

# Studies on the Irrigation and Manure Requirements of Wheat\*

by

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**Introduction:** For normal crop production of wheat basic requirements of soil moisture and nutrients need to be provided in appropriate doses and at the appropriate stages of crop growth. Wadleigh *et al* (1946) reported that the plant growth is reduced as the soil moisture stress is increased. Mitra and Sabnis (1945) observed that water requirement of wheat varied between 8"—11" in three irrigations inclusive of 3—5 inches of presowing irrigation. Khan and Dhesi (1941) observed that two irrigations were sufficient for a successful wheat crop. Singh and Das (1961) found that in case of wheat crop 50 lb N level gave better yield over 25 lb dose of nitrogen. Singh and Rao (1954) reported that optimum dose of nitrogen was 60 lb per acre for wheat. Singh (1960) found that under each level of irrigation (wet, moist and dry) the yield of wheat increased with increased application of nitrogen and that more irrigation without fertiliser was harmful. Pandey and Haque (1965) reported that two irrigations, each of 7.5 cm/ha scheduled at 30 and 55 days from the date of sowing gave the optimum grain yield at both 45 and 67 kg/ha levels of nitrogen. With a view to find out whether irrigations at other stages of plant growth have any bearing on yield characteristics, a modified experiment was laid out at the Irrigation Research Station, Bikramganj under the Sone command area.

**Materials and Methods:** An experiment was laid out at the Irrigation Research Station, Bikramganj, (Shahabad) within the Sone Command area and conducted during the years 1962—'63, 1963—'64 and 1964—'65. The soil was loam having coarse sand 17.5, fine sand 43.7, silt 14.9 and clay 21.05 per cent. The specific gravity and volume weight were 2.62 and 1.54 respectively. Field capacity and wilting point were found to be 20 and 12 per cent respectively on oven dry weight basis. Soil samples for soil moisture studies were taken with the help of a soil auger from depths of 7.5, 22.5, and 45 cm. and oven dried at 100°C, a day prior to the scheduled date of irrigation to find out the exact quantity of irrigation necessary to bring the root zone to field capacity.

**Treatments:** The experiment was laid out in a split-plot design with 4 replications having plot size 28 m x 3.5 m. Manures, (M<sub>1</sub>) consisted of 33.6 kg N in combination with 33.6 kg phosphate and (M<sub>2</sub>) 67.2 kg N with

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67.2 kg phosphate per hectare as the lower and the higher levels of fertilisers respectively. Irrigation levels incorporated in the experiment were (I<sub>1</sub>) control, (I<sub>2</sub>) one irrigation 30 days after sowing, (I<sub>3</sub>), one irrigation 30 days after sowing and followed by a second irrigation at the preflowering stage, (I<sub>4</sub>), Two irrigations; first, 30 days after sowing and the second at post-flowering stage, and (I<sub>5</sub>), a single irrigation at the pre-flowering stage. Nitrogen and phosphate were applied in the forms of Ammonium Sulphate and single super-phosphate respectively. Full dose of phosphate and half dose of nitrogen were applied with sowing and the rest half of nitrogen was given as top dressing with irrigation one month after sowing. Wheat crop was usually sown during first half of November and harvested at the end of March every year.

*Crop Weather:* The amount of rainfall received during the crop period, November to March, was 32.80 mm whereas, evaporation loss during the same period was 573.8 mm. The mean humidity at 7 A. M. over the same period was 77.6 per cent. Atmospheric temperature was also favourable to growth and development of the wheat crop.

*Results:* The depth of irrigation applied to the various treatments yearwise are presented in Table 1.

TABLE 1. *Depths of Irrigation (mm) 1962-'63 to 1964-'65*

Year	Treatments				
	I <sub>1</sub>	I <sub>2</sub>	I <sub>3</sub>	I <sub>4</sub>	I <sub>5</sub>
1962-'63	Nil	76.2	165.0	153.9	88.9
1963-'64	Nil	63.5	139.7	177.8	101.6
1964-'65	Nil	58.4	121.9	139.7	67.2
Mean	Nil	66.0	142.2	161.5	88.2

Table 2 presents the three years' pooled data in respect of tillers, height of plants, length of 'ear' head, number grains per 'ear' and weight of 1000 grains.

TABLE 2. *Mean plant population height of plants, etc*

Plant characters	I <sub>1</sub>	I <sub>2</sub>	I <sub>3</sub>	I <sub>4</sub>	I <sub>5</sub>	Mean	C. D. @ 5%
Tiller no.	14.5	17.4	18.8	17.2	15.9	16.8	Sig.
Ht. of plants (cm)	102.6	118.5	118.9	118.2	111.1	119.8	Sig.
Length of 'ear' (cm)	10.4	11.2	11.5	10.8	10.7	10.9	Sig.
No. of grain	39.6	42.0	45.1	43.0	41.0	42.2	Sig.
Wt. of 1000 grain (g)	46.8	47.6	46.1	46.3	46.9	46.7	N. S.

The effect of irrigation on plant characters except that of 1000 grains weight was significantly superior to no irrigation treatment.

*Grain yield:* The results of grain yield in quintal per hectare have been presented in Table 3.

TABLE 3 Grain yield Qa/ha (1962-63 to 1964-65)

Year	Manures	I <sub>1</sub>	I <sub>2</sub>	I <sub>3</sub>	I <sub>4</sub>	I <sub>5</sub>	Mean	C. D. at 5%
1962-63	M <sub>1</sub>	7.28	14.81	15.38	14.08	13.65	12.97	(Irri.) 1.96
	M <sub>2</sub>	9.75	16.06	17.11	16.22	14.71	14.77	
	Mean	8.33	15.43	16.24	15.15	14.17	13.87	
1963-64	M <sub>1</sub>	12.14	17.94	18.12	17.02	12.74	15.59	(Irri.) 1.80
	M <sub>2</sub>	11.99	22.77	23.56	22.12	16.44	19.37	(M) Sign.
	Mean	12.07	20.35	20.83	19.56	14.59	17.48	(MxI) 3.15
1964-65	M <sub>1</sub>	12.30	14.72	15.88	14.05	13.30	13.85	(Irri.) 1.09
	M <sub>2</sub>	14.42	17.04	23.08	18.87	13.97	17.48	(M) 1.01
	Mean	13.36	15.87	19.48	15.46	13.13	15.66	(MxI) 1.40
Combined	M <sub>1</sub>	10.33	16.63	17.34	15.85	13.57	14.74	(Irri.) 3.05
	Mean	13.50	19.21	22.52	20.12	15.82	18.23	(M) 1.17
Grand	Mean	11.91	17.92	19.93	17.98	14.69	16.48	

The effect of irrigation on grain yield was significant in all the years. The treatment I<sub>3</sub> was significantly superior to the treatments I<sub>5</sub> and I<sub>1</sub> which is apparent from the results of individual years analysis as well as from combined analysis. Since the treatments I<sub>2</sub> and I<sub>4</sub> behaved *at par* with each other in all the years it is suggestive of the fact that post flowering irrigation is of no advantage. It is also revealed that application of one irrigation one month after sowing (I<sub>2</sub>) is superior to the application of one irrigation at the post-flowering stage only (I<sub>5</sub>).

Higher level of manuring was significantly superior to the application of manure at lower level.

*Straw yield:* The straw yield data for all the three years have been presented in Table 4.

TABLE 4. Straw yield Qa/ha (1962-63 to 1964-65).

Year	Manures	I <sub>1</sub>	I <sub>2</sub>	I <sub>3</sub>	I <sub>4</sub>	I <sub>5</sub>	Mean	C. D. at 5%
1962-63	M <sub>1</sub>	25.55	27.60	23.94	30.81	23.88	26.35	(M) Sign.
	M <sub>2</sub>	30.43	29.32	35.88	30.81	38.55	33.00	
	Mean	27.94	28.50	29.90	30.81	31.21	29.67	
1963-64	M <sub>1</sub>	15.29	27.89	32.21	27.50	19.57	24.49	(M) Sign.
	M <sub>2</sub>	18.80	32.12	39.24	33.66	23.85	29.53	(Irri.) 2.45
	Mean	17.64	30.00	35.72	30.58	21.71	27.01	
1964-65	M <sub>1</sub>	13.92	16.83	18.94	16.02	19.57	17.95	(M) 6.02
	M <sub>2</sub>	14.40	26.55	30.12	25.41	21.85	23.66	(Irri.) 1.94
	Mean	14.16	21.69	24.53	20.51	20.71	20.36	
Combined	M <sub>1</sub>	18.25	24.45	28.41	24.83	19.48	23.08	(M) 3.77
	Mean	21.25	29.39	35.14	30.02	23.13	28.78	(Irri.) 4.38
Grand	Mean	19.75	26.92	31.78	27.42	23.81	25.93	



The effect of manure on straw yield was significant in all the years. Higher level of manuring produced more straw yield as compared to the lower level of manuring. The effect of irrigation on straw yield was significant during the years 1963—64 and 1964—65. The straw yield of treatment  $I_3$  was significantly higher than the rest of the treatments. The treatment  $I_1$  produced significantly the lowest straw as compared to the rest of the treatments.

**Discussion :** The mean irrigation levels including 32.8 mm. of mean rainfall applied to the treatments  $I_1$ ,  $I_2$ ,  $I_3$ ,  $I_4$  and  $I_5$  amounted to 32.8, 98.8, 175.0, 189.9 and 121.77 mm. respectively and the corresponding percentage increases in grain yields over the control ( $I_1$ ) worked out to 50.4, 68.0, 50.9 and 23.3 respectively. Thus the superiority of the treatment  $I_3$  receiving two irrigations only, first 30 days after sowing and the second at pre-flowering stage, over the rest of the irrigation treatments is established. This confirms the findings of Pandey and Haque (1965). Since the treatments  $I_2$  and  $I_4$  behaved *at par* with each other so far as the increase in grain yield is concerned it is evident that post-flowering irrigation is of no advantage. It was also revealed that the application of one irrigation one month after sowing (treat.  $I_2$ ) was superior to the application of one irrigation at the pre-flowering stage only. The higher level of manuring, 67.2 kg N in combination with 67.2 kg phosphate per hectare was found superior to the lower level of manures, 33.6 kg N plus 33.6 kg phosphate per hectare in respect of grain yields.

Response of treatment ( $I_3$ ) in respect to straw yield was significantly superior to other irrigation levels. The higher level of manures as compared to the lower level significantly increased straw yield.

Treatments  $I_2$ ,  $I_3$  and  $I_4$  being *at par* in respect of tiller numbers, height of plants, number of grains per ear head and ear length was significantly superior to the treatments  $I_1$  and  $I_5$ .

**Summary and Conclusion :** With a view to study the effect of manures and irrigation at different stages of plant growth on yield characteristics of wheat, an experiment was conducted for three years, 1962—63 to 1964—65 and the conclusions were :

(i) For optimum grain yield of wheat two irrigations, first one month after sowing of crop and the second at pre-flowering stage appeared necessary. Depth of each irrigation application amounted to 70 mm.

(ii) Application of irrigation at the post-flowering stage was of no significant advantage to giving irrigations one month after sowing only.

(iii) Application of one irrigation only one month after sowing of wheat was significantly superior to the application of one irrigation at the pre-flowering stage only.

(iv) Higher level of manuring (67.2 kg N plus 67.2 kg phosphate per hectare) significantly increased grain yield of wheat as compared to the lower level of manures (33.6 kg N plus 33.6 kg phosphate per hectare).

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