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Studies on growth and yield of wheat (*Triticum aestivum* L.) genotypes under irrigated condition

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Abstract
In the *rabi* season of 2019-2020, an experiment entitled "Studies on growth and yield of wheat (*Triticum aestivum* L.) genotypes under irrigated condition" was carried out at the farm of Wheat Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (M.S.). The treatments consisted of 15 treatment combinations comprised of three irrigation levels i.e., two irrigations (CRI, Flowering), four irrigations (CRI, Tillering, Flowering and Milk stage), six irrigations (CRI, Tillering, Jointing, Flowering, Milk and Dough stage) and five wheat genotypes *viz.*, AKAW-4627, AKAW- 4832, WSM 109-4, PDKV SARDAR, and PDKV WASHIM. The experiment was laid out in a factorial randomized block design with three replications. The soil was clayey with a pH of 7.64 and 212.72, 22.27 and 368.45 kg ha^{-1} of available N, P and K, respectively. When wheat crop was irrigated with six irrigations (CRI, Tillering, Jointing, Flowering, Milk and Dough stage) instead of four irrigations (CRI, Tillering, Flowering, Milk stage) and two irrigations (CRI, Flowering), the growth and yield attributes were significantly improved. Grain yield was significantly higher with six irrigations (CRI, Tillering, Jointing, Flowering, Milk and Dough stage). Genotype AKAW-4627 performed better than other genotypes in terms of plant height (cm), numbers of functional leaves plant^{-1}, leaf area plant^{-1} (dm2), number of tillers plant^{-1}, dry matter accumulation plant^{-1}(g), weight of spike (g), number of spike plant^{-1}, number of spikelet spike^{-1}, number of grain spike^{-1}, weight of grains spike^{-1}(g), test weight (g), grain yield (kg ha^{-1}), straw yield (kg ha^{-1}), biological yield and harvest index (%).

Keywords: Growth, Irrigation levels, wheat genotypes, yield

Introduction
Wheat (*Triticum aestivum* L.) holds the status of being the most significant crop globally, serving as a staple food for approximately one-third of the global population. (Hussain *et al*., 2002) [8]. In India, three types of wheat are grown: common wheat (*Triticum aestivum*), Marconi or durum wheat (*Triticum durum*), and emmer wheat (*Triticum dicoccum*), with *Triticum aestivum* covering the most land. "Wheat dominates the largest portion of cultivated areas during the dry season, contributing to around 20% of household calories and 50% of total calorie intake from cereals" (Shiferaw *et al.*, 2013) [12]. The area under wheat cultivation in India in 2019-20 is 31.45 million ha, with an annual yield of 107.59 million tonnes and an average productivity of 3421 kg ha^{-1} (Anonymous a, 2019-20) [3]. It has occupied 10.56 lakh ha in Maharashtra, with a yield of 17.93 lakh tonnes and a productivity of 1696.78 kg ha^{-1} (Anonymous b, 2019-20) [4]. "Optimal soil moisture levels can be achieved through well-timed irrigation scheduling. This approach helps mitigate the negative impacts of both low and high temperatures on plant growth – low temperatures during the vegetative phase and high temperatures during the reproductive phase (Talukder, 1987) [14]."
While scheduling irrigation to wheat it is known that some of the critical stages are important from yield point of view. "Missing irrigation in critical stages affect the grain yield significantly" (Deshmukh *et al*., 1992) [7]. "Irrigating at the right time, particularly during the crown root development phase, is crucial for wheat's optimal growth and can significantly influence its grain yield" (Randhawa *et al*., 2004) [11]. "Its global expansion and heightened productivity can be attributed to its remarkable adaptability and sustainability across diverse agro-climatic conditions."" (Kumar *et al.*, 2014) [9]. Various methods exist for scheduling irrigation, considering factors like crop type, soil conditions, atmospheric influences, and plant-water interactions. The most important approach under limited irrigation facilities is a critical growth stage approach. In wheat different growth stages *viz.*, crown root initiation, tillering, jointing, flowering, milk and dough are well distinguished. Information on the critical stages is useful in areas with limited water resources where maximum production per unit area

is aimed at. Over the past two decades, there has been a noticeable shift in the rainfall pattern and surrounding environmental conditions. The altered distribution and quantity of total rainfall have posed challenges to sustaining the wheat crop, given the limited availability of irrigation water. Due to lack of irrigation water during crucial growth stages of wheat, scientists have been forced to investigate the problem and find a solution under restricted irrigation in order to maintain remunerative wheat production.

Material and Methods

During the *rabi* season of 2019-2020, the field experiment was undertaken at Wheat Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (M.S.). The experimental plot's soil was clayey in texture and somewhat alkaline in reactivity, with a pH of 7.64. The organic carbon content (5.8 g ha^{-1}) and available nitrogen content (212.72 kg ha^{-1}) were moderate and low respectively. Available phosphorus (22.27 kg ha^{-1}) was low while the soil was fairly rich in available potassium (368.45 kg ha^{-1}). The treatments consisted of 15 treatment combinations comprised of three irrigation levels i.e., two irrigations (CRI, Flowering), four irrigations (CRI, Tillering, Flowering and Milk stage), six irrigations (CRI, Tillering, Jointing, Flowering, Milk and Dough stage) and five wheat genotypes *viz.*, AKAW-4627, AKAW-4832, WSM 109-4, PDKV SARDAR, and PDKV WASHIM. The study followed a factorial randomized block arrangement, comprising three replications. Within each replication, a random selection was made of five plants and tagged from each net plot per treatment for recording the various biometric observations at 30-day intervals.

Results and Discussion

A) Growth attributes

Data on growth attributes recorded at various crop growth stages at 30- days interval as affected by various treatments are presented in Table 1.

Table 1: Plant height (cm), Number of functional leaves $plant^{-1}$, Leaf area $plant^{-1}$ (dm2), Dry matter accumulation $plant^{-1}$(g) and Number of tillers m-2 as influenced by various levels of irrigation and genotypes

Treatments	Plant height (cm)			Number of functional leaves $plant^{-1}$			Leaf area plant-1(dm2)		Dry matter accumulation $plant^{-1}$(g)			Number of tillers m-2
	Days after sowing											
Factor A – Irrigation levels	**60**	**90**	**At harvest**	**30**	**60**	**90**	**60**	**90**	**60**	**90**	**At harvest**	**At 45**
I1- 2 Irrigation (CRI, Flowering)	67.40	81.00	82.53	4.02	19.67	10.03	2.60	1.61	11.38	19.31	21.74	278.22
I2- 4 Irrigation (CRI, Tillering, Flowering, Milk stage)	71.43	86.83	87.73	4.52	21.56	13.22	3.79	2.24	12.86	23.94	24.85	346.53
I3- 6 Irrigation (CRI, Tillering, Jointing, Flowering, Milk and Dough stage)	75.60	92.27	93.61	4.85	23.96	15.84	4.66	3.05	15.00	26.96	28.86	352.68
S.E. (m) ±	1.14	1.17	1.24	0.25	0.48	0.42	0.10	0.05	0.28	0.59	0.49	7.32
C.D at 5%	3.31	3.40	3.60	NS	1.40	1.21	0.31	0.16	0.83	1.72	1.44	21.22
Factor B - Genotypes												
G1- AKAW-4627	74.01	89.13	90.16	4.98	22.66	13.41	3.62	2.17	13.26	23.18	24.48	332.96
G2- AKAW-4832	68.13	82.00	83.03	4.12	20.25	11.30	3.17	1.90	11.04	20.87	22.53	317.95
G3- WSM 109-4	61.54	76.41	77.65	3.65	18.22	9.36	2.81	1.72	10.55	19.53	21.85	288.19
G4- PDKV SARDAR	70.11	85.04	86.07	4.65	21.83	12.96	3.37	2.00	12.95	22.93	24.02	325.35
G5- PDKV WASHIM	73.30	87.01	88.75	3.96	20.12	11.12	3.03	1.84	12.79	21.63	23.61	297.41
S.E. (m) ±	1.47	1.51	1.60	0.33	0.62	0.54	0.14	0.07	0.37	0.76	0.64	9.46
C.D. at 5%	4.28	4.39	4.65	NS	1.81	1.57	0.40	0.20	1.08	2.22	1.86	27.39
Interaction (IxG)												
S.E. (m) ±	2.56	2.62	2.78	0.57	1.08	1.93	0.24	0.12	0.64	1.33	1.11	16.38
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
GM	71.47	86.70	87.95	4.46	21.72	13.03	3.68	2.30	13.07	23.40	25.15	325.80

CRI, Crown-root initiation; I, Irrigation levels; G, Genotypes

Effect of irrigation levels

Various irrigation levels posed the significant effect over the growth attributes of genotypes at all growth stages. The treatment that received six irrigations (I3) had significantly higher plant height and dry matter accumulation $plant^{-1}$ at 60, 90 DAS and at harvest followed by treatment receiving four irrigations (I2) and lowest was recorded with two irrigations (I1).

Leaf area $plant^{-1}$ and number of functional leaves $plant^{-1}$ was found significantly highest with six irrigations (I3). The leaf area $plant^{-1}$ (4.66 dm2) and number of functional leaves $plant^{-1}$ (23.96) with this treatment at 60 DAS. Treatments of four irrigations (I2) and two irrigations (I1) were followed by six irrigations (I3). Treatments that received six irrigation (I3) and four irrigation (I2) recorded higher number of tillers m-2 (352.68 and 346.53, respectively) at 45 DAS over two irrigation treatment. However, these two treatments were at par with one another. The finding is in support to those of Abhineet *et al.* (2019) [1].

Effect of genotypes

The data on genotypes revealed that G1 (AKAW-4627) showed the highest plant height (90.16 cm), dry matter accumulation $plant^{-1}$ (24.48 g), number of functional leaves plant- 1(22.66), Leaf area $plant^{-1}$ (3.62 dm2) and number of tillers m-2 (332.96) which was found at par with genotypes G4 (PDKV SARDAR) and significantly superior over rest of the genotypes.

B) Yield attributes of wheat

The major yield contributing characters, which determine the yield in wheat are length of spike (cm), weight of spike (g),

number of spike plant^{-1}, number of spikelet spike^{-1}, number of grains spike^{-1}, weight of grains spike^{-1} (g) and test weight (g). As a result, every effort has been made to accurately measure each of these characteristics. The perusal of data related to yield attributes of wheat is presented in Table 2 and revealed that they were significantly influenced by irrigation levels and genotypes.

Effect of irrigation levels

The wheat crop with six irrigations (I3) received higher spike length of 9.56 cm, weight of spike (7.29 g), number of spike plant^{-1}(4.00), number of spikelets spike^{-1}(17.00), number of grains spike^{-1} (42.00), weight of grains spike^{-1} (2.61 g), test weight (44.38 g) followed by four irrigation(I2) and two irrigations (I1). The findings are in support to those of Baloch *et al.* (2014) [5], Ahmad and Kumar (2015) [2], Mahla and Wanjari (2017) [10] and Abhineet *et al.* (2019) [1].

Effect of genotypes

In case of varieties the maximum weight of spike (6.63 g), number of spike plant- 1(4.00), number of spikelets spike^{-1} (17.00), number of grains spike^{-1} (38.00), weight of grains spike^{-1} (2.38 g), test weight (45.82 g) was recorded with variety AKAW-4627 which was at par with PDKV SARDAR and significantly superior over rest of the varieties. The maximum length of spike (8.97 cm) was recorded in G4 (PDKV SARDAR) which was statically at par with G2 (AKAW-4832), G1 (AKAW-4627) and G5 (PDKV WASHIM). Minimum length of spike (8.02 cm) was found in G3 (WSM 109-4).

C) Yield studies

Effect of different irrigation treatments and genotypes during study was significant in respect of grain yield, straw yield and biological yield are presented in Table 2.

Table 2: Yield attributes, Grain yield (kg ha^{-1}), straw yield (kg ha^{-1}), biological yield (kg ha^{-1}), and harvest index (%) of wheat as affected by various levels of irrigation and genotypes

Treatments	Length of spike (cm)	Weight of spike (g)	No. of spike plant^{-1}	No. of spikelet spike^{-1}	No. of grains spike^{-1}	Weight of grains spike^{-1} (g)	Test weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Biologic al yield (kg ha^{-1})	Harvest index (%)
Factor A- Irrigation levels											
I1- 2 Irrigation (CRI, Flowering)	8.16	4.89	3.00	15.00	30.00	1.64	40.63	2689	7415	10103	26.61
I2- 4 Irrigation (CRI, Tillering, Flowering, Milk stage)	8.85	5.95	4.00	16.00	35.00	2.08	42.50	3137	8303	11440	27.42
I3- 6 Irrigation (CRI, Tillering, Jointing, Flowering, Milk and Dough stage)	9.56	7.29	4.00	17.00	42.00	2.61	44.38	3518	9180	12698	27.70
S.E. (m) ±	0.18	0.17	0.13	0.34	0.98	0.09	1.01	49	80	82	-
C.D at 5%	0.53	0.51	0.36	0.99	2.84	0.27	2.94	141	231	237	-
Factor B- Genotypes											
G1- AKAW-4627	8.46	6.63	4.00	17.00	38.00	2.38	45.82	3926	8406	12332	31.83
G2- AKAW-4832	8.71	5.30	3.00	15.00	31.00	1.82	39.00	2620	7882	10502	24.94
G3- WSM 109-4	8.02	3.90	2.00	13.00	28.00	1.30	37.80	2038	7086	9125	22.33
G4- PDKV SARDAR	8.97	6.39	3.00	16.00	34.00	2.07	43.21	3800	8251	12051	31.53
G5- PDKV WASHIM	8.36	4.88	3.00	14.00	29.00	1.72	41.99	2180	7669	9849	22.13
S.E. (m) ±	0.23	0.23	0.16	0.44	1.27	0.12	1.31	63	103	106	-
C.D. at 5%	0.68	0.66	0.47	1.28	3.67	0.35	3.80	183	298	306	-
Interaction (IxG)											
S.E. (m) ±	0.40	0.40	0.28	0.77	2.20	0.20	2.27	109	178	183	-
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	316	516	NS	-
GM	8.85	6.04	4.00	16.00	36.00	2.10	42.50	3115	8299	11414	26.81

CRI, Crown-root initiation; I, Irrigation levels; G, Genotypes

Effect of irrigation levels

Among the irrigation levels, application of six irrigations produced maximum grain yield (3518 kg ha^{-1}), straw yield (9180 kg ha^{-1}), biological yield (12698 kg ha^{-1}) and harvest index (27.70%) significantly higher than other levels of irrigation, and it was followed by four irrigations and two irrigations. This may be because when the number of irrigation was increased in relation to proper growth stages, there was a significant increase in tillers, plant height, leaf area and dry matter accumulation and yield attributes such as length of spike, weight of spike, number of spike plant^{-1}, number of spikelets spike^{-1}, no. of grains spike^{-1}, weight of grains spike^{-1} and test weight in wheat genotypes. While conducting their experiment under various irrigation schedules, Mahla and Wanjari (2017) [10], Singh *et al.* (2018) [13], Abhineet *et al.* (2019) [1] and Dawlatzay *et al.* (2020) [6] noticed similar results for grain yield, straw yield, and biological yield namely an increase in yield with increasing irrigation levels.

Effect of genotypes

The wheat crop responded significantly in terms of grain yield, straw yield, and biological yield to various genotypes. In case of genotypes the maximum grain yield (3926 kg ha^{-1}), straw yield (8406 kg ha^{-1}) and biological yield (12332 kg ha^{-1}) and harvest index (31.83%) of wheat were recorded with genotype AKAW-4627 which were at par with PDKV SARDAR and significantly superior over rest of the genotypes. Genotype WSM 109-4 recorded significantly minimum grain yield (2038 kg ha^{-1}), straw yield (7086 kg ha^{-1}) and biological yield (9125 kg ha^{-1}).

Interactions

The interaction effect of irrigation schedule and genotypes on grain yield and straw yield were found to be significant. The combination of six irrigations with genotype AKAW- 4627 performed best with the highest grain yield (4648 kg ha^{-1}) (Table 3). As a result, farmers can be advised to use a combination of these treatments to increase their yield only

after the results of further research have been confirmed. At six irrigations, all genotypes yielded significantly more grain yield.

Treatment combination of genotype AKAW-4627 with six irrigations resulted in significantly higher straw yield (10035 kg ha^{-1}), which was at par with combination of six irrigation with genotype PDKV SARDAR (9612 kg ha^{-1}) and significantly higher than all other treatment combinations which is presented in Table 4.

Table 3: Grain yield (kg ha^{-1}) as influenced by interaction of various levels of irrigation and genotypes

Treatments	Genotypes					Mean 'A'
	AKAW-4627	AKAW-4832	WSM 109-4	PDKV SARDAR	PDKV WASHIM	
I1- 2 Irrigation (CRI, Flowering)	3740	2177	1931	3663	1931	2689
I2- 4 Irrigation (CRI, Tillering, Flowering, Milk stage)	4112	3062	2145	3937	2429	3137
I3- 6 Irrigation (CRI, Tillering, Jointing, Flowering, Milk and Dough stage)	4648	3393	2478	4140	2930	3518
Mean 'B'	3926	2620	2038	3800	2180	
SE (m) ±	109					
C.D. at 5%	316					

Table 4: Straw yield (kg ha^{-1}) as influenced by interaction of various levels of irrigation and genotypes

Treatments	Genotypes					Mean 'A'
	AKAW-4627	AKAW-4832	WSM-109-4	PDKV SARDAR	PDKV WASHIM	
I1- 2 Irrigation (CRI, Flowering)	8061	7449	6598	7687	7278	7415
I2- 4 Irrigation (CRI, Tillering, Flowering, Milk stage)	8751	8315	7574	8814	8059	8303
I3- 6 Irrigation (CRI, Tillering, Jointing, Flowering, Milk and Dough stage)	10035	8992	8909	9612	8351	9180
Mean 'B'	8406	7882	7086	8251	7669	
SE (m) ±	178					
C.D. at 5%	516					

Conclusion

Wheat genotype AKAW-4627 produced higher growth parameters, grain and straw yield than other genotypes. Irrigating wheat at all the critical stages (CRI + Tillering + Jointing + Flowering + Milk + Dough stage) produced higher grain yield and harvest index.

References

1. Abhineet, Kumar R, Singh S, Nand V, Chaudhary V. Effect of restricted irrigation levels on yield attributes and yield of various varieties of wheat (*Triticum aestivum* L.). Journal of Pharmacognosy and Phytochemistry. 2019;8(2):122-125.
2. Ahmad A, Kumar R. Effect of irrigation scheduling on the growth and yield of wheat genotypes. Agricultural Science Digest - a Research Journal. 2015;35(3):199-202. htt ps://doi.org/10.5958/0976-0547.2015.00045.2
3. Anonymous a, 2019-20. Indian institute of Wheat and Barley research, Karnal, Haryana. htt ps://iiwbr.icar.gov.in.
4. Anonymous b, 2019-20. Department of Agriculture Maharashtra. Krishi.maharashtra.gov.in
5. Baloch SU L, Li-jun MN, Kandhroo S, Fahad SA, Sabiel SK, Baloch *et al*. 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.
6. Dawlatzay Z, Suresh K, Parveen K, Hooda VS. Productivity of bed planted wheat as influenced by irrigation and fertilizer levels. International Journal of Agriculture Sciences. 2020;12(23):10448-10450.
7. Deshmukh SV, Khandekar PK, Atale SB, Kale HB. Performance of various rabi crop under limited irrigation. PKV Research Journal. 1992;16(1):114-115.
8. Hussain MI, Shah SH, Hussain S, Iqbal K. Growth, yield and quality response of three wheat (*Triticum aestivum* L.) varieties to different levels of N, P, and K. International Journal of Agriculture and Biology. 2002;4:189-198.
9. Kumar P, Sarangi A, Singh DK, Parihar SS. Wheat performance as influenced by saline irrigation regimes and cultivars. Journal of Agri. Research. 2014;1(2):66-72.
10. Mahla SK, Wanjari SS. Response of wheat to irrigation and hydrogel with nutrient management. International Journal of Agricultural. 2017;7(2):267-272.
11. Randhawa AS, Jolly RS, Arora BS. The effect of' sowing time and rates and time of nitrogen application on dwarf wheat. J Res. Panjab Agric. Univ. 2004;13(2):130-135.
12. Shiferaw B, Smale M, Braun H. Crops that feed the world 10. Past successes and future challenges to the role played by wheat in global food security. Food Sec. 2013;5:291-317.
13. Singh T, Singh N, Kumar P, Singh S. Effect of different irrigation and fertility levels on dynamic growth and yield of late sown wheat (*Triticum aestivum* L.). International Journal of Chemical Studies. 2018;6(1):1523-1528.
14. Talukder MSU. Growth and development of wheat as affected by soil moisture stress. Indian J Agric. Science. 1987;57(8):559-564.