www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(7): 929-933

www.thepharmajournal.com
Received: 06-02-2022
Accepted: 16-06-2022

Dinesh Patel
M.Sc., Department of Agronomy, Faculty of Agricultural Sciences & Allied Industries, Rama University, Kanpur, Uttar Pradesh, India

Ram Niwas
Assistant Professor, Department of Agronomy, Faculty of Agricultural Sciences & Allied Industries Rama University, Kanpur, Uttar Pradesh, India

AS Yadav
Department of Agronomy, Faculty of Agricultural Sciences & Allied Industries Rama University, Kanpur, Uttar Pradesh, India

Shravan Kumar Maurya
Ph.D., Research Scholar, Department of Agronomy, C.S.A University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

Jitendra Kumar
Department of Horticulture, Faculty of Agricultural Sciences & Allied Industries Rama University, Kanpur, Uttar Pradesh, India

Avinash Singh
M.Sc., Department of Agronomy Faculty of Agricultural Sciences & Allied Industries Rama University, Kanpur, Uttar Pradesh, India

Corresponding Author:
Dinesh Patel
M.Sc., Department of Agronomy, Faculty of Agricultural Sciences & Allied Industries, Rama University, Kanpur, Uttar Pradesh, India

Increasing productivity with profitability through irrigation scheduling and varieties of wheat [*Triticum aestivum* (L.)] crop

Dinesh Patel, Ram Niwas, AS Yadav, Shravan Kumar Maurya, Jitendra Kumar and Avinash Singh

Abstract
An agronomic investigation to study the response of various wheat varieties to different irrigation scheduling treatments through critical growth stage approach was conducted during *Rabi* season of year 2020-21 an agricultural Farm at Rama University, Kanpur 209217 (U.P) India. The experiment was laid out in split plot design with three replications. Four irrigation scheduling treatments [*viz.* I_1- one irrigation at CRI stage, I_2- Two irrigations at CRI & Late jointing stage, I_3- Three irrigations at CRI, Late jointing & Milking stage and I_4- Four irrigations at CRI, Maximum tillering, Late jointing & Milking stage] were allocated to main plots; whereas three wheat varieties (*viz.* HD-2967, K-1006 and HD-3086) were sown in sub plots. Higher growth attributing characters at different crop stages and yield attributing characters at harvest *viz.* plant height, number of tillers, leaf area index, plant dry matter, length of spike, number of spike, number of grains per spike and test weight were produced in wheat variety HD-2967 with irrigating the crop for four irrigations at CRI, maximum tillering, late jointing & milking stage. Similarly, higher grain yield, highest harvest index & Protein (%) along with B: C ratio and crop water use efficiency was recorded in variety HD-2967 with four irrigations at CRI, maximum tillering, late jointing & milking stage as compared to all the other treatments. All these plant growth and yield attributing characters and yield along with net monetary income & B: C ratio and lowest water use efficiency was observed in variety K-1006 under the condition of one irrigation at CRIstage applied in wheat.

Keywords: Irrigation scheduling, growth attribute, variety, wheat and yield

Introduction
Wheat (*Triticum aestivum* L.) is the most important crop among all cereals used as a food grain in the world. It is a staple food for two billion people (36 percent of the world's population) and provides almost 55% of carbohydrates and 20% of calories. It has a high nutritional profile, with an average of 12.2% protein, 1.8% fats, 1.8% ash, 2.0% reducing sugars, and 314 kcal per 100g of food. It ranks first in the world cereal area and production. Globally, wheat covers an area of 220.4 million ha (FAO, 2019) with production of 766.4 million tonnes (FAO, 2019). In India, wheat is cultivated in almost all part of the country and occupied 30.22 million ha (14% of global area) with the production of 99.71 million metric tone, (13.64% of world production) in 2018-19 (USDA/FAS, 2019). Among wheat cultivated states, Uttar Pradesh leads in area (9.65 million ha) and production (26.87 Mt), but productivity (27.86 q ha^{-1}) is significantly lower than Punjab (44.91qha^{-1}) and Haryana (45.74qha^{-1}) (Anonymous, 2019). The demand of wheat in the country by this year (2020) has been anticipated to be between 105-109 million tonnes as against 101.20 million tonnes production of present day. There are many factors responsible for low yield of wheat crop but in adequate irrigation and poor crop nutrition are the most important. Water is required at every stage of development, from seed germination to plant maturity, in order to harvest the maximum yield of wheat. The frequency of irrigation and grain yield have a positive relationship. Irrigation failure during a critical growth stage might result in a significant reduction in grain output due to lower test weight. One of the good agronomic management methods is efficient water management, it not only leads to improve crop productivity but also minimize susceptibility from disease and insect pest under favourable environment for flourishing this biotic stress. Agriculture is the prime user of water resources accounting for about 80% of the total water withdrawal.

Among the different sources of irrigation water, ground water plays a significant role in the India's irrigated farming, which contributes about 68.4 M ha of the net cultivated area. Water is a limited resource which availability is declining with each passing year. In respect of per capita water availability in 2001 was 1820 m^3 per year and it is projected that by 2025, the per capita water availability will further reduce significantly to 1341 m^3 and to1140 m^3 in 2050 (Bhatacharya *et al.* 2015). Going by Falkenmark criteria, most of the Indian states will have touched the water stress condition by 2025 and almost water scarcity condition by 2050.

Irrigation scheduling is one of the important professional activities and it aids the efficient consumption of water by crops. It governs the process to decide when to irrigate, how to irrigate and how much water to apply to crop. It optimizes agricultural production with minimizing yield loss due to water shortage and improving performance and sustainability of any irrigation system through conserving water. Irrigation schedules based on phenological stages (crown root initiation, tillering, booting, anthesis, soft dough and hard dough stage) of wheat varieties has been practical approach to the farmers.

Variety selection is the most important decision for the farmers. There are several varieties developed which are best under late sown condition than normal varieties. For the increasing wheat yield performances in the country over the past few decades, there is need to improve of wheat varieties performance under various management practices which could maximize the economic returns under local growing conditions (Sapkota *et al.* 2007) [18]. The old and degenerated varieties due to their low yield potential and other factors like maturity, shattering habit, poor response to fertilizers and irrigation and susceptibility to insect-pest and diseases have poor productivity as compared to improved varieties of the region (Yamben *et al.* 2020). Selection of improved varieties are important for producer to achieve high crop yield by improving the fertilizer use efficiency and water use efficiency.

Materials and Methods

The field experiment was conducted during *Rabi* season of 2020-2021 at Agricultural Research Farm, of Rama University, Mandhana, Kanpur Nagar (U.P.) which is situated in the alluvial tract of Indo - Gangatic Plain in central part of Uttar Pradesh between $25^0$26′ to $26^0$58' North latitude, $79^0$31′ to $31^0$34' East longitude and on the altitude of 125.9 meters. The irrigation facilities are adequately available on this farm. The farm is situated in the main campus of the university. During the cropping season maximum temperature ranges from 17 to 35.1^{0}C, while the lowest temperature ranges from 6 to 21.7^{0}C. During the cropping period, relative humidity ranged from 24 to 94 percent. During the trial, average wind speeds ranged from 1.3 to 6.3 km hr^{-1}. During the testing period, the trail location got a total of 43.2 mm of rain in one wet day, providing favourable conditions for crop development. The experiment was laid out in split plot design with three replications. Four irrigation scheduling treatments *viz.* I_1- one irrigation at CRI stage, I_2- Two irrigations at CRI & Late jointing stage, I_3- Three irrigations at CRI, Late jointing & Milking stage and I_4- Four irrigations at CRI, Maximum tillering, Late jointing & Milking stage were allocated in main plots; whereas sub plots consisted three varieties *viz.* HD-2967, K-1006 and HD-3086. All plots of experiment was equally fertilized with recommended dose of fertilizers (150:60:40 kg ha^{-1} NPK). The source of nitrogen, phosphorus and potassium were urea, di-ammonium phosphate and murate of potash respectively. The soil of the experimental site was clay loamy in texture, low in organic carbon (0.40%), available nitrogen (166.53 kg ha^{-1}) and medium in available phosphorus (18.73 kg ha^{-1}) and potash (266.27 kg ha^{-1}) with slightly alkaline in reaction (8.2 pH). The wheat variety 'HD-2967, K-1006 and HD-3086' was sown in line at 20 cm row to row distance and seed rate 120.0 kg ha^{-1} was used for sowing of experimental crop and before sowing seed was treated with vitavax @ 2.5 g kg^{-1} of seed. Experimental crop was irrigated as per treatments.

Results and Discussion

Response to irrigation scheduling

The data plant height as affected by irrigation scheduling is presented in (Table. 1). Tallest plants at 60 and 90 DAS and at harvest were recorded with four irrigations at CRI, maximum tillering, late jointing & milking stage over one irrigation at CRI stage in comparison one irrigation at CRI stage. It may be due to the supply of efficient irrigation during critical growth stages. (Ranjita *et al.* 2007) and (Kabir *et al.* 2009) [9]. It have fulfill the presence of enough moisture in the crop root zone, the uptake of different nutrients, and a relative improvement in plant growth characteristics. Similar results have also been reported by (Ingle *et al.* 2007) [8] and (Ali *et al.* 2012) [2]. Similarly, maximum number of effective tillers at harvest 374.33 m^{-2} were found with four irrigations at CRI, maximum tillering, late jointing & milking stage which may be due to sufficient moisture availability. Such effect of irrigation scheduling on number of tillers was also reported earlier by (Aslam *et al.* 2014) [5] and (Nayak *et al.* 2015) [13] Similar reasons might be responsible for higher LAI with four irrigations at CRI, maximum tillering, late jointing & milking stage at 60, 90, 120 DAS in comparison to other treatments and it also has been reported by (Ahmad and Kumar 2015) [1] and (Baloch *et al.* 2014) [5, 6]. The superior vegetative growth and morphological parameters *viz.* plant height, LAI, number of tillers with four irrigations at CRI, maximum tillering, late jointing & milking stage were further reflected into higher plant dry matter accumulation at30, 60 and 90 DAS. It is also reported by many researches (Saren *et al.* 2004) [19], and (Khokar *et al.* 2010).

Increases in growth-related characters eventually showed up in yield-related characters *viz.* Spike length (cm), number of spike m^{-1}, number of grains per spike and seed index (Table. 2); which were recorded higher (9.21cm, 374.44, 43.79 and 42.22g respectively) with application of four irrigations at CRI, maximum tillering, late jointing & milking stage. The benefits of irrigation planning on different yield-contributing traits such as *viz.* Spike length (cm), number of spike m^{-1}, number of grains per spike and seed index and growth characters (plant height, number of tillers, LAI, dry matter accumulation) resulted in Higher grain yield and harvest index (54.46 q ha^{-1} and 42.06% respectively) along with maximum protein content and crop water use efficiency. All these parameters were recorded lowest in treatment I_1- one irrigation at CRI stage; it might be as a result of the intricate interactions between its parts, which are influenced by the growth cycle during vegetative stages and mirrored during productive phases. Different irrigation schedule improved the values of several growth and yield contributing features. Similarly reported by several researchers *viz.*, (Khan Naqvi

2011) [10], (Baloch *et al.* 2014) [5, 6]. Maximum net return (70379 Rsha^{-1}) and benefit cast ratio (1.3) was recorded with four irrigations at CRI, maximum tillering, late jointing & milking stage. Whereas, minimum net return (59440.25 Rsha^{-1}) and benefit cast ratio (1.18) recorded under one irrigation at CRI stage (Table. 3). Net return and benefit cast ratio was more due to higher production grain yield of wheat crop. The effect of irrigation scheduling on economics was also reported by (Kibe and Singh 2003) [11] and (Mekkei *et al.* 2014) [12].

Response to varieties

The effect of varieties on growth attributing characters *viz.*, plant height, number of effective tillers and LAI and dry matter accumulation was significant at all the growth stages of the crop with HD-2967 (Table. 1). It could be as a result of the various morpho-physiological traits of varieties, which are represented in their genetic makeup (Verma *et al.* 2003) [21] and (Kumar *et al*. 2015) [1]. Perusal of data presented in (Table. 2) yield attributing characters *viz.* length of spike (cm), number of spike, number of grains spike^{-1} and test weight; which were recorded higher (9.02 cm, 376.24, 43.03 and 4.62g, respectively) with variety HD-2967 as compared to other variety; It might be due to the better suitability and performance of HD-2967 under specific agro-climate of the region where experiment was conducted. Similar findings have been also reported by (Sachan *et al*. 2019) [16] and (Kumari *et al.* 2014) [4]. Similarly, HD-2967 was recorded significantly higher grain yield (54.23 q ha^{-1}) and harvest index (41.97%) along with protein content and crop water use efficiency as compared to other variety (Table. 3). The positive effect of variety on various yield attributing characters such as *viz*. spike length (cm), number of spike m^{-1}, number of grains per spike and seed index and growth characters (plant height, number of tillers, LAI, dry matter accumulation) resulted in higher wheat yield. Effect of variety on yield have been also reported by (Singh *et al.* 2012) [20]. Increased grain yield of HD-2967 has been further reflected in higher net return (71197.75Rs ha^{-1}), B: C ratio (1.37) as compared to other variety. Similar findings have been also reported by (Sana *et al*., 2014) [17] and (Pyare *et al.* 2015) [14].

Table 1: Effect of irrigation scheduling and varieties on growth attributing characters of wheat.

Treatment	Plant height at harvest	Effective tillers at harvest	Dry matter accumulation at 90 DAS	LAI		
				30 DAS	60 DAS	90 DAS
Irrigation Scheduling						
I_1- One irrigation at CRI stage	71.12	348.04	1012.50	1.49	3.88	4.72
I_2- Two irrigations at CRI & Late jointing stage	75.62	365.51	1028.90	1.50	4.05	4.95
I_3- Three irrigations at CRI, Late jointing & Milking stage	85.30	372.22	1030.80	1.51	4.15	5.01
I_4- Four irrigations at CRI, Maximum tillering, Late jointing & Milking stage	90.82	374.33	1044.70	1.48	4.48	5.10
SE ±	1.31	4.39	9.36	0.02	0.07	0.10
CD (at 5%)	3.94	13.16	28.14	NS	0.18	0.22
Variety						
V_1-HD-2967	86.44	372.86	1050.5	1.52	4.22	5.08
V_2-K-1006	75.12	359.74	1014.6	1.47	4.07	4.84
V_3-HD-3086	80.62	362.49	1022.5	1.49	4.14	4.90
SE ±	1.25	4.23	9.12	0.2	0.6	5.08
CD (at 5%)	3.78	12.68	27.36	NS	NS	0.21
Interaction effect (I × V)	NS	NS	NS	NS	NS	NS

Table 2: Effect of irrigation scheduling and varieties on yield attributing characters, quality and crop water use efficiency of wheat.

Treatment	Length of spike (cm)	No. of spike (m^{-2})	No. of grains Spike^{-1}	Test weight (g)	Protein content (%) in grain	Crop water use efficiency (kgha^{-1} mm^{-1})
Irrigation Scheduling						
I_1- One irrigation at CRI stage	7.22	346.27	38.82	38.89	10.05	12.81
I_2- Two irrigations at CRI & Late jointing stage	8.88	365.73	41.18	40.36	10.23	14.22
I_3- Three irrigations at CRI, Late jointing & Milking stage	9.04	372.40	42.27	41.78	10.24	14.45
I_4- Four irrigations at CRI, Maximum tillering, Late jointing & Milking stage	9.21	374.44	43.79	42.22	10.26	15.09
SE ±	0.14	4.43	0.45	0.71	0.24	0.41
CD (at 5%)	0.41	13.24	1.24	2.23	NS	1.23
Variety						
V_1-HD-2967	9.02	376.24	43.03	42.33	10.29	15.03
V_2-K-1006	8.26	353.82	40.29	40.00	10.12	13.35
V_3-HD-3086	8.48	364.09	41.26	40.12	10.16	14.00
SE ±	0.13	4.50	0.41	0.74	0.23	0.42
CD (at 5%)	0.40	13.52	1.25	2.22	NS	1.25
Interaction effect (I × V)	NS	NS	NS	NS	NS	NS

Table 2: Effect of irrigation scheduling and varieties on yield, and economics of wheat.

Treatment	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest index (%)	Net return (Rs. ha^{-1})	B:C ratio
Irrigation Scheduling						
I_1- One irrigation at CRI stage	46.21	82.78	128.99	35.82	59440.25	1.18
I_2- Two irrigations at CRI & Late jointing stage	51.31	80.97	132.28	38.79	67805.25	1.32
I_3- Three irrigations at CRI, Late jointing & Milking stage	52.12	80.29	132.41	39.36	68194.5	1.31
I_4- Four irrigations at CRI, Maximum tillering, Late jointing & Milking stage	54.46	75.01	129.47	42.06	70379	1.32
SE ±	1.28	1.61	2.64	-	-	-
CD (at 5%)	3.86	4.83	NS	-	-	-
Variety						
V_1-HD-2967	54.23	74.98	129.21	41.97	71197.75	1.37
V_2-K-1006	48.16	83.41	131.57	36.60	62313.5	1.22
V_3-HD-3086	50.53	80.96	131.49	38.43	65570.25	1.26
SE ±	1.34	1.61	2.61	-	-	-
CD (at 5%)	4.02	4.86	NS	-	-	-
Interaction effect (I × V)	NS	NS	NS	-	-	-

Conclusion

It can be concluded from the present investigation that irrigation scheduling practice with four irrigations at CRI, maximum tillering, late jointing & milking stage increases the growth & yield attributes and yield of wheat. Similarly wheat variety HD-2967 shows better performance in terms of growth and yield as compared to variety K-1006 and HD-3086. Four irrigations at CRI, maximum tillering, late jointing & milking stage and variety HD-2967 are increases protein (%), crop water use efficiency, net monetary income and B: C ratio in wheat crop.

References

1. Ahmad A, Kumar R. Effect of irrigation scheduling on the growth and yield of wheat genotypes. Agricultural Science Digest. 2015;35(3):199-202.
2. Ali BT, Hwary E, Yagoub OS. Effect of different irrigation intervals on wheat (*Triticum aestivum* L.) in semiarid regions of Sudan. Journal of Science and Technology. 2012;12(3):75-83.
3. Anonymous Annual report, Department of Agricultural Cooperation & Farmer Welfare, 2019.
4. Kumari A, Sairaqm RK, Santosh Kumar Singh, Krishna AK. Early growth response: an indicator of subsequent growth and yield of wheat genotypes grown under simulated water stress condition. Indian Journal of Plant Physiology. 2014;19(2):94-100.
5. Aslam H, Ansari MA, Baloch SK, Baloch SU, Baloch AS. Effect of irrigation scheduling on the growth and harvest index of wheat (*Triticum aestivum* L.) varieties. Persian Gulf Crop Protection. 2014;3(2):15-29.
6. Baloch SU, Li-jun L, Muhammad NK, Shah F, Salih AL, Baloch SK, Shabeer AB. Effect of different irrigation schedules on the growth and yield performance of wheat (*Triticum aestivum* L.) varieties assessment in district Awaran (Balochistan). Journal of Biology, Agriculture and Healthcare. 2014;4(20):2224-3208.
7. Bhattacharyya R, Das TK, Sudhishri S, Dudwal B, Sharma AR, Bhatia A, Singh G. Conservation agriculture effects on soil organic carbon accumulation and crop productivity under arice–wheat cropping system in the western Indo-Gangetic Plains. European Journal of Agronomy. 2015;70:11-21.
8. Ingle AU, Shelke DK, Aghav VD, Karad ML. Effect of irrigation schedules and nutrient management on WUE and nutrient uptake of wheat on Vertisol. Journal of Soils and Crops. 2007;17(1):188-190.
9. Kabir N, Khan AR, Islam MA, Haque MR. Effect of seed rate and irrigation level on the performance of wheat cv. Gourab. Journal of Bangladesh Agricultural University. 2009;7(1):47-52.
10. Khan N, Naqvi FN. Effect of water stress in bread wheat hexaploids. Current Research Journal of Biological Sciences. 2011;3(5):487-498.
11. Kibe AM, Singh S. Influence of irrigation, nitrogen and zinc on productivity and water use by late sown wheat. Indian Journal of Agronomy. 2003;48(3):186-191.
12. Mekkei MER, El-Haggan, Eman AMA. Effect of different irrigation regimes on grain yield and quality of some Egyptian bread wheat cultivars. Journal of Agri-Food and Applied Sciences. 2014;2(9):275-282.
13. Nayak MK, Patel HR, Prakash V, Kumar A. Influence of irrigation scheduling on crop growth, yield and quality of wheat. Journal of Agriculture Research and Technology. 2015;2:65-68.
14. Pyare R, Singh RK, Dixit KK, Verma VK. Comparative studieson wheat (*Triticum aestivum* L.) varieties and date of sowing under late sown conditions. Agriways. 2015;3:4-9.
15. Bhahma R, Janawade AD, Palled YB. Water use studies in durum wheat as influenced by irrigation schedules, mulch and antitranspirant application in black soils of northern transitional zone of Karnataka. Karnataka Journal of Agricultural Sciences. 2007;(1):120-122.
16. Sachan P, Verma V, Sachan A, Pyare R. Screening of timly sown wheat (*Triticum aestivum* L.) varieties in relation to climate change in central plain zone of Uttar Pradesh. Journal of Pharmacognosy and Phytochemistry. 2019;8(5):1995-1997.
17. Sana Ullah Baloch, LIU Li-Jun, Muhammad Nawaz Kandhroo, Shah Fahad, Salih AL Sabiel, Shahbaz Khan Baloch. *et al*. Effect of different rrigation schedules on the growth and yield performance of wheat (*Triticum aestivum* L.) varieties assessment in district Awaran (Balochistan). Journal of Biology, Agriculture and Health care. 2014;4(20):5-17.
18. Sapkota D, Dahal KR, Shah SK, Shrestha SM. Response of Wheat Varieties to Different Levels of Nitrogen under Late-Sown Irrigated Conditionin Chitwan. Beekeepers Need A wake up in Autumn to have Better Harvest in

Winter Honey Flowin Chitwan, Nepal, 2007.
19. Saren BK, Dey S, Mandal D. Effect of irrigation and sulphur on yield attributes, productivity, consumptive use, consumptive use efficiency of wheat (*T. aestivum*). Indian Journal of Agriculture Science. 2004;74(5):257-261.
20. Singh D, Shamim M, Pandey R, Kumar V. Growth and yield of wheat genotypes in relation to environmental constraints under timely sown irrigated condition. Indian Journal of Plant Physiology. 2012;17:113-120.
21. Verma UN, Kumar S, Pal SK, Thakur R. Growth analysis of wheat (*Triticum aestivum* L.) cultivars under different seeding date sand irrigation levels in Jharkhand. Indian Journal of Agronomy. 2003;48(4):282-286 29-38.
22. Yambem S, Zimik L, Laishram B, Hajarimayum SS, Keisham M, Banarjee L. Response of different rapeseed (*Brassica campestris*) and mustard (*Brassica juncea*) varieties on growth and yield under zero tillage conditions. The Pharma Innovation Journal. 2020;9(12):210-212.