

Scheduling irrigations for summer groundnut (*Arachis hypogaea*)

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ABSTRACT

An experiment was conducted at Bilaspur during summer seasons of 1994 and 1995 to study the effect of irrigation levels on kernel yield, nutrient uptake and oil yield of groundnut (*Arachis hypogaea* L.). Irrigating summer groundnut at an 0.8 IW : CPE ratio (irrigation at 75 mm CPE) gave significantly higher pods/plant, kernel yield and oil yield and resulted in higher uptake of N, P and K by the plants over 0.6 IW : CPE ratio (irrigation at 100 mm CPE). Irrigations scheduled under 1.0 and 1.2 IW : CPE ratio had no further advantage over an 0.8 IW : CPE ratio. Stress-day index concept proved useful to schedule irrigation in summer groundnut. Water-use efficiency (WUE), net and additional returns and input:output ratio were highest with an 0.8 IW : CPE ratio irrigation schedule.

Key words : Groundnut, Irrigation schedule, Yield, Nutrient uptake

Water deficit in general reduces yield, seed size, and during flowering it increases the number of shrivelled seeds with reduced protein content and shows association with reduced nutrient uptake by groundnut plant (Rao *et al.*, 1988). In spite of drought tolerance, the crop responds to irrigations. Prolonged stress during moisture-sensitive stages of flowering, pegging and pod development leads low yield. Groundnut as a summer crop is becoming increasingly popular due to its higher productivity in the newly developed irrigation commands area of Chhattisgarh region of Madhya Pradesh. The present study was therefore undertaken to find out the optimum irrigation schedule to increase productivity and net return of summer groundnut.

MATERIALS AND METHODS

The field study was conducted in randomized block design with 5 replications at Bilaspur during the summer season of 1994 and 1995. The soil was sandy loam with 0.82, 1.31, 2.07 and 3.46 cm available water in 0-15, 15-30, 30-60 and 60-90 cm soil depth respectively. Irrigation water of 60 mm depth measured with Parshal flume was applied at each irrigation. Irrigations were given when cumulative pan evaporation (CPE) reached the required value. The concept of stress-day index (SDI) outlined by Hiller *et al.* (1974) was adopted. Groundnut 'J 11' was sown in rows, spaced 40 cm apart with intra-row spacing of 15 cm during the last week of January

and harvested in the last week of May each year. It received 20, 80 and 20 kg N, P₂O₅ and K₂O/ha at sowing. The N, P and K content of kernel samples were determined as per standard procedures. Effective rainfall of 8 mm and 96 mm was received during the crop seasons of first and second years respectively.

RESULTS AND DISCUSSION

Yield and its attributes

Irrigation schedule of 0.8 IW : CPE throughout crop growth resulted in higher pod and kernel yields than 0.6 IW : CPE schedule during both the years (Table 1). However, there was no significant difference in yield between 0.8 and 1.0 ratios. Further, it was observed that more frequent irrigations under 1.2 IW : CPE schedule reduced the pods/plant compared to 0.8 and 1.0 ratios. Greater soil moisture encouraged vigorous growth, resulting in reduction in number of pods due to distribution of sink to the vegetative parts of the plant and thereby leading to more unfilled pods. Low yield under moisture-stress condition with 0.6 IW : CPE irrigation schedule might be due to non-coincidence of irrigations given in this treatment with early vegetative and pre-flowering stages. But irrigations under 0.8 and 1.0 ratios coincided with critical stages of the crop, thereby benefiting in producing higher yield. Negative crop-susceptibility factor also indicated similar results (Table 2). Concept of stress-day index is the convenient method to identify the critical stage and to estimate the magnitude of yield reduction due to stress. This can also be used for scheduling irrigation considering the values of stress-day factor values at irrigation. Similar observations were made by Ramachandrapa *et al.* (1992) also.

Oil content and its yield

Oil content of the kernel showed no significant difference among irrigation sched-

Table 1. Effect of irrigation schedules on yield attributes and yield of summer groundnut

Irrigation schedule (IW:CPE)	Pods/plant		Immature pods/plant		100-kernel weight (g)		Pod yield (kg/ha)		Kernel yield (kg/ha)		Shelling (%)	
	Y ₁	Y ₂	Y ₁	Y ₂	Y ₁	Y ₂	Y ₁	Y ₂	Y ₁	Y ₂	Y ₁	Y ₂
0.6	16.4	18.2	6.2	4.5	33.4	35.2	2,242	2,142	1,547	1,499	69	70
0.8	28.8	26.5	3.1	3.0	37.0	36.9	3,180	3,012	2,321	2,169	73	72
1.0	28.0	26.0	3.0	4.2	36.8	37.2	3,245	3,045	2,369	2,284	73	75
1.2	21.2	20.8	9.4	8.6	37.2	36.4	2,793	2,798	1,983	2,042	71	73
CD (P = 0.05)	3.4	4.1	2.2	3.5	1.2	NS	331	389	305	313		

Y₁, 1994; Y₂, 1995

Table 2. Stress-day index values as influenced by irrigation levels in groundnut

Irrigation schedule (IW:CPE)	Crop susceptibility		Stress day (mm of CPE)	Stress Day index	
	1994	1995		1994	1995
0.6 (100)	0.20	0.23	75	15.20	17.48
0.8 (75)	-0.14	-0.08	75	-10.64	-6.08
1.0 (60)	-0.16	-0.09	75	-12.16	-6.84
1.2 (50)					

Figures in parentheses are CPE values in mm for respective irrigation schedules

Table 3. Effect of irrigation schedule on oil content and oil yield of summer groundnut

Irrigation schedule (IW:CPE)	Oil content (%)		Oil yield (kg/ha)	
	1994	1995	1994	1995
0.6	46.32	46.18	716.57	692.24
0.8	47.45	47.29	1,101.31	1,025.72
1.0	47.60	46.82	1,127.64	1,069.37
1.2	46.70	47.67	926.06	973.42
CD (P = 0.05)	NS	NS		

Table 4. Effect of irrigation schedule on content and uptake of N, P and K in groundnut seed

Irrigation schedule (IW:CPE)	N (%)		P (%)		K (%)		N (kg/ha)		P (kg/ha)		K (kg/ha)	
	Y ₁	Y ₂	Y ₁	Y ₂	Y ₁	Y ₂	Y ₁	Y ₂	Y ₁	Y ₂	Y ₁	Y ₂
	0.6	4.26	4.38	0.37	0.35	0.36	0.39	95.51	93.82	8.29	7.50	8.07
0.8	4.15	4.20	0.39	0.40	0.41	0.43	131.97	126.50	12.40	12.05	13.04	12.95
1.0	3.86	4.22	0.41	0.40	0.42	0.43	125.26	120.50	13.30	12.18	13.63	13.09
1.2	3.78	3.81	0.43	0.42	0.46	0.49	105.57	106.60	12.01	11.75	12.85	13.71
CD (P = 0.05)	0.29	NS	0.05	0.04	0.05	0.70						

Y₁, 1994; Y₂, 1995

ules. However, oil yield was significantly influenced by the irrigation levels identical to kernel yield. Increase in oil yield was due to an increase in kernel yield. However, more number of irrigations did not bring about an increase in oil yield because of the reduction in kernel yield (Table 3).

Contents and uptake of N, P and K

Irrigation levels improved P and K contents of the kernel during both the years and N content in first year only (Table 4). Nutrients content under stress treatment (0.6 IW : CPE) was comparatively higher than in other irrigation schedules; however, total uptake of

nutrients was much less in this treatment. This could probably be due to lower kernel yield which could not be fully compensated by higher nutrients content. The higher uptake with 0.8 IW : CPE schedule might be due to more favourable environment for the distribution of the sink to the reproductive components which led to higher biomass production and increased uptake of nutrients. The results confirm findings of Rao *et al.* (1988) and Zalawadia and Patel (1983).

Water use and its efficiency

Irrigation schedule had a marked influence on water use and water-use efficiency

Table 5. Water-use components under different irrigation schedules in groundnut (pooled data of 2 years)

Irrigation schedule (IW:CPE)	Pod yield (kg/ha)	Water applied (mm)	Effective rain (mm)	Total water use (mm)*	WUE (kg/ha-cm)
0.6 (100)	2,192	360	51.8	452.20 (6)	48.47
0.8 (75)	3,096	600	51.8	659.90 (10)	46.92
1.0 (60)	3,145	720	51.8	778.10 (12)	41.42
1.2 (50)	2,795	840	51.8	895.80 (14)	31.20

*Includes quantity of irrigation water applied + effective rains + stored moisture at sowing + water given as common irrigation

Figures in parentheses indicate the number of irrigation.

Table 6. Economics of production of summer groundnut as influenced by irrigation schedules

Irrigation schedule (IW:CPE)	Cost of cultivation (Rs/ha)		Net return (Rs/ha)		Additional return (Rs/ha)		Input: output ratio	
	1994	1995	1994	1995	1994	1995	1994	1995
0.6 (100)	12,900	14,200	7,469	7,420			1:1.6	1:1.5
0.8 (75)	13,600	14,700	15,193	15,620	7,024	7,500	1:2.1	1:2.1
1.0 (60)	14,100	15,200	15,323	15,450	6,654	7,030	1:2.1	1:2.0
1.2 (50)	14,550	15,700	11,921	12,480	2802	3,560	1:1.8	1:1.8

Price of seed @ Rs 2000/q

Price of produce Rs 900 and Rs 1000/q in 1995 and 1996 respectively

(Table 5). The water-use efficiency was highest under 0.6 IW : CPE treatment, but decreased with increase in the number of irrigations. Irrigations scheduled at 50 mm and 60 mm CPE did not influence the seed yield compared with irrigations scheduled at 75 mm CPE and resulting in reduction in water-use efficiency. The greatest reduction in pod yield was in 0.6 IW : CPE ratio and 1.2 IW : CPE ratio and which received delayed and more frequent irrigations respectively. This indicates that both delayed and frequent irrigations are not congenial for obtaining high water-use efficiency in summer groundnut.

Economic returns

Economics of different treatments indicated that irrigation schedule of 0.8 IW : CPE accrued the highest net and additional returns over other IW : CPE. However, more number of irrigation under 1.0 and 1.2 IW : CPE treat-

ments did not show additional advantage. This is primarily due to lower pod yield in these treatments. Input : output ratio was also highest with 0.8 IW : CPE irrigation schedule compared to other schedules (Table 6).

REFERENCES

- Hiller, E.A., Howell, T.A., Lewis, R.B. and Bose, R.P. 1974. Irrigation timing by the SDI method. *Transactions of American Society of Civil Engineers* 17 : 393-398.
- Ramachandrappa, B.K., Kulkarni, K.R. and Najappa, H.V. 1992. Stress day index for scheduling irrigation in summer groundnut (*Arachis hypogaea*). *Indian Journal of Agronomy* 37 : 276-279.
- Rao, Nageswara, R.C., Williams, J.H., Shivakumar, M.V.K. and Wadia, K.D.R. 1988. Effect of water deficit at different growth phases of peanut. II. Response to draught during pre-flowering phase. *Indian Journal of Agronomy* 80 : 431-438.
- Zalawadia, N.M. and Patel, M.S. 1983. Growth responses and phosphorus uptake by groundnut in calcareous soil in relation to applied phosphorus under varying moisture condition. *Journal of Indian Society of Soil Science* 31 : 486-490.