Plant Archives Vol. 26, Supplement 1, 2026 pp. 1473-1476 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2026.v26.supplement-1.196

EFFECT OF IRRIGATION REGIMES AND FERTILITY LEVELS ON GROWTH AND YIELD OF WHEAT (*TRITICUM AESTIVUM* L.) CULTIVARS IN LOAMY SAND

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(Date of Receiving : 15-09-2025; Date of Acceptance : 29-11-2025)

ABSTRACT

A field experiment was conducted at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Dantiwada, Gujarat during the two consecutive *rabi* seasons of the year 2023-24 and 2024-25 on "Effect of irrigation regimes and fertility levels on growth and yield of wheat (*Triticum aestivum* L.) cultivars in loamy sand". The soil of experiment field was loamy sand in texture, slightly alkaline in reaction, low in organic carbon and available nitrogen and medium in available phosphorus and potash status. There was total twenty-seven treatment combinations comprising of three irrigation regimes *viz*., 0.6, 0.8 and 1.0 IW/CPE; three wheat cultivars *viz*., GW 451, GW 496 and GW 513 and three fertility levels *viz*., 75%, 100% and 125% RDF tested in split split plot design with three replications. Among different treatments, wheat cultivar GW 513, irrigated at 1.0 IW/CPE and fertilized with 125% RDF recorded significantly higher plant height, total tillers per metre row length, grain yield and straw yield of wheat.
Keywords **:** Wheat, Irrigation, RDF, Cultivar, Yield.

Introduction

Wheat (*Triticum aestivum* L.) is described as "Staff of life or King of cereals" and one of the most important staple food crop of the world. Wheat belongs to *Poaceae* family and it is the second important food grain crop of India being next to rice. This crop is mainly responsible for the green revolution and mitigating the problem of food insecurity in India. Wheat is one of the most important cereal crop in our country, its demand is increasing day by day with our ever-increasing population. To fulfil the required demand of population can be achieved only by maximizing the productivity as there is no scope for increasing the area under production. Productivity can be maximized by adopting high yielding cultivars and appropriate agronomic practices like optimum seed rate, time of sowing, irrigation scheduling, fertilizer uses, weed management, time of harvesting *etc*. Out of all the above-mentioned factors, the most important aspects directly related to improve the productivity of wheat are water management, nutrient management and crop variety.

Wheat is highly sensitive to water stress during the CRI and flowering stage, but excess irrigation may lead to heavy vegetative growth and shortening of reproductive period in association of good fertility. Thus, timing the length of irrigation intervals with the stages of crop growth might bring a reduction in the number of irrigations and resulting in an economic crop yield. Although, high water status throughout the growing season is necessary to maintain unimpaired crop growth and high economic yield, imposition of some stress by longer irrigation intervals during vegetative or maturation by way of narrowing or widening IW: CPE ratio could attain similar economic

yields as well as saving of irrigation water and improving water use efficiency.

Variety plays an important role in producing high yield of a crop. Because of genetic variation, different cultivars of crop differ in their growth and developmental behaviour as well as response differently to varied input, prevailing environment and management practices (Ram *et al*., 2018).

Among the agronomical factors known to augment the wheat yield, fertilizer management is a vital importance in increasing the crop productivity. Nitrogen is one of the essential elements of plant food for proper growth and development of plant which are low in the soil of this region. Nitrogen is an essential constituent of protein and is present in many other compounds of great physiological importance in fat metabolism. It is therefore, a basic constituent of 'life' and it is an integral part of chlorophyll, which is the primary absorber of light energy needed for photosynthesis. Among the primary nutrients, phosphorus plays important role in plant growth and development. Phosphorus plays many essential functions in plant life and its role in energy storage and transfer is the most important, which act as "Energy currency" within plant.

By keeping this view in mind, the present experiment was formulated to study "Effect of irrigation regimes and fertility levels on growth and yield of wheat (*Triticum aestivum* L.) cultivars in loamy sand"

Material and Methods

A field experiment was conducted at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Dantiwada, Gujarat during the two consecutive *rabi* seasons of the year 2023-24 and 2024-25. The experiment was laid out in split split design with three replications having twenty-seven treatment combinations comprising of three irrigation regimes *viz*., 0.6, 0.8 and 1.0 IW/CPE as main plot treatments; three wheat cultivars *viz*., GW 451, GW 496 and GW 513 as sub plot treatments and three fertility levels *viz*., 75%, 100% and 125% RDF (90-60-00 kg N-P_2O_5-K_2O/ha) as sub-sub plot treatments with three replications in a gross plot size of 5.0 m × 4.5 m.

Geographically, Sardarkrushinagar is located at 24° 19' North latitude and 72° 19' East longitude with an elevation of 154.52 metre above the mean sea level and situated in the North Gujarat Agro-climatic Zone. The climate of this region is sub-tropical monsoon type and falls under the semi-arid region having extreme cold winter and hot and dry windy summer. The soil was low in organic carbon and available nitrogen estimated by alkaline permanganate method and medium in available phosphorus (by Olsen's method) and potash (by Flame photometer method).

Wheat was sown during the month of November with recommended seed rate of 120 kg/ha by maintaining 22.5 cm distance between the rows and harvested during the month of march during both the year of experimentation. The cumulative pan evaporation values were calculated from daily pan evaporation measured with the help of USWB class 'A' open pan evaporimeter installed at the meteorological observatory, which was in the proximity of the experimental plot. The quantity of irrigation water applied in surface flooding was measured by parshall flume. A fixed depth of 60 mm irrigation water was applied to each treatment based on IW/CPE of 0.6, 0.8 and 1.0. Initial common irrigation was applied for crop establishment and at CRI stage after that 60 mm flood irrigation was applied as per treatments. FYM @10 t/ha was applied as a common at the time of land preparation.

Plant height, total tillers and chlorophyll content were recorded from randomly selected and previously tagged 5 plants in each net plot at different stages of wheat. The grain yield was calculated from each net plot after threshing, winnowing and cleaning, and expressed in kg per ha. Straw yield was calculated by subtracting the grain yield from total dry matter of each net plot.

Results and Discussion

Effect of irrigation regimes

Growth attributing characters, *viz*. plant height at 60 DAS (72.51 cm), 90 DAS (85.22 cm) and at harvest (93.28 cm), chlorophyll content at 60 DAS (29.96) and total tillers per metre row length (99.87) of wheat was found significantly higher when irrigation scheduled at 1.0 IW/CPE, over 0.8 and 0.6 IW/CPE (Table 1). Application of irrigation at 1.0 IW/CPE produced significantly higher grain (4805 kg/ha) and straw yield (6474 kg/ha) of wheat over rest of the irrigation schedules (0.8 and 0.6 IW/CPE) (Table 1). Higher yield was observed due to the favorable soil water balance (applied water), since water plays a vital role in the carbohydrate metabolism, protein synthesis, cell division, cell enlargement and partitioning of photosynthates to sink for improved development of growth traits. Moreover, maintenance of adequate available soil moisture in the root zone would be conducive for proper uptake as well as utilization of nutrients, which has a variable impact on growth

component and yield attributes for better yield. Chaudhary *et al*. (2022) observed that significantly higher plant height, grain yield and straw yield of wheat was recorded with 1.0 IW/CPE ratio. Significantly higher plant height, cholorophyll content and grain yield was recorded with application of 100% of recommended amount of irrigation (Elmasry, 2024).

Effect of wheat cultivars

Different wheat cultivars exhibited significant effect on plant height of wheat. Data pertaining to plant height (Table 1) indicated that GW 513 recorded significantly higher plant height at 60 DAS (68.81 cm), 90 DAS (85.86 cm) and at harvest (91.57 cm). Significantly higher total tillers per metre row length (98.25) was registered under GW 513 cultivar, which remained statistically at par cultivar GW 451 (Table 1). However, effect of different cultivars on chlorophyll content was found non-significant. Significantly the highest grain yield (4632 kg/ha) (Table 1) of wheat was observed under GW 513 as compared to other cultivars (GW 451 and GW 496). Whereas, significantly higher straw yield of 6304 kg/ha was observed under cultivar GW 513 in pooled analysis which was at par with GW 451 (Table 1). Significantly higher chlorophyll content, total tillers, grain yield and straw yield was recorded with variety Raj 4037 (Arif *et al*. 2019). Sikawar *et al*. (2020) reported that significantly higher plant height, total tillers, grain and straw yield of wheat was recorded with variety C 306.

Effect of fertility levels

Application of 125% RDF registered significantly higher plant height (Table 1) at 60 DAS (69.94 cm) ,90 DAS (83.09 cm) and at harvest (91.28 cm) over 100% RDF and 75% RDF. Significantly higher chlorophyll content at 60 DAS (29.78) and total tillers per metre row length (97.39) was recorded with application of 125% RDF (Table 1). The enhancement in growth parameters with increase in fertilizer doses was owing to the rapid conversion of synthesized carbohydrates into protein and thus increases in the number and size of cell, which might cause increase in plant height and thereby ultimately increase in dry-matter accumulation. Significantly the highest grain (4632 kg/ha) and straw yield of wheat (6402 kg/ha) was observed with 125% RDF (Table 1). Higher application of nitrogen and phosphorus which are involved in energy transformation, activation of enzyme in carbohydrate metabolism and consequently greater translocation of photosynthates towards vegetative and reproductive parts led to overall improvement of growth and yield attributes which ultimately reflected on grain yield. Thakur *et al*. (2020) found that the application of 100% RDF (120 kg N + 60 kg P_2O_5 + 40 kg K_2O/ha) recorded higher plant height, total tillers per metre square, grain and straw yield of wheat. Niwas *et al.* (2023) observed that significantly higher plant height, grain and straw yield of wheat was recorded with application of 85% RDF + FYM @ 5 t/ha.

Interaction effect

Interaction effect of irrigation regimes and fertility levels (I × F) for grain and straw yield (kg/ha) was found significant. Interaction between 1.0 IW/CPE × 125% RDF (I_3F_3) registered significantly higher grain (5012 kg/ha) and straw yield (6712 kg/ha) during 2024-25 and in pooled mean, respectively, which was at par I_3F_2, I_2F_3 and I_2F_2 (Table 2). Mandal *et al*. (2005) observed that significantly higher grain yield of wheat was recorded with application of three irrigations along with 100% NPK + FYM @10 t/ha.

Conclusion

It is concluded that wheat crop should be irrigated at 0.8 IW/CPE with application of 100% RDF (90-60-00 kg N-P_2O_5-K_2O/ha) along with application of FYM @ 10t/ha for achieving maximum yield in loamy sand. Further wheat cultivar GW 513 found superior with respect to producing higher yield over GW 451 and GW 496.

Table 1: Effect of irrigation regimes, wheat cultivars and fertility levels on grow attributes and yield of wheat (Pooled data of two years)

Treatments	Plant height (cm)			Chlorophyll content (SPAD)	Total tillers (per meter row length)	Grain Yield (kg/ha)	Straw yield (kg/ha)
	60 DAS	90 DAS	At harvest				
Main plot: Irrigation regimes							
I_1: 0.6 IW/CPE	56.93	76.79	82.57	26.33	90.21	3622	5405
I_2: 0.8 IW/CPE	67.50	81.71	88.28	29.24	96.34	4623	6318
I_3: 1.0 IW/CPE	72.51	85.22	93.28	29.96	99.87	4805	6474
S.Em.±	1.45	0.31	0.98	0.22	0.21	50.30	73.08
C.D. (P = 0.05)	4.74	1.02	3.18	0.72	0.68	164	238
C.V. %	13.53	9.69	9.95	11.95	7.66	11.28	13.35

Sub plot: Wheat cultivars							
V_1: GW 451	60.73	74.73	82.39	28.55	96.59	4346	6098
V_2: GW 496	67.40	83.14	90.16	27.99	91.57	4054	5796
V_3: GW 513	68.81	85.86	91.57	28.98	98.25	4650	6304
S.Em. ±	1.13	0.94	1.07	0.37	0.84	60.74	92.35
C.D. (P = 0.05)	3.29	2.75	3.14	NS	2.44	177	270
I × V	NS	NS	NS	NS	NS	NS	NS
C.V. %	12.62	8.53	8.97	9.62	6.44	10.26	11.19
Sub sub plot: Fertility levels							
F_1: 75% RDF	58.91	79.45	83.89	26.82	92.93	4022	5665
F_2: 100% RDF	68.09	81.18	88.95	28.92	96.09	4395	6131
F_3: 125% RDF	69.94	83.09	91.28	29.78	97.39	4632	6402
S.Em.±	1.04	0.62	0.87	0.37	0.65	47.91	54.15
C.D. (P = 0.05)	2.94	1.74	2.44	1.03	1.84	135	153
I × F	NS	NS	NS	NS	NS	S	S
V × F	NS	NS	NS	NS	NS	NS	NS
I × V × F	NS	NS	NS	NS	NS	NS	NS
C.V. %	11.69	5.58	7.23	9.42	5.01	8.09	6.56

Table 2: Interaction effect of irrigation regimes and fertility levels on grain and straw yield of wheat (Pooled data of two years)

Treatments	F_1: 75% RDF	F_2: 100% RDF	F_3: 125% RDF
Grain yield (kg/ha)			
I_1: 0.6 IW/CPE	3289	3472	4105
I_2: 0.8 IW/CPE	4239	4849	4780
I_3: 1.0 IW/CPE	4539	4864	5012
S.Em.±	82.99		
C.D. (P = 0.05)	234		
Straw yield (kg/ha)			
I_1: 0.6 IW/CPE	4924	5402	5890
I_2: 0.8 IW/CPE	5831	6520	6604
I_3: 1.0 IW/CPE	6239	6471	6712
S.Em.±	93.80		
C.D. (P = 0.05)	264		

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