	148.8	7.0	12.4	4.3
7.	Hard dough	148.9	7.1	12.5	4.8
8.	At 75 mm evaporation	148.6	7.0	13.5	6.3
9.	Recommended irrigations	149.1	7.2	13.8	6.5
C.D. (0.05)		6.6	0.4	0.6	0.2

