

Use of Open Pan Evaporimeter in Scheduling Irrigation for Wheat Crop in South Gujarat

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ABSTRACT

An experiment for scheduling irrigation based on irrigation water applied (IW) to cumulative pan evaporation (CPE) ratios was conducted on wheat crop at the Main Irrigation Research Centre, Navsari during the year 1977-78 and 1978-79. Irrigation water of 60 mm (I_1) and 80 mm (I_2) each, as measured by water meter was given at four IW: CPE ratios viz. $R_1 = 0.60$, $R_2 = 0.75$, $R_3 = 0.90$ and $R_4 = 1.05$ in both the years. The actual values of evapotranspiration for each treatment combination were worked out.

It was observed that application of six irrigations each of 80 mm at an IW: CPE ratio of 0.90 was optimum. It gave the maximum yield of 34.24 q/ha with a profit of Rs. 1975/ha, and the water use efficiency of 7.53 kg/ha mm of water applied. The actual evapotranspiration value as observed under this treatment was 450 mm, which had a significant correlation ($R = 0.87$) with the USWB pan evaporation value.

(Received on Octo. 9, 1980)

INTRODUCTION

Evapotranspiration is not only a physiological process but a physical phenomenon too, governed by the incident energy at a place (Plenman, 1948 and Thornthwaite, 1948). The loss of water through evapotranspiration is largely a function of meteorological parameters. Hobbs and Krogman (1974), Dastane *et al.* (1970), Singh (1966), Ram and Singh (1976), Pai and Hukkeri (1979) and many other workers have reported the schedule of irrigation for different parts of the country in wheat crop. Dwarf wheat varieties respond well to nitrogen fertilizer and is largely regulated by moisture conditions.

The area under wheat crop is increasing every year under Ukia-Kakra-

par command area, as the water supply is assured. But for want of knowledge on scheduling in wheat crop, on the part of canal authorities as well as farmers, the yield of wheat crop is not satisfactory. It is observed that the efficiency of water is decreased with higher or lower frequency of irrigation. With this objective in view, a research project was undertaken to determine the schedule of irrigation in wheat crop, so that it can be useful to both the irrigators as well as the canal authorities.

MATERIALS AND METHODS

An experiment was conducted during the year 1976-77 and 1977-78 at the Main Irrigation Research Centre, Navsari to determine the schedule of irrigation in a high yielding recom-

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mended wheat variety Junagadh-24 for the upland areas of heavy black soils of South Gujarat tract. The values of the soil physical properties of the experimental plot viz., field capacity, bulk density and permanent wilting point in 0-60 cm layer were 31%, 1.50 g/cc and 18%, respectively (Anonymous, 1975).

The field was ploughed after one heavy irrigation of 100 mm in the first week of December and a basal dose of 60-60-0 kg NPK/ha was applied in both the years. The experiment was laid out in a randomised block design. Wheat (J-24) was sown on December 11 and 6 in the year 1976 and 1977, respectively, at the rate of 100 kg/ha. The first common irrigation of 75 mm was given immediately after sowing for satisfactory germination. The second light irrigation of 60 mm was given on December 19 and 11, respectively in the year 1976 and 1977 to facilitate establishment of the crop. These two irrigations are necessary as the soil has a tendency to crack and form a crust on the surface. The rest of the irrigations amounting to 60 mm (I_1) and 80 mm (I_2) as measured by water meter were applied at IW:CPE ratios ($R_1=0.60$, $R_2=0.75$, $R_3=0.90$ and $R_4=1.05$) in both the years. The cumulative pan evaporation values were taken from USWB pan evaporimeter installed in the centre of the experimental field.

Actual evapotranspiration was worked out for each treatment from the soil moisture data taken for every 15 cm depth upto 120 cm soil profile, before and after each irrigation.

RESULTS AND DISCUSSION

The data on the yield of grains, quantity of water applied, number of irrigations given, and the net profit in

each treatment are given in (Table 1). Treatment I_1R_3 , I_2R_3 , I_2R_4 , and I_1R_4 receiving 435, 455, 455, and 495 mm of irrigation water, in 7, 6, 6 and 8 irrigations (including 2 common irrigations) respectively, were at par and were significantly superior to the rest of the treatments. Amongst these four treatments, the treatment I_2R_3 i.e. application of 80 mm water at each irrigation at an IW: CPE ratio of 0.90 gave the maximum yield (34.24 q/ha) and profit (Rs. 1975/ha), with water use efficiency of 7.53 kg of grain/ha/mm of irrigation water. The other three treatment combinations viz., I_1R_3 , I_2R_4 and I_1R_4 had water use efficiency of 7.41, 7.47 and 6.90 kg/ha-mm of water, respectively. The treatment combination I_2R_3 was, therefore found to be the best for adoption by the farmers.

The actual evapotranspiration (ET) worked out from the soil moisture data and the corresponding values of evaporation (EO), obtained from pan evaporimeter for each treatment, at each irrigation are given in Table 2. The values of actual evapotranspiration were 414, 429, 444, 546, 385, 396, 450 and 477 mm for treatments I_1R_1 , I_1R_2 , I_1R_3 , I_1R_4 , I_2R_1 , I_2R_2 , I_2R_3 , and I_2R_4 , respectively. The correlation between actual value of evapotranspiration and pan evaporation was worked out (Table 2). Treatment I_1R_1 gave significant correlation ($r=0.93$) for IW:CPE ratio of 0.60 but the yield (28.64 q/ha) obtained in this treatment was very low (Table 1). Treatment I_2R_3 gave the highest correlation ($r=0.97$) and was highly significant for IW: CPE ratio 0.75. But the yield (26.50 q/ha) in this treatment was also low. Treatments I_2R_3 , and I_2R_4 gave significant correlation of 0.87, and 0.85

TABLE 1
Effect of irrigation on wheat yield (J-24) during 1976-77 and 1977-78.

Sl. No.	Treatment	No. of irrigation	Total quantity of water applied (mm)	Grain yield (q/ha)		Straw yield (q/ha)		Net profit (Rs./ha)	Water use efficiency kg/ha. mm of water
				1976-77	1977-78	1976-77	1977-78		
1	I ₁ R ₁	5	315	30.33	26.95	31.15	39.23	1364	9.09
2	I ₁ R ₂	6	375	32.56	28.33	39.94	45.50	1592	8.18
3	I ₁ R ₃	7	435	29.06	35.40	29.06	56.64	1737	7.41
4	I ₁ R ₄	8	495	36.31	31.99	43.82	60.19	1859	6.90
5	I ₂ R ₁	4	295	21.18	22.35	23.65	25.85	560	7.38
6	I ₂ R ₂	5	375	25.44	27.56	30.39	34.65	1052	7.07
7	I ₂ R ₃	6	455	36.05	32.42	43.21	44.81	1975	7.53
8	I ₂ R ₄	6	455	34.83	33.11	42.79	54.74	1966	7.47
S. Em. ±				1.64	1.39	—	—	—	—
C.D. at 5%				5.48	4.08	—	—	—	—

TABLE 2
Actual values (mm) of evapotranspiration (ET) and USWB pan evaporation (EO) for various treatments in wheat (1977-78 and 1978-79).

Irrigation schedule	I ₁ R ₁		I ₁ R ₂		I ₁ R ₃		I ₁ R ₄		I ₂ R ₁		I ₂ R ₂		I ₂ R ₃		I ₂ R ₄	
	ET	EO	ET	EO	ET	EO	ET	EO	ET	EO	ET	EO	ET	EO	ET	EO
1st	45.67	26.0	43.03	26.0	44.81	26.0	59.14	26.0	32.99	26.0	23.80	26.0	42.67	26.0	47.75	26.0
2nd	82.22	77.05	68.48	57.25	59.30	44.25	65.36	35.25	65.71	108.35	87.58	82.58	63.33	63.80	82.04	55.25
3rd	93.85	96.95	63.58	78.25	35.68	64.10	52.01	55.85	132.85	144.95	96.34	112.80	79.93	89.50	61.10	71.15
4th	87.17	100.75	107.30	80.05	77.78	67.65	96.73	57.40	153.40	139.05	97.96	100.15	111.16	89.30	67.13	76.05
5th	105.55	112.60	71.81	79.75	66.48	66.60	35.54	53.95	—	—	—	—	—	83.80	88.33	77.50
6th	—	—	70.95	97.05	69.41	65.55	75.12	60.04	—	—	—	—	—	80.65	130.70	112.40
7th	—	—	—	—	90.16	79.20	87.23	52.60	—	—	—	—	—	71.92	—	—
8th	—	—	—	—	—	—	75.42	76.90	—	—	—	—	—	—	—	—
Total	414.46	418.35	429.15	418.35	443.75	418.35	546.55	418.35	384.95	418.35	395.78	418.35	449.66	418.35	477.08	418.35
Coefficient of correlation 'r'	0.93*		0.41 ^{ns}		0.57 ^{ns}		0.12 ^{ns}		0.89 ^{ns}		0.97**		0.87**		0.85*	

TABLE 3

Schedule of irrigation (days) after sowing in each treatment for wheat (J-24) crop.

Irrigation schedule	Days after sowing in various treatments							
	I_1R_1	I_1R_2	I_1R_3	I_1R_4	I_2R_1	I_2R_2	I_2R_3	I_2R_4
1st	1	1	1	1	1	1	1	1
2nd	8	8	8	8	8	8	8	8
3rd	33	28	24	22	40	34	29	27
4th	56	46	39	35	73	60	50	44
5th	77	64	55	49	—	81	70	61
6th	—	81	70	61	—	—	87	78
7th	—	—	83	74	—	—	—	—
8th	—	—	—	85	—	—	—	—

for IW:CPE ratios of 0.90 and 1.05, respectively.

The irrigation schedule followed in each treatment is given in Table 3. According to this schedule, the treatment I_2R_3 received six irrigations on 1st, 8th, 29th, 50th, 70th and 87th days after sowing. The first two irrigations 75 mm and 60 mm were given for satisfactory germination and establishment of crop, respectively. The rest of the irrigations each of 80 mm were given during the crop growth period. This schedule may therefore be recommended for wheat crop in heavy black soils (upland), for maximum and economical production in Ukai-Kakrapar command area of South Gujarat region.

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