

Effect of Irrigation at Different Stages of Development on Growth and Yield of Wheat

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A field experiment was conducted to monitor the effect of irrigation at crown root, booting, soft dough and hard dough stages on wheat (*Triticum aestivum* L, cv. Sonalika) for three consecutive years. Irrigation at single stage could significantly improve plant height, panicle length, grain/panicle and yield of grain but that at dual stages it is decidedly better if applied at crown root and booting stages. However, days of 85% maturity of grain changed insignificantly. Irrigation more than thrice during growth span of wheat increased the growth and yield but not significantly.

Introduction

As a vital factor, plant water deficit results in the retardation of growth and metabolism of corn¹⁻⁵, barley⁶⁻⁹, tomato¹⁰, tobacco¹¹, rice¹², wheat¹³⁻¹⁵, sugar¹⁶, beets and other cereal crops¹⁷⁻¹⁸. The existence of a moisture sensitive critical period or periods, thus, has been demonstrated for different crops. Considerable research has been done in the past to find out an optimum and practicable irrigation schedule for maximization of wheat yield.

Extensive research is being carried out by Bangladesh Agricultural Research Institute (BARI) to grow more wheat along with rice as a substitute of the later. Traditional methods of cultivation result in the very low yield of wheat compared to that in many neighbouring countries which could be improved by using improved varieties and modern methods of cultivations. In Bangladesh, wheat is mainly a rainfed crop grown on residual soil moisture. However, at the present time, due to orientation of farming system for intensive cropping to wheat and other cereal crops to obtain a high rate of production per unit area of land, limited irrigation practices are being followed where the farmer has experiences that its yield can be substantially increased by irrigation. It is

worthwhile to find out the appropriate irrigation schedule for wheat production in soils with limited reserve of moisture. Irrigation was given at four different stages of development and its impact on growth and yield of wheat (*Triticum aestivum* L, cv. Sonalika) was observed.

Experimental

A field experiment was conducted in a typical wheat growing soil located in the District of Rangpur at Mohipur Experimental station managed by Bangladesh Water Development Board in rabi season for three successive years (1979-1981). The soil belongs to the Tista silty loam with pH 6.1.

The treatments were consisted of a factorial combinations of irrigation at four different stages of development (crown root, booting, soft dough and hard dough). All TSP (84 kg P₂O₅/ha) and MP (61.6 kg K₂O/ha) together with one half of nitrogen (84 kg urea-N/ha) were applied at the time of final preparation of land. The other half of nitrogen was applied in two equal splits as top dressing during crown root and booting stages. The experiment with 15 treatments was laid out in a randomized block design and each treatment was replicated three times. A control treatment (no irrigation, rainfed) was also included in the design.

The unit plot size was 28.86, 18.57 and 13.94 square metre for the years 1979, 1980 and 1981 respectively. The plots in the block were arranged in such a way by a buffer zone that no runoff among them was allowed. Granosan-M treated Sonalika wheat seeds were sown (138 kg/ha) in continuous lines. Line to line distance maintained was 25 cm. The dates of sowing were 24th November, 1978; 10th December, 1979 and 22nd December, 1980. Diazinon (60%) was applied as a plant protection measure at crown root and just before lowering stages of growth. The irrigation treatments were scheduled to correspond with critical growth stages. Parshell-Flume was used to supply irrigation water with a constant head from one end of the plot and continued till the whole plot get moistened.

Data for rainfall (in inch) is shown below. The pattern of cropping in the experimental field during 3 consecutive years was: Green manuring--Wheat--T. Aus (1978-79), T. Aman--Wheat--Summer pulses (1979-80); and T. Aman--Wheat--green manuring (1980-81).

Year	Months				
	Nov.	Dec.	January	February	March
1978-79	Nil	Nil	0.50	0.25	Nil
1979-80		1.85	Nil	0.05	0.76
1980-81		Nil	0.47	0.61	Nil

Results and Discussion

Supply of irrigation of different stages of growth and development of wheat has been investigated for consecutive three years (Tabs. I and II). Irrigation in only one stage of growth during booting, soft dough and hard dough significantly reduced the height of the plant in comparison to plants receiving irrigation more than once (Tab. I). Irrigation at crown root stage is significantly better than that applied at other stages of growth as far as the plant height is concerned (Tab. I). Generally supply of irrigation at three stages of growth showed no significantly better result to modify the height of the plant. The favourable effect of irrigation at crown root and booting stages be

attributed to the better functioning of water on the physiology of the plants²⁰.

Penicle length was also significantly influenced by the irrigation treatment in 1979 (Tab. I). However, the variation in penicle length in the years 1980 and 1981 was not statistically significant. The effect of the treatments on penicle length was very similar to that of plant height. The impact of irrigation during all the four stages of growth (crown root, booting, soft dough and hard dough) on height and penicle length in comparison to other treatments was not apparent.

Grain per penicle was counted (Tab. I). The number of grains per penicle varied significantly due to variation in irrigation treatments. All the treatments produced more grains over the control during three years of trial. However, the variation among the treatments was not appreciable. This indicated the fact that irrigation is highly essential for the production of grain if applied at crown root or booting stages of growth. Frequent irrigation at different stages of growth did not produce any notable result.

The days of maturity of 85% grains were 113 to 116, 108 to 111 and 110 to 112 days in the years 1979, 1980 and 1981 respectively (Tab. I). Statistically, maturation of the grains was not significantly influenced by irrigation at different stages of growth. The apparent variation between the treatments and among the years might be due to other associated factors responsible for growth.

Yield of grain increased dramatically over the control due to irrigation (Tab. II). Obviously all the irrigation treatments produced significant increase in yield over the nonirrigated treatment. Maximum yield (4250.3 kg/ha) in 1979 was obtained when irrigated at crown root, booting and hard dough stages. However, in 1980 and 1981 cropping years, highest yields were recorded in the plot receiving irrigation at four different stages of growth and the values were 2892.1 and 2859.9 kg/ha respectively. Demonstration results show that yield of grain was about 1.5 times higher in 1979 than those of the later two years. This increase might be attributed to the enrichment

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Table 1. Effect of irrigation at different growth stages on the various growth parameters of sonalica wheat

Treatments (Stages of irrigation)	Height (cm/plant)		panicle length (cm)		Grains/panicle		Days of 85% maturity					
	1979	1980	1979	1980	1979	1980	1979	1980				
Crown root	100.3	90.2	101.6	10.2	8.9	9.5	42	37	35	116	111	110
Booting	98.4	83.2	96.5	9.5	9.5	8.9	40	36	37	116	109	110
Soft dough	92.1	81.3	99.1	8.9	9.5	8.3	36	35	37	114	106	110
Hard dough	91.4	85.7	99.1	8.3	8.9	8.9	36	36	36	114	108	112
Crown root + Booting	101.0	90.8	101.6	9.5	9.5	9.5	38	39	35	115	110	110
Crown root + Soft dough	100.3	87.0	102.2	8.9	9.5	8.9	38	35	37	116	111	110
Crown root + Hard dough	94.6	87.0	103.5	8.3	8.9	8.9	35	35	37	116	111	112
Booting + Soft dough	98.4	81.9	99.7	10.2	9.5	9.5	39	37	37	116	109	110
Booting + Hard dough	94.0	81.9	98.4	9.3	9.5	8.9	38	37	37	116	109	112
Soft dough + Hard dough	91.4	90.2	99.7	8.9	8.9	8.9	36	39	34	116	108	112
Crown root + Soft dough + Hard dough	100.3	86.4	101.0	9.5	8.9	9.5	38	37	35	116	111	112
Crown root + Booting + Soft dough	101.0	87.0	100.8	9.5	8.9	8.9	38	37	37	116	110	112
Crown root + Booting + Hard dough	100.3	89.3	98.4	9.5	8.1	8.9	40	36	37	116	110	112
Booting + Soft dough + Hard dough	98.4	85.1	98.4	9.5	8.9	9.5	39	33	34	116	109	112
Crown root+Booting+Soft dough+Hard dough	99.1	85.1	99.1	9.5	8.9	8.9	40	39	33	116	110	112
Control (No irrigation)	85.0	81.2	96.7	7.1	9.5	8.9	32	35	33	113	108	110
L S D at 5% level	1.21	1.01	1.14	0.52	NS	NS	0.33	0.25	0.13	NS	NS	NS

Table II. Effect of irrigation at different growth stages on grain yield of sonalica wheat.

Treatments (Stages of irrigation)	Yield of grain (kg/ha)			
	1979	1980	1981	Average
Crown root	3694.7	2499.8	2653.2	2949.2
Booting	3638.7	2416.3	2582.5	2879.2
Soft dough	2753.5	2250.1	2330.9	2444.8
Hard dough	2889.3	2333.6	2222.5	2481.8
crown root + Booting	4222.8	2884.7	2817.6	3308.4
Crown root + Soft dough	2824.5	2769.9	2742.3	2778.9
Crown root + Hard dough	4139.2	2734.0	2773.6	3215.6
Booting + Soft dough	3638.7	2408.0	2617.4	2838.0
Booting + Hard dough	3667.2	2571.5	2617.4	2952.0
Soft dough + Hard dough	2945.3	2207.9	2526.5	2559.9
Crown root + Soft dough + Hard dough	4000.5	2582.5	2833.3	3138.8
Crown root + Booting + Soft dough	4083.2	2728.5	2790.9	3200.9
Crown root + Booting + Hard dough	4250.3	2749.7	2817.7	3272.6
Booting + Soft dough + Hard dough	3883.4	2405.3	2667.1	2986.9
Crown root + Booting + Soft dough + Hard dough	4222.7	2892.1	2859.9	3324.9
Control (No irrigation)	2804.1	2250.1	2249.2	2101.1
L S D at 5% level	23.2	19.4	14.6	

of the soil with organic matter from pre-green manuring. This is quite possible that green manuring could undoubtedly improve the physical and chemical conditions of the soil which, in turn, gave positive effect on yield. Moreover, sowing of seeds in optimum time (15-30th November) during 1979 might produced better yield since time of sowing is the vital factor for wheat production. Late sowing (10th Dec. 1980 and 25th Dec. 1981) in the subsequent years might be associated with lower yield of grain. Furthermore, wheat grown in the month of November (optimum time) benefited from sufficient residual moisture as compared to that grown during December. Yield pattern due to various treatments remained almost similar during every cropping year.

The result further clearly demonstrates that application of irrigation either at crown root or booting stage could be improved more promisingly provided irrigation is supplied in both the stages of growth. This indicates that application of irrigation during crown root and booting stages is crucial for wheat as far as grain yield is concerned. Irrigation at crown root stage possibly promoted growth and that at booting stage favoured the full formation of inflorescence and prevented drying up of some of the flowers. Denmead and Show¹ observed that supply of water at booting stage causes better formation of inflorescence and thereby yield.

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