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Effect of moisture regimes and sowing methods on yield, economics and nutrient uptake by grain and straw of timely and late sown cultivar of wheat (*Triticum aestivum* L.)

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Abstract
The field experiment was conduct, at Agronomy Research farm, Acharya Narendra Dev University of Agriculture and Technology, Kumarganj, Ayodhya, (U.P.) during Rabi season of two combined year of 2017-18 and 2018-19 with an objective of to find out the suitable wheat two cultivars with moisture regime and different sowing method system. Eighteen treatment combination consisted of two wheat variety (PBW-343 and HUW-234) and three moisture regimes (irrigation at 0.8 IW/CPE, 1.0 IW/CPE ratio and irrigation at CRI late jointing and flowering stage allotted in main plots and three sowing methods system (Broad casting, seed drill and FRIB) in sub-plots. The experiment was conducted in split plot design (SPD) with 3 replication on silty loam soil having low organic carbon (0.33% and 0.32%) and available nitrogen (137.60 kg ha^{-1} and 136.82 kg ha^{-1}) medium in phosphorus (15.20 kg ha^{-1} and 14.70 kg ha^{-1}) and available potassium (249.30 kg ha^{-1} and 248.32 kg ha^{-1}) and soil pH is high (8.30 and 8.20). The crop was show on November 25 in the first and second both years, respectively using a seed rate of 125 kg ha^{-1} with row sowing of 22.5 (cm) apart. The crop was harvest on April 17 and April 19 during 2018 and 2019 respectively. The biological yield with harvest index were found significantly high with variety PBW-343along with moisture regime 1.0 IW/CPE and wheat sown by FIRB (Furrow irrigation raised bed) method over rest of the treatments during both year. The highest gross income (₹ 125203.80 and 134785.75 ha^{-1}), net return (₹ 91728.80 and 98485.75 ha^{-1}) and benefit: cost ratio (2.74 and 2.71 $₹^{-1}$ invested) was obtained with the PBW-343 and Irrigation at 1.0 IW/CPE ratio along with furrow irrigated raised bed method during 2017-18 and 2018-19, respectively.

Keywords: Nutrient uptake, economic, yield, moisture regimes, sowing method, wheat

Introduction
Wheat (*Triticum aestivum* L.) belongs to family poaceae. India is second largest producer of wheat after China with an area of 30.00 mha with a production of 98.51 mt and productivity of 3200.00 kg ha^{-1} covering 12 per-cent of world production (Anonymous, 2017-2018) [2-3]. The large area occupied by PBW-343 is a major concern and other varieties need to be popularized for better production and profitability. In late sown varieties of wheat, all the growth stages, such as tillering, flowering, and grain filling, are adversely affected by the shortened growing period. As per result, it affects two important yield parameters, *i.e*., the number of grains per spike and grain weight (Ugarte *et al.*, 2007) [26]. It is mostly due to shorter growth period available to late sown wheat coupled with high temperature and hot winds during reproductive growth period, which leads to forced maturity and ultimately poor grain yield. In FIRB planting system, generally, two to three rows of wheat are planted on the top of bed 70 cm wide and irrigation is done through furrows. It has been reported that wheat crop under FIRB system produced higher grain yield compared to conventional sowing. Besides yield advantage, no lodging was observed in any of the varieties. It also provides an opportunity of mechanical weeding in furrows and on the top of beds (Anonymous, 1996) [2-3]. Water is a precious and scare input plays a vital role in assured crop production since it is essential for the maintenance to turgidity, absorption of nutrients and the metabolic process of the plants.

Therefore, it becomes imperative to develop an optimum irrigation schedule to maintain the sufficient available soil moisture throughout the crop period for best exploitation of crop yield potential. Among the several recognized criteria of irrigation scheduling, climatologically approach is very scientific and widely accepted among the scientists and research workers throughout the world. It is well known that evapotranspiration by a full crop cover is closely associated with the evaporation from an open pan (Dastane, 1972) [8]. Parihar *et al.,* (1976) [19, 20] suggested a relatively more practical meteorological approach of IW/CPE which is a ratio between fixed amount of irrigation water and cumulative pan evaporation minus rains. This IW/CPE approach merits on account of its simplicity of operation and high water use efficiency. Therefore, the climatologically approach of scheduling irrigation by evaluating different IW/CPE ratios in wheat crop has been proposed in this study. It is estimated that even after achieving the full irrigation potential, nearly 50% of the total cultivated area will remain rainfed (Anonymous, 2020) [2-3]. Irrigation increases the availability of water and nutrients through the establishment of relatively favorable moisture conditions around root zone of the crop (Zhelev, 1975) [27]. However, the research work done on irrigation scheduling of wheat crop raised under different methods of sowing is very negligible, hence there is need to work out irrigation requirement of wheat crop. In generally 4-5 irrigation are recommended which may be increased up to 5-6 irrigation depending upon the climatic conditions as well as underground water table and productivity of wheat under late sowing condition is very low because of a cut in the growing time and delayed emergence of seedlings due to prevailing low temperature and forced maturity due to high temperature and hot desiccating wind during grain filling stage (Sardana *et al*., 2005). It must achieve the water economy such that the demand of climate is balanced by the supply, available to it. Since water is very scare and costly input, so it must be used very judiciously by adopting an appropriate technique *i.e.* IW/CPE ratio or critical stages and plating system. It is highest water use efficiency (WUE) 11.3 kg/ha mm (Limon *et al.,* 2000) [14].

Materials and Methods

The present study was conducted at Agronomy Research Farm of Acharya Narendra Deva University of Agriculture & Technology, Ayodhya (Uttar Pradesh) during *Rabi* season of two consecutive years of 2017-18 to 2018-19. Geographically, experimental site falls under the sub-tropical climate of Indo-Gangatic alluvial plains zone (IGP) having alluvial calcareous soil and located at 26º47' N latitude and 82º12' E longitude with an altitude of 113 m above the mean sea level. The total average rainfall received during crop season was 1.0 mm and 71.5 mm during 2017-18 and 2018-19, respectively. The weekly mean minimum temperature ranged from 4.7 to 21.8^{0}C an average of 13.2^{0}C during 2017-18 and 3.5^{0}C to 24.1^{0}C with an average of 18.8^{0}C during 2018-19. A relative humidity average of 64.4 and 64.3 percent during 2017-18 and 2018-19. The soil of the field may be classified as silty loam in texture. The soil was slightly alkaline in reaction, low in organic carbon (0.33 and 0.32), available nitrogen (137.60 and 136.82 kg ha^{-1}), medium available phosphorus (15.20 and 14.70 kg ha^{-1}), available potassium (249.30 and 248.32 kg ha^{-1}) and medium in fertility during 2017-18 and 2018-19. The experiment was constituted with 18 treatment combinations involving two varieties (PBW-343 and HUW-234) and three moisture regimes (Irrigation at 0.8 IW/CPE ratio, 1.0 IW/CPE ratio and irrigation at CRI, late jointing & flowering stage) in main plots and three sowing methods (Broad casting, seed drill and furrow irrigated raised bed) in sub-plots was laid out in split plot design (SPD) with three replications. The experiment was constituted with 18 treatment combinations involving two varieties (PBW-343 and HUW-234) and three moisture regimes (Irrigation at 0.8 IW/CPE ratio, 1.0 IW/CPE ratio and irrigation at CRI, late jointing & flowering stage) in main plots and three sowing methods (Broad casting, seed drill and furrow irrigated raised bed) in sub-plots was laid out in split plot design (SPD) with three replications. A plot size is 3.6 x 5 (m) and size of ridge 0.5 (m) were made between replication and individual plots to check the out flow of nutrient and reduce the border effect. Varieties PBW-343 and HUW-234 was sown at row spacing 22.5 (cm) with line sowing of seed. The techniques used for recording observations on yield (grain, straw and harvest index), nutrient uptake and economic (gross return, net return and B: C ratio).

Results and Discussion

Grain and straw yield was significantly influenced by different varieties. The highest Grain and straw yield was obtained in cultivar of PBW-343 followed by HUW-234 (Table-1). Minimum Grain and straw yield were recorded with cultivar of HUW-234. This might be due to less number of spike bearing tillers, small length of spike and less number of grains spike^{-1} and poor grain development. Similar findings were obtained by Shirpurkar *et al.* (2008) and Pandey *et al.* (2017) [17, 18] and Bachhao *et al.* (2018) [6], Patel *et al*. (2018) [21]. Grain and straw yield was influenced significantly by different moisture regimes (Table-1). Highest grain yield was recorded under 1.0 IW/CPE ratio. Similar finding were reported by Atikullah *et al*. (2014) [5], Ahmad *et al.* (2016) [1], Chauhan *et al.* (2017), Kumar *et al.* (2017) [7, 11-13, 15, 18], Sharma *et al.* (2018). The maximum yield was recorded under furrow irrigated raised bed method than broad casting. Therefore was more suited for furrow irrigated raised bed planting system than broad casting. Similar findings were reported by Jai (2012), Kumar *et al.* (2013) [7, 11-13, 15, 18], Singh and Kaur (2019) [7, 16, 18, 23, 25]. Harvest index speaks the conversion efficiency of dry matter to grain portion. All the moisture regimes and sowing methods on late and timely sown varieties of wheat did not differ significantly on harvest index. Highest harvest index were noticed under PBW-343 and lowest in HUW-234 (Table-1). Similar finding were reported by Mohan *et al.* (2018).

Table 1: Effect on yield of moisture regimes, sowing methods and timely and late sown cultivar of wheat

Treatments	Grain yield (q ha^{-1})		Straw yield (q ha^{-1})		Harvest index (%)	
	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19
(A) Varieties						
(i) PBW-343	43.32	44.18	59.26	59.41	42.23	42.64
(ii) HUW-234	37.91	38.67	52.77	52.91	41.80	42.22
S.Em +	0.76	0.64	0.86	0.86	0.618	0.624
CD at 5%	2.28	1.91	2.58	2.58	NS	NS
(B) Moisture regimes						

(i) Irrigation at 0.8 IW/CPE ratio	40.71	41.53	56.03	56.18	42.07	42.50
(ii) Irrigation at 1.0 IW/CPE ratio	43.92	44.80	59.98	60.13	42.27	42.69
(iii) Irrigation at CRI, late jointing & flowering stage	37.22	37.96	52.03	52.17	41.70	42.11
S.Em +	0.93	0.78	0.86	1.05	0.618	0.536
CD at 5%	2.80	2.34	2.58	3.16	NS	NS
(C) Sowing methods						
(i) Broad casting	36.60	37.11	51.00	51.14	41.78	41.94
(ii) Seed drill	42.00	42.84	57.80	57.95	42.07	42.50
(iii) FIRB	43.24	44.10	59.24	59.39	42.19	42.60
S.Em +	0.49	0.78	0.80	0.81	0.531	0.536
CD at 5%	1.41	2.34	2.30	2.31	NS	NS

The N, P and K, which resulted in maximum yield and ultimately higher nutrient uptake by timely and late variety of wheat (Table-2). The maximum recorded N, P and K uptake by grain and straw under variety of PBW-343 and minimum recorded was HUW-234. Similar result was also reported by Parihar and Tiwari (2003) [19, 20]. NPK uptake by grain and straw were influenced significantly due to different moisture regimes. The maximum NPK uptake by grains, straw and total uptake were recorded under moisture regimes 1.0 IW/CPE ratio over 0.8 IW/CPE ratio and irrigation at CRI, late jointing and flowering stage. Similar result was also reported by Singh *et al.* (2012) [7, 16, 18, 23, 25]. The maximum NPK uptake by grain and straw was recorded under furrow irrigated raised bed method of sowing as compared to broad casting method of sowing. Similar result have been reported by Jain (2012) [10], Hada *et al.* (2013) [9].

Table 2: Effect on N, P and K uptake (kg ha^{-1}) by grain and straw of moisture regimes and sowing methods of timely and late sown varieties of wheat

Treatments	N uptake in grain (kg ha^{-1})		N uptake in straw (kg ha^{-1})		P uptake in grain (kg ha^{-1})		P uptake in straw (kg ha^{-1})		K uptake in grain (kg ha^{-1})		K uptake in straw (kg ha^{-1})	
	2017-18	2017-18	2017-18	2017-18	2017-18	2017-18	2017-18	2017-18	2017-18	2018-19	2017-18	2018-19
(A) Varieties												
(i) PBW-343	73.57	76.29	27.36	28.22	16.46	16.69	6.48	6.49	13.41	13.52	97.19	96.97
(ii) HUW-234	64.56	65.35	24.65	24.90	14.07	14.39	5.72	5.61	11.55	11.87	87.52	86.96
S.Em +	0.528	0.882	0.419	0.273	0.130	0.185	0.057	0.057	0.126	0.168	0.819	0.935
CD at 5%	1.583	2.644	1.257	0.819	0.389	0.553	0.170	0.172	0.377	0.502	2.455	2.804
(B) Moisture regimes												
(i) Irrigation at 0.8 IW/CPE ratio	69.43	70.83	26.40	26.40	15.34	15.40	6.10	6.04	12.52	12.84	92.02	92.09
(ii) Irrigation at 1.0 IW/CPE ratio	74.99	76.80	27.66	28.78	16.61	16.93	6.54	6.50	13.61	13.68	98.67	99.16
(iii) Irrigation at CRI, late jointing & flowering stage	62.77	64.83	23.95	24.50	13.83	14.29	5.66	5.60	11.31	11.58	86.37	84.64
S.Em +	0.528	0.882	0.419	0.273	0.130	0.185	0.057	0.057	0.126	0.168	0.819	0.935
CD at 5%	1.583	2.644	1.257	0.819	0.389	0.553	0.170	0.172	0.377	0.502	2.455	2.804
(C) Sowing methods												
(i) Broad casting	64.38	66.14	24.61	24.77	14.34	14.41	5.77	5.76	11.31	11.93	87.15	86.75
(ii) Seed drill	69.68	71.08	26.12	26.81	15.34	15.73	6.10	6.02	12.52	12.77	93.16	92.59
(iii) FIRB	73.13	75.24	27.29	28.09	16.11	16.48	6.43	6.36	13.61	13.40	96.75	96.55
S.Em +	0.816	0.655	0.194	0.264	0.160	0.130	0.062	0.056	0.113	0.125	1.019	0.932
CD at 5%	2.339	1.878	0.557	0.756	0.460	0.372	0.176	0.162	0.325	0.359	2.922	2.672

The highest value of gross income (₹ 125203.80 and 134785.75 ha^{-1}) was recorded under the combination of PBW-343 and 1.0 IW/CPE ratio along with FIRB method during both years (Table-3). This was mainly due to additional output by additional expenditure made on same combination of treatments. The highest net income (₹ 91728.80 and 98465.75 ha^{-1}) as well as net income per rupee invested (2.74 and 2.71) was obtained under the treatment combination of PBW-343 and 1.0 IW/CPE ratio along with FIRB method (Table-3).This was mainly due to higher yield of grain and straw and comparatively less investment made on moisture regimes. The similar results were reported by Maurya *et al.* (2014) [15], Singh and Kaur (2019) [7, 16, 18, 23, 25].

Table 3: Effect on deferent treatment combinations economics of wheat

Treatments combination	Gross return (□ ha^{-1})		Net return (□ ha^{-1})		Benefit cost ratio (B:C)	
	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19
$V_1I_1S_1$	99453.40	107096.00	66228.40	71246.00	1.99	1.98
$V_1I_1S_2$	112833.60	121478.50	80108.60	86128.50	2.44	2.43
$V_1I_1S_3$	116281.40	125193.75	83806.40	90093.75	2.58	2.56
$V_1I_2S_1$	107305.00	115541.25	73080.00	78491.25	2.13	2.11
$V_1I_2S_2$	121147.80	130429.75	87422.80	93879.75	2.59	2.56
$V_1I_2S_3$	125203.80	134785.75	91728.80	98485.75	2.74	2.71
$V_1I_3S_1$	90613.20	97581.00	59388.20	64131.00	1.90	1.91
$V_1I_3S_2$	104174.00	112183.50	73449.00	79233.50	2.39	2.40
$V_1I_3S_3$	106961.80	115172.75	76486.80	82472.75	2.50	2.52

$V_2I_1S_1$	86874.20	93563.25	53024.20	56963.25	1.56	1.55
$V_2I_1S_2$	99769.40	107423.25	66419.40	71323.25	1.99	1.97
$V_2I_1S_3$	102353.20	110198.00	69253.20	74348.00	2.09	2.07
$V_2I_2S_1$	93779.80	100980.00	58929.80	63180.00	1.69	1.67
$V_2I_2S_2$	107107.60	115321.25	72757.60	78021.25	2.11	2.09
$V_2I_2S_3$	110206.00	118662.50	76106.00	81612.50	2.23	2.20
$V_2I_3S_1$	79046.80	85140.00	47196.80	50940.00	1.48	1.49
$V_2I_3S_2$	92069.40	99159.50	60719.40	65459.50	1.93	1.94
$V_2I_3S_3$	94073.40	101318.25	62973.40	67868.25	2.02	2.03

References

1. Ahmad A. Water use efficiency, consumptive use and soil moisture extraction pattern of wheat as influenced by irrigation schedules and genotypes. Agriculture Update 2016;11(1):12-15.
2. Anonymous. Progress report, resource management. AICWIP, Directorate of Wheat Research, Karnal 1996.
3. Anonymous. The Economics time of Agriculture Report, Production of wheat 2017-2018. http://economictimes.indiatimes.com.
4. Anonymous. Perspective Plan, Directorate of Wheat Research, Karnal, Vision 2020, P36-41.
5. Atikullah MN, Sikder RK, Asif MI, Mehraj H, Jamaluddin AFM. Effect of Irrigation levels on growth, yield attributes and yield of Wheat. Journal Bio-science and Agriculture Research 2014;2(2):83-89.
6. Bachhao KS, Kolekar PT, Nawale SS, Kadlag AD. Response of different wheat varieties to different sowing dates. Journal of Pharmacognosy and Phytochemistry 2018;7(1):2178-2180.
7. Chouhan BS, Kaushik MK, Napelia V, Solanki NS, Singh B, Devra NS, Kumawat P, Kumar A. Effect of sowing methods, scheduling of irrigation based on IW/CPE ratio and chemical weed control on plant height, dry matter accumulation and yield of wheat. Journal of Pharmacognosy and Phytochemistry 2017;6(3):169-172.
8. Dastane NG. A practical manual for water use research in agriculture. Navbharat Prakashans, Poona-4, India 1972.
9. Hada N, Nepalia V, Tomar SS. Influence of balanced nutrition, weed control and sowing methods on yield and nutrient uptake by durum wheat. (*T. Durum* desf.) Annals of Plant and Soil Research 2013;15:19-22.
10. Jain P. Effect of sowing methods, input and varieties levels on growth, yield components, yield and nutrient uptake of durum wheat (*Triticum durum* desf.). Trends in Biosciences 2012;5:22-24.
11. Kumar B, Dhar S, Vyas AK, Paramesh V. Impact of irrigation schedules and nutrient management on growth, yield and root traits of wheat (*Triticum aestivum*) varieties. Indian Journal of Agronomy 2015;60(1):87-91.
12. Kumar M, Yadav A, Mehta AK. Influence of methods of sowing and N management strategies on yield attributes and yield of wheat (*Triticum aestivum* L.*)* Agric. Sci. Digest 2013;33:279-283.
13. Kumar V, Bharose R, Malik K. Effect of different sowing dates and irrigation schedule on yield attributes of wheat varieties under Allahabad conditions. Journal of Pharmacognosy and Phytochemistry 2017;6(5):1379-1382.
14. Limon Ortega A, Sayre KD, Franciss CA. Wheat water and nitrogen use efficiency in bed planting system in north west Maxico. Indian J Agronomy 2000;92(2):303-309.
15. Maurya P, Kumar V, Maurya KK, Kumawat N, Rakesh Kumar R, Yadav MP. Effect of potassium application on growth and yield of wheat varieties, Department of Agronomy, CSAU & T, Kanpur, India 2014;9(4):1371-1373.
16. Narolia RS, Meena H, Singh P, Meena BS, Ram B. Effect of irrigation scheduling and nutrient management on productivity, profitability and nutrient uptake of wheat (*Triticum aestivum*) grown under zero-tilled condition in southeastern Rajasthan. Indian Journal of Agronomy 2016;61(1):53-58.
17. Pandey IB, Paswan S, Sinha NK, Pandey RK. Response of late sown wheat (*Triticum aestivum* L.) varieties to nitrogen levels. Indian J Agrill. Scie 2008;78(6):537-539.
18. Pandey Nareshmani, Kumar Sanjay, Raghuvansi Nikhil, Singh AR. Effect of sulphur nutrient and moisture regimes on economics of wheat (*Triticum aestivum* L.) varieties. Journal of Pharmacognosy and Phytochemistry 2017;6(6):2294-2297.
19. Parihar SS, Tiwari RB. Effect of irrigation and nitrogen levels on yield, nutrients uptake and water use of late-sown wheat. Indian Journal of Agronomy 2003;48:103-107.
20. Parihar SS, Khera KL, Sandhu KS, Sandhu BS. Comparison of irrigation schedule based on pan evaporation and growth stages in wheat. Indian Journal of Agronomy 1976;68:650-653.
21. Patel MD, Dabhi MS, Patel AK, Desai HA, Chatra Ram. Response of Wheat Varieties (*Triticum aestivum* L. and *Triticum durum* Desf.) to Sowing Time. Int. J Curr. Microbiol. App. Sci 2018;7(10):1555-1561.
22. Shirpukar GN, Sonawane PD, Wagh MP, Patil DT. Performance of wheat genotype under restricted irrigation condition. Agricultural Science Digest 2008;28(1):57-58.
23. Singh A, Yadav AS, Verma SK. Productivity, nutrient uptake and water use efficiency of wheat (*Triticum aestivum* L.) under different irrigation levels and fertility sources. Indian Journal of Ecology 2010;37(1):13-17.
24. Singh L, Singh CM, Singh GR. Response of bed planted wheat (*Triticum aestivum* L.) under different moisture regimes on water use and its efficiency. Journal of Chemical and Pharmaceutical Research 2012;4(11):4941-4945.
25. Singh Kuldeep, Kaur Satvir. Effect of different methods of sowing and row orientation on growth, yield and quality of wheat (*Triticum aestivum* L.). Journal of Pharmacognosy and Phytochemistry 2019;8(3):1047-1050.
26. Ugarte C, Calderini DF, Slafer GA. Grain weight and grain number responsiveness to pre-anthesis temperature in wheat, barley and triticale. Field Crops Research 2007;100:240-248.
27. Zhelev R. Characteristics of the root system of wheat as influenced by soil moisture. Rasteniev dni-Nauki 1975;12:27-39.