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RESEARCH ARTICLE

Morpho-physiological evaluation of wheat variety AKAW-4627 under different irrigation schedules

■ **JAYA TUMDAM, D.V. DURGE, N.R. POTDUKHE, MITALI DEOGIRKAR AND M.M. DESHMUKH**

SUMMARY

Field experiment on morpho-physiological evaluation of wheat variety AKAW-4627 grown under different irrigation schedules was conducted during *Rabi* 2012-13 and 2013-14 at Wheat Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. An experiment was conducted in Randomized Block Design with four replications and net plot size of 7.2 m^2. Different irrigation schedules on the basis of climatological approach *i.e.*, on IW/CPE ratio; was utilized for irrigating the crop. Favourable soil moisture was maintained in the irrigation scheduling treatments of 1.2 IW/CPE and 1.0 IW/CPE throughout the growing period and it was always maintained in allowable depletion regime. The result indicated that the different irrigation schedules affected morpho-physiological attributes. It is concluded that 1.2 IW/CPE was found superior over rest of the treatments for morpho-physiological attributes followed by 1.0 IW/CPE, control, 0.8 IW/CPE, 0.6 IW/CPE and no irrigation treatments. In respect of plant height 1.0 IW/CPE and control treatments were at par with each other.

Key Words : Irrigation scheduling, IW/CPE ratio

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Wheat is the third most produced cereal after maize and rice and is a leading source of protein than other major cereals globally (Khichar and Niwas, 2007). Worldwide, wheat provides nearly 55 per cent of the carbohydrates and 20 per cent of the food calories consumed globally (Breiman and Graur, 1995).

MEMBERS OF THE RESEARCH FORUM

Author to be contacted :
JAYA TUMDAM, Department of Agricultural Botany, Post Graduate Institute, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, AKOLA (M.S.) INDIA

Address of the Co-authors:
D.V. DURGE, N.R. POTDUKHE, MITALI DEOGIRKAR AND M.M. DESHMUKH, Department of Agricultural Botany, Post Graduate Institute, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, AKOLA (M.S.) INDIA

All India basis only 1/3 irrigated wheat receive desired irrigation and remaining is under limited irrigation only. Agriculture sector is the largest consumer of water and irrigation is considered as a backbone of modern intensive agriculture in India. However, the irrigation water seems to be most limiting factor for agricultural development in the coming days. Under natural condition a maximum potential of crops is seldom attained because of limitations on morphological and physiological process imposed by stress (Krizek *et al.*, 1981). Irrigation scheduling techniques can be based on soil water depletion approach, plant basis or plant indices, climatic approaches, critical growth stage approaches and plant water status itself. One of the methods of irrigation scheduling based

on climatological approach is IW/CPE ratio. In IW/CPE approach, a known amount of irrigation water is applied when cumulative pan evaporation (CPE) reaches a predetermined level. Water requirement of crop is expressed by evapotranspiration, which mainly depends upon climate. For practical purpose, irrigation should be started when about 50 per cent of the available moisture in the root zone is depleted. All phases of plant growth are not equally vulnerable to water shortage. Whereas some phases can cope-up with water shortage very well, others are more vulnerable to water shortages that may result in serious yield losses. To meet the ever increasing demand of wheat production and challenges to be faced for increasing productivity without scope of increasing the area, there is prime need to follow the advanced physiological tools, which may be useful in formulating the breeding programme. Although both timing and amount of water applied affect irrigation water productivity, timing has the greatest effect on crop yield and quality because at some growth stages, excessive soil moisture stress caused by delayed irrigation can irreversibly reduce the potential yield or quality or both. To meet the increasing demand of wheat production without increasing area, there is need to incorporate new physiological tools. Therefore, this study entitled "morpho-physiological evaluation of wheat variety AKAW-4627 under different irrigation schedules" was planned to study the physiological changes under different irrigation schedules.

MATERIAL AND METHODS

Field experiment was conducted during *Rabi* 2012-13 and 2013-14 at Wheat Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. An experiment was conducted in Randomized Block Design with four replications and net plot size of 7.2 m^2. The daily climatological data were collected from meteorological observatory in Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. Different irrigation schedules on the basis of climatological approach *i.e.*, on IW/CPE ratio; was utilized for irrigating the crop. The details of treatments are as follows :

Treatment details	
I_1	IW/CPE ratio = 0.6
I_2	IW/CPE ratio = 0.8
I_3	IW/CPE ratio = 1.0
I_4	IW/CPE ratio = 1.2
I_5	Control with six irrigations at crown root initiation (CRI), maximum tillering, late jointing, flowering, milking stage and dough stage.
I_6	No irrigation at all

Table A : Irrigation scheduling details

Sr. No.	Particulars		Observations
1.	Total available water (TAW), mm		149
2.	Depth of irrigation (IW), mm		75
3.	Cumulative pan	I_1 (IW/CPE=0.6)	125
	evaporation at which	I_2 (IW/CPE=0.8)	93.8
	irrigation scheduled	I_3 (IW/CPE=1.0)	75
	treatment wise (CPE), mm	I_4 (IW/CPE=1.2)	62.5

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Morpho-physiological parameters :

Irrigation scheduling treatments affects all morpho-physiological parameters and also affect functions of plant growth, this effect depends on the level of water stress, the length of time to which the plant is subjected to water stress and the genotype of plant species.

The data pertaining to plant height (cm) affected due to different irrigation scheduling to wheat variety AKAW- 4627 are presented in Table 1. All of the irrigation scheduling treatment at 60 DAS recorded higher plant height over the control treatment (I_6- no irrigation) during the year 2012-13, 2013-14 as well as in pooled of two years. Irrigation scheduling treatments I_4 (IW/CPE ratio =1.2), I_5 (six irrigation) and I_3 (IW/CPE ratio =1.0) exhibited statistically significant plant height over the control treatment (I_6- no irrigation). Among the morphological characters plant height decreased at maturity due to water stress. Similar types of results were reported by Khan and Naqvi (2011), they found that the decrease in plant height in response to water stress could be due to decrease in relative turgidity and dehydration of protoplasm, which is associated with a loss of turgor and reduced cell division.

The data revealed that all of the irrigation scheduling treatment recorded higher leaf area $plant^{-1}$, tillers per meter row length, total dry matter (Table 1), leaf area index $plant^{-1}$, relative water content, canopy temperature depression, stomatal index (Table 2), fv/fm, relative growth rate and net assimilation rate (Table 3) over the control treatment (I_6- no irrigation) during the year 2012-

13, 2013-14 as well as in pooled of two years. All of the irrigation scheduling treatment recorded irrigation scheduling treatments I_4 (IW/CPE ratio =1.2), I_3 (IW/CPE ratio =1.0) and I_5 (six irrigation) exhibited statistically significant over the control treatment (I_6- no irrigation) at 60 DAS. Similar results were recorded by Akram (2011) who determine the sensitivity of wheat to water stress and changes in physiological attributes of wheat *(Triticum aestivum* L.) under water stress conditions applied at different growth stages.

Wherever in almost all morpho-physiological characters, treatment I_4 and I_3 were statistically significant over I_5 (six irrigation). In both treatments numbers of irrigations applied were same (six irrigation). The irrigation applied in I4 (IW/CPE=1.2) was as per the crop requirement according to atmospheric demand *i.e.*, irrigation was scheduled when the cumulative pan evaporation reaches the predetermined level (62.5 mm) due to which favorable moisture was maintained in soil throughout the growing period. In treatment I_5 also six

Table1: Effect of different irrigation scheduling on morpho-physiological parameters of wheat variety AKAW-4627

Treatments	Plant height (cm)			Leaf area plant^{-1} (dm^2)			Tillers per meter row length			Total dry matter (g)		
	2012-13	2013-14	Pooled	2012-13	2013-14	Pooled	2012-13	2013-14	Pooled	2012-13	2013-14	Pooled
I_1	75.25	63.75	69.50	1.04	0.91	0.97	58.80	59.25	59.01	2.85	2.35	2.60
I_2	80.10	64.00	72.05	1.43	1.27	1.35	68.25	62.13	65.17	3.41	2.94	3.18
I_3	81.20	66.30	73.73	1.87	1.76	1.82	79.63	72.88	76.24	4.67	5.13	4.90
I_4	86.06	71.80	78.91	1.98	1.85	1.86	85.13	76.50	80.80	8.21	9.06	8.64
I_5	82.60	68.50	75.53	1.46	1.36	1.41	76.75	62.50	69.61	7.25	8.61	7.93
I_6	68.95	59.20	64.06	0.86	0.81	0.84	42.80	45.25	44.01	2.13	1.97	2.05
S.E. ±	3.47	2.49	3.02	0.057	0.061	0.056	3.33	3.09	3.21	0.252	0.267	0.259
C.D. (P=0.05)	10.45	7.49	4.78	0.172	0.185	0.169	10.03	9.30	9.27	0.759	0.803	0.780
CV %	8.78	7.58	8.35	7.96	9.25	8.15	9.71	9.78	9.75	10.60	10.64	10.60

Table 2 : Effect of different irrigation scheduling on morpho-physiological parameters of wheat variety AKAW-4627

Treatments	Leaf area index plant^{-1}			Relative water content (%)			Canopy temperature depression (^{0}C)			Stomatal index		
	2012-13	2013-14	Pooled	2012-13	2013-14	Pooled	2012-13	2013-14	Pooled	2012-13	2013-14	Pooled
I_1	4.57	4.02	4.22	74.23	76.28	75.24	6.98	8.04	7.47	56.02	58.56	57.25
I_2	4.94	4.84	4.81	81.28	81.31	81.28	7.43	8.21	7.78	57.24	59.03	58.10
I_3	6.03	5.78	5.87	90.31	85.31	87.79	8.28	8.55	8.38	61.32	64.63	62.94
I_4	6.49	6.26	6.29	94.57	89.57	92.05	10.10	11.59	10.85	62.75	66.05	64.36
I_5	5.25	5.28	5.22	83.31	83.57	83.42	7.78	8.25	7.98	59.59	61.91	60.71
I_6	3.77	3.51	3.62	64.34	65.43	64.87	6.93	6.28	6.57	54.47	55.75	55.07
S.E. ±	0.286	0.274	0.280	4.096	3.965	4.031	0.422	0.439	0.43	2.42	2.30	2.77
C.D. (P=0.05)	0.863	0.825	0.844	12.34	11.95	11.64	1.272	1.321	1.244	7.30	6.92	8.01
CV%	11.251	11.166	11.205	10.07	9.88	9.98	9.47	9.90	9.90	8.27	7.53	9.15

Table 3 : Effect of different irrigation scheduling on morpho-physiological parameters of wheat variety AKAW-4627

Treatments	Relative growth rate (g/g/dm^2)			Net assimilation rate (g/dm^2/day)			Fv/fm 60 DAS		
	2012-13	2013-14	Pooled	2012-13	2013-14	Pooled	2012-13	2013-14	Pooled
I_1	0.0923	0.0924	0.0925	0.00498	0.00513	0.00505	0.66	0.68	0.65
I_2	0.1599	0.1267	0.1280	0.00522	0.00523	0.00522	0.71	0.73	0.70
I_3	0.1699	0.1579	0.1639	0.00598	0.00539	0.00569	0.81	0.80	0.79
I_4	0.1703	0.1674	0.1689	0.00622	0.00650	0.00636	0.85	0.84	0.83
I_5	0.1599	0.1565	0.1582	0.00533	0.00538	0.00535	0.72	0.77	0.73
I_6	0.0927	0.0902	0.0913	0.00470	0.00499	0.00485	0.64	0.61	0.60
S.E. ±	0.0061	0.0062	0.0048	0.00030	0.00031	0.00022	0.031	0.034	0.030
C.D. (P=0.05)	0.0253	0.0256	0.0201	0.00091	0.00093	0.00067	0.095	0.102	0.091
CV%	8.95	9.33	7.21	11.13	11.37	8.26	8.58	9.14	8.24

irrigation were applied but here irrigations were applied as per the crop growth stages (CGS), and the interval between the CGS was not same, hence, there may be a moisture stress occurred due to which there was depletion in soil moisture which directly affect the all morpho-physiological characters. Therefore, the treatment I_4 was found superior over rest of the treatments as compared to I_5 treatment.

Conclusion :

On the basis of result it was concluded that 1.2 IW/CPE ratio was suitable for late sown condition followed by 1.0 IW/CPE ratio. Favorable soil moisture was maintained through the growing period in 1.2 IW/CPE ratio treatment and found superior over rest of the treatment. Physiological traits of wheat differed in their responses to deficit irrigation. Selection based on the physiological traits will helpful under moisture stress condition. On the basis of above findings it is concluded that the wheat crop can be grown by using the irrigation scheduling approach. However, the seasonal irrigation application should vary with seasonal rainfall and the moisture condition before sowing, since the depletion to soil profile was considerable in the evapotranspiration components.

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