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Evaluation of Irrigation Schedules and Varieties onWheat (*Triticum aestivum* L.) Crop under Late Sown Condition in Eastern Uttar Pradesh

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Abstract A field experiment was conducted during *rabi* seasons of 2013-14 and 2014-15 to find out the effect of irrigation schedules for suitable variety of wheat (*Triticum aestivum* L. emend. Fiori and Paol.) under late sown conditions of eastern Uttar Pradesh. The 5 irrigation schedules (CRI, CRI + Booting, CRI + Tillering + Booting, CRI + Tillering + Booting + Milking and CRI + Tillering + Jointing +Flowering + Milking) and 4 wheat varieties (HUW 234, Kundan, HUW 510 and PBW 373) were tested in a field experiment at BHU, Varanasi. Irrigation schedules at CRI + Tillering + Jointing + Flowering + Milking recorded maximum plant height (89.0 cm), number of tillers/m^2 (367.1), LAI (4.09), dry matter/m^2 (964.5 g), number of grain/spike (33.0) test weight (40.4 g), grain yield (2.769 t/ha), straw yield (3.695 t/ha), nitrogen uptake by grain (55.0 kg/ha), phosphorus uptake by grain (12.3 kg/ha), potassium uptake by grain (13.6 kg/ha), nitrogen uptake by straw (22.9 kg/ha), phosphorus uptake by straw (3.3 kg/ha), potassium uptake by straw (107.2 kg/ha), net return (Rs 29,624) and BCR (1.08). Varieties trend in grain yield ranged from 2.435 to 2.713 t/ha in the order of HUW 510>HUW 234>PBW 373>Kundan. Variety HUW 510 recorded highest grain yield which is 11.42, 4.38 and 3.23% more over Kundan, PBW 373 and HUM 234, respectively. Growth, yield component, nutrient uptake and economics of different varieties followed the similar trends of grain yield.

Keywords Irrigation schedule, Growth, Yield attributes, Economics, Wheat varieties.

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Introduction

Wheat (*Triticum aestivum* L.) is one of the most important stable food grain crop cultivated in at least

43 countries and provides 20% of food calories to the mankind, covering 244 million hectares area and producing 717 million tones with an average productivity of 3.08 t/ha in the world. Wheat is second most important food grain crop and contributes one third of the total food grain production of India. That is associated with the food security of our country.

Though climatic conditions of eastern Uttar Pradesh are optimum for wheat cultivation. Generally, wheat sown after harvesting of rice crop or sugarcane therefore, delay of sowing wheat crop owing to low productivity in eastern Uttar Pradesh. Irrigation is one of the major input to production of wheat crop. The irrigation scheduling is the process of determining when to irrigate and how much irrigate water to apply per irrigation. Proper irrigation scheduling is essential for the efficient use of water, economic, energy and other production inputs. Three major considerations influencing irrigation schedule are : (a) water need of crop; (b) availability of water for irrigation and (c) capacity of the root zone to store water. The objective of this study was to evaluate the effect of irrigation schedules on growth, yield attributes, yield and nutrient uptake by wheat crop.

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Materials and Methods

A field experiment was conducted in two consecutive *rabi* seasons of 2013-14 and 2014-15 at Agriculture Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. The farm is situated at latitude 25°18'N, longitude 83°03'E and altitude 76 meters above mean sea level. Soil of the experimental field was sandy clay loam in texture with pH 7.6 having moderate fertility i.e. low in organic carbon (0.36%) and available N (185.0 kg/ha), medium in available P_2O_5 (20.02 kg/ha) and K_2O (225.80 kg/ha). The experiment was laid out in split -plot design replicated thrice (Gomez and Gomez 1984) with 5 irrigation schedules viz. I_1 (Crown root initiation, CRI), I_2 (CRI + Booting), I_3 (CRI + Tillering + Booting), I_4 (CRI + Tillering + Booting + Milking) and I_5 (CRI + Tillering + Jointing +Flowering + Milking) in main plots and 4 varieties viz., V_1 (HUW 234), V_2 (Kundan), V_3 (HUW 510) and V_4 (PBW 373) in sub plots; 120 kg/ha seed was sown with row to row distance 22.5 cm on 09 and 12 December during first and second year. The crop received 141.3 and 76.8 mm rainfall during the crop period in first and second year, respectively. Fertilizers were applied as per recommendations (120-60-60 kg NPK/ha). DAP, urea and muriate of potash were taken as fertilizer sources for N, P and K respectively. Full dose of P and K and half dose of N were applied as basal about 5 cm below the seed. Remaining half dose of nitrogen was top dressed at first irrigation. Irrigation was applied as per irrigation schedules. The mature wheat crop was harvested both years. The nutrient uptake by the crops was obtained as product of nutrient concentration and yield. Two years data was mean and statistically analyzed.

Results and Discussion

Yield and yield atributes of wheat crop were affected significantly due to irrigation schedules and varieties (Table 1). Significant increase in plant height, leaf number/meter^2, number of tiller/meter^2, LAI and dry matter accumulation with I_5 irrigation schedule over I_1 irrigation schedule and I_2 irrigation schedule but the same was found to be at par with I_3 irrigation schedule, I_4 irrigation schedule. This has been resulted because of adequate availability of soil moissture therefore enhanced nutrient availability to wheat crop. Moreover, irrigation I_3 irrigation schedule was not significantly superior over I_2 and I_1 irrigation schedules. However, both the levels (I_4 and I_5) were found significantly better than I_1 and I_2 during the both years. This might be attributed to the fact that avail soil moisture at all the stages of growth while I_1 and I_2 irrigation schedule suffers most due to moisture stress. Singh et al. (2009) have recorded significantly higher yield attributes and yield and straw of wheat crop with applied 4 irrigation schedule. LAI is a good indicator of the overall health conditions of the crop which is yield contributing characters of wheat

Table 1. Effect of irrigation schedules and wheat varieties on growth, yield attributes and yield (mean data of 2 years). CR=Crown root initiation, Tl = Tillering, Jt =Jointing, Bt = Booting, Fw = Flowering, Mk=Milking.

Treatments	Plant height (cm)	Number of tiller /m^2	Maxi-mum LAI	Dry matter accu-mulation (g/m^2)	Number of gains /spike	Test weight (g)	Gram yield (t/ha	Straw yield (t/ha)	Harvest index
Irrigation schedule									
CR	75.8	273.8	3.48	631.3	24.7	33.1	2.342	3.147	37.0
CR + Bt	80.6	311.8	3.62	755.9	27.0	36.2	2.547	3.347	39.2
CR + T l + Bt	83.5	337.0	3.80	913.4	28.2	37.2	2.612	3.463	40.7
CR + Tl + Bt + Mk	85.7	349.3	3.98	939.7	29.9	38.6	2.702	3.625	40.9
CR + Tl + Jt + Fw + Mk	89.0	367.1	4.09	964.5	31.0	40.4	2.769	3.695	40.3
SEm ±	2.2	8.2	0.10	19.8	0.7	0.9	0.066	0.089	1.0
CD (p = 0.05)	7.0	36.6	0.33	64.6	2.7	3.1	0.218	0.292	2.3
Varieties									
HUW 234	80.9	312.5	3.65	786.3	25.8	36.1	2628	3400	39.6
Kundan	76.2	284.6	3.39	727.8	26.6	35.4	2435	3277	39.7
HUW 510	91.1	348.8	4.03	935.2	28.3	37.3	2713	3653	39.3
PBW 373	82.1	364.9	3.71	915.0	27.1	36.2	2599	3491	39.1
SEm ±	1.4	5.2	0.06	13.2	0.4	0.6	42.0	55.6	0.6
CD (p=0.05)	3.9	18.1	0.18	38.1	1.3	NS	121.4	160.6	1.3

crop were influenced significantly by the irrigation schedules (Table 1) . Significantly superior values of yield and yield contributing characters i.e. spike length (cm), no.of grains/spike, test weight, grain yield and straw yield were recorded with the I_5 irrigation schedule but found to be at par with irrigation applied critical growth stages by I_4 irrigation schedule and which also registered higher values of above characters over I_2 and I_1 irrigation schedules in both the years (Kumar et al.2015). Straw yield was also significantly increased with increse in the proportion of irrigation number and being highest in I_5 irrigation schedule which was significantly higher over I_1 and I_2. Harvest index ratio increased with increasing irrigation number but higherst harvest index was recorded with I_4 irrigation schedule followed by I_5, I_3, I_2 and I_1 irrigation schedules but did not reach at the level of significance during both the years. Among cultivar, significantly superior values of yield and yield and yield contributing characters i.e. spike length (cm), no. of grains/spike, test weight, grain yield and straw yield were recorded with HUW 510 followed by HUW 234, PBW 373 and Kundan (Patel et al. 2012).

Nutrient uptake by wheat crop (grain yield + straw yield) were affected significantly due to irrigation schedules and varieties (Table 2). Total N, P and K uptake by wheat crop increased significantly with increasing irrigation number and maximum nutrient uptake by I_5 irrigation schedules. With increasing in the number of irrigation indeed, assured the availability of the nutrients to the crop in adequate amount. Hence, Proper and affluent nutrition of wheat crop increased production, produced healthy and more vigorus plants resulted higher wheat grain yield and straw yield and increased uptake of nutrients (N, P and K). It was also true to the findings of (Kumar et al. 2015) in which higher uptake and greater content of N, P and K in grain yield and straw.

Total N, P and K uptake were influenced significantly by the variety (Table 2). Significantly higher values of nutrient uptake i.e. N, P and K were recorded with cultivar HUW 510. It seems that recommended dose application of fertilizers could not utilized by I_1 and I_2 irrigation schedules at critical growth stages of irrigation wheat crop because of stress of soil moisture to dissolve nutrients to release pattern that caused inferior growth, grain yield and straw yield and resulted lower uptake of N, P and K.

The successive increase in the schedules of irrigation caused an increased in cost of cultivation, net return and Benefit : Cost ratio up to the maximum

Table 2. Effect of irrigation schedules and wheat cultivars on nutrient uptake in grain yield, straw yield and economics (mean data of 2 years). CR = Crown root initiation, Tl = Tillering, Jt = Jointing , Bt = Booting, Fw = Flowering, Mk = Milking.

Treatments	Nutrient uptake in grain (kg/ha)			Nutrient uptake in straw (kg/ha)			Economics		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	Cost of cultivation (Rs)	Net return (Rs)	BCR
Irrigation schedules									
CR	33.3	7.9	8.6	14.5	2.6	82.1	27393	18973	0.80
CR + Bt	39.8	9.3	10.4	15.5	2.8	88.2	28013	24122	0.97
CR + Tl + Bt	46.1	10.5	11.7	16.9	2.9	92.1	28740	27060	1.05
CR + Tl + Bt + Mk	51.0	11.6	12.7	20.3	3.0	99.3	29391	28546	1.07
CR + Tl + Jt + Fw + Mk	55.0	12.3	13.6	22.9	3.3	107.2	30133	29624	1.08
SEm ±	2.0	0.5	0.5	0.5	0.1	2.7	0.00	952.3	0.03
CD (p=0.05)	4.4	1.0	1.1	1.1	0.2	6.1	0.00	2111.9	0.11
Varieties									
HUW 234	43.0	10.0	11.1	17.1	2.9	91.2	28405	25343.9	0.99
Kundan	40.7	9.4	10.4	15.7	2.7	86.3	28416	22788.0	0.90
HUW 510	44.2	10.1	11.2	17.8	2.9	93.6	28405	25916.3	1.01
PBW 373	42.2	9.7	10.8	16.7	2.8	90.6	28310	24653.0	0.97
SEm ±	1.3	0.3	0.3	0.4	0.1	2.3	0.00	753.3	0.03
CD (p=0.05)	2.6	0.6	0.7	0.8	0.1	4.6	0.00	1479.4	0.08

irrigation schedules of I_5 irrigation schedule during both the years (Table2). The maximum cost of cultivation Rs 30,133 with I_5 followed by Rs 29,391 with I_4, Rs 28,740 with I_3 Rs 28,013 with I_2 and lowest Rs 27,393 with I_1 were observed. The net return and mean : B : C ratio was Rs 32,536 and 1.08 with I_5 followed by Rs 31,448 and 1.07 with I_4 Rs 30,056 and 1.05 with I_3 Rs 27,032 and 0.97 with I_2 and lowest with Rs 21,875 and 0.80 with I_1, respectively. Significantly higher yield of grain yield and straw yield were obtained at maximum irrigation schedules I_5 irrigation schedule always determined greater values of these important parameter of economics i.e. cost of cultivation, net return and benefit cost ratio. Among cultivar, HUW 510 gave significantly highest gross return, net return and Benefit : Cost ratio with I_5 and I_4 irrigation treatments. Similar effect of irrigation schedules on economics of wheat crop has been reported by Kumar et al . (2015), Meena et al. (2015) and Reddy and Reddy (2010).

Conclusion

Significantly higher yield of grain and straw were obtained at I_5 irrigation schedules at (CRI + Tilering + Jointing + Flowering + Milking) in comparison, I_2 and I_1 irrigation schdules but at par with I_4 and I_3 irrigation schedules. However, where water scarcity, there I_4 and I_3 irrigation schedules also suitable for production. Among cultivars, HUW 510 was superior. Farmers may adopt I_3 irrigation schedule with variety HUW 510 for maximum production in limited condition of water under late sown condition in eastern Uttar Pradesh.

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