

Original Research Article

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Effect of Last Irrigation Scheduling and Foliar Spray of Bio Regulators on the Productivity of Wheat (*Triticum aestivum* L.) In Context to the Changing on Climate under South East Rajasthan, India

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ABSTRACT

A field experiment was conducted during two consecutive years from 2014-15 and 2015-16 at Agricultural Research Station, Kota, entitled "Effect of last irrigation scheduling and foliar spray of bio regulators the productivity of wheat (*Triticum aestivum* L.) in context to the changing climate under South East Rajasthan". In this experiment, treatments comprised combinations of five irrigation schedule (early milk, late milk, early soft dough, late soft dough and IW/CPE 0.8 control) and three bio-regulators foliar spray at tillering and heading stage (thiosalicylic acid 100 ppm, thiourea 500 ppm and control) thereby making twelve treatment combinations were replicated four replications. Pooled data shows that under last irrigation at late milk stage was recorded significantly the highest grain yield (5.3 t/ha) and straw yield (7.0 t/ha) as compare to early milk, late soft dough stage and control but at par with early soft dough stage. Under the last irrigation at late milk stage were recorded significantly the highest net return (Rs.86.5 thousand/ ha) and B:C ratio (4.27) as compare to early milk, late soft dough stage and control but at par with early dough stage. The maximum grain yield (5.2 t/ha) and straw yield (7.0 t/ha), net returns (Rs.83.7 thousand/ ha) and benefit cost ratio (4.05) of wheat were recorded under foliar spray of thiosalicylic acid (100 ppm) in pooled analysis. Higher water use efficiency (157.20 kg/ha-cm) under last irrigation at late milk stage and (159.36 kg/ha-cm) foliar spray of thiosalicylic acid were observed over control.

Keywords

Wheat, Bio regulator, Yield and water use efficiency

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Introduction

Wheat (*Triticum aestivum* L.) is the most important staple food crop of about 36 per cent of the world population. Worldwide this crop provides nearly 55 per cent of the carbohydrates and 20 per cent of the food calories. In India, wheat is the second most important cereal crop after rice and during 2015-16 it was cultivated on 30.96 million ha area with the production of 88.93 million tones and productivity of 2872 kg/ha

(Anonyms, 2016). In Rajasthan, cultivated area under wheat crop 3118 thousand ha with the production of 9869 thousand tones and productivity of 2974 kg/ha (Anonyms, 2016).

Yield of wheat crop is influenced by improved production technology and water management practices (Sharma *et al.*, 2007). In command area, method of irrigation and time of application plays an important role in

increasing water productivity. Declining availability of irrigation water, needs sustainability in crop production and increasing demand of food can be achieved through adoption of improved irrigation water management technology. In recent years, use of bio-regulators has offered new avenues for enhancing productivity of several crops. To improve water use efficiency on the basis of increasing crop yields there must be a proper irrigation scheduling strategy (Li *et al.*, 2000). Scheduling irrigation have been well studied and widely practiced for improving crop yield and/or increasing irrigation water use efficiency (Wang *et al.*, 2002; Kang *et al.*, 2002). Water use efficiency has been reported to be decreasing with increasing in irrigation times and amount of irrigation water applied per growing season (Qui *et al.*, 2008). Partitioning of dry matter to yield storage organs is considered to be a major determinant for agricultural yield and this is dependent on the efficiency of photosynthetic translocation in crop during grain filling period when developing grains are the storing sink. It has been reported that bio-regulators plays important role in greater partitioning of photosynthetic towards reproductive sink thereby improves the harvest index. Foliar applications of thiourea (Sahu and Singh, 1995) have been reported to be effective for enhancing wheat productivity under different environmental conditions. Keeping this in view, experiment was conducted at Agricultural Research Station, Kota under AICRP on Irrigation Water Management to improve productivity and water use efficiency of wheat.

Materials and Methods

Field experiment was conducted during two consecutive years from 2014-15 and 2015-16 at Agricultural Research Station, Kota. The experiment was laid out in split plot design with four replications. The bulk density, pH

and cation exchange capacity of these soils varies between 1.30-1.60 Mg/m³, 7.75-8.50 and 30-40 Cmol/kg, respectively. The soils of the region are poor in organic carbon (0.50±0.08) and available nitrogen (275±5 kg/ha) but are low to medium in available P₂O₅ (24.2± 1.0 kg/ha) and medium to high in available K₂O (290 ± 8 kg/ha).

In this experiment, treatments comprised combinations of five irrigation schedule (early milk at 88-92 DAS, late milk at 96-100 DAS, early soft dough at 102-106 DAS, late soft dough at 108-112 DAS and IW/CPE 0.8 control) and three bio-regulators (thiosalicylic acid 100 ppm, thiourea 500 ppm and control) two foliar spray at tillering and heading stage thereby making twelve treatment combinations were replicated four replications. Wheat were sown using 100 kg/ha seed rate with improved technology in second week of November and harvested in second week of April every year. Total four irrigations were applied including pre sowing irrigation during the crop season. Data were recorded under experiment during crop season and analyzed for different parameters.

Results and Discussion

Pooled data revealed that (Table 1), under last irrigation at late milk stage were recorded significantly the highest plant height (109.75 cm.), Leaf area index (5.42), dry matter accumulation at 90 DAS (801 g/m²), spike/m²(331), grain/spike (58.20), grain weight/spike (2.88 g) and test weight (41.93 g) as compare to early milk, late soft dough stage and control but it was found at par with early soft dough stage. The maximum plant height (108.07 cm.), Leaf area index (5.37), dry matter accumulation at 90 DAS (795 g/m²), spike/m² (329), grain/spike (56.97), grain weight/spike (2.87 g) and test weight (41.44 g) were recorded under foliar spray of thiosalicylic acid (100 ppm) over control.

Table.1 Effect of last irrigation scheduling and foliar spray of bio regulators on growth parameter and yield attributes of wheat

Treatment	Pl. ht. (cm)			LAI at 90 DAS			DMA at 90 DAS (g/m ²)			Spike/m ²			Grain/spike			Grain wt./spike (g)		
	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled
(A) Irrigation Schedule																		
Early milk stage	104.73	106.58	105.66	5.32	5.35	5.33	770	785	782	323	326	325	54.17	55.92	55.04	2.83	2.85	2.84
Late milk stage	108.82	110.67	109.75	5.41	5.43	5.42	798	803	801	330	333	331	57.33	59.08	58.20	2.88	2.89	2.88
Early soft dough stage	106.52	108.42	107.47	5.37	5.39	5.38	798	795	796	330	332	331	56.17	57.92	57.04	2.87	2.87	2.87
Late soft dough stage	103.72	106.00	104.86	5.26	5.28	5.27	772	778	775	320	322	321	52.33	54.08	53.20	2.80	2.82	2.81
IW/CPE 0.8	104.48	106.33	105.41	5.31	5.34	5.32	776	783	780	323	325	324	53.42	55.17	54.29	2.81	2.84	2.82
SEm±	1.12	1.07	1.00	0.02	0.02	0.01	5.64	4.69	4.75	2.19	2.15	1.99	0.89	0.81	0.78	0.01	0.01	0.009
CD (P=0.05)	3.20	3.05	3.05	0.05	0.05	0.04	16.09	13.40	14.63	6.25	6.13	6.12	2.55	2.31	2.40	0.04	0.04	0.027
(B) Bio regulator spray																		
Thiourea 0.2 % two spray	106.25	108.10	107.18	5.35	5.37	5.36	788	789	789	327	329	328	55.20	56.95	56.07	2.85	2.87	2.86
Thiosalicylic acid 100 ppm two spray	107.14	109.00	108.07	5.36	5.39	5.37	792	798	795	328	331	329	56.10	57.85	56.97	2.87	2.88	2.87
Control	103.58	105.70	104.64	5.30	5.31	5.31	774	779	776	321	323	322	52.75	54.50	53.62	2.79	2.82	2.80
SEm±	0.87	0.83	0.78	0.01	0.01	0.009	4.37	3.64	3.68	1.70	1.66	1.54	0.69	0.63	0.60	0.01	0.01	0.009
CD (P=0.05)	2.48	2.36	2.25	0.04	0.04	0.02	12.46	10.38	10.62	4.84	4.75	4.44	1.98	1.79	1.75	0.03	0.03	0.025

Table.2 Effect of last irrigation scheduling and foliar spray of bio regulators on yield, economics and WUE of wheat

Treatment	Test wt (g)			Grain yield (kg/ha)			Straw yield (kg/ha)			WUE(kg/ha-cm)			Net Return (Rs/ha)			B:C ratio		
	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled
(A) Irrigation Schedule																		
Early milk stage	40.75	41.43	41.09	4363	5152	4758	6422	6274	6348	128.33	151.54	139.94	68802	80982	74892	3.39	3.99	3.69
Late milk stage	41.67	42.18	41.93	4927	5763	5345	7149	7037	7093	144.90	169.51	157.21	79997	93048	86523	3.95	4.58	4.27
Early soft dough stage	41.45	41.96	41.71	4878	5520	5199	7013	6734	6874	143.48	162.37	152.93	78815	88252	83534	3.88	4.34	4.11
Late soft dough stage	39.92	40.43	40.18	3984	4929	4457	5806	5994	5900	117.18	144.96	131.07	60889	76561	68725	2.99	3.77	3.38
IW/CPE 0.8	40.23	40.73	40.48	4243	5050	4647	6159	6168	6164	151.55	180.36	165.96	66693	79629	73161	3.37	4.03	3.70
SEm±	0.27	0.21	0.22	158	148	140	201	182	176	4.82	4.55	4.31	3109	2910	2769	0.16	0.15	0.14
CD (P=0.05)	0.77	0.61	0.68	450	422	432	574	519	543	13.76	12.98	13.27	8874	8303	8528	0.44	0.41	0.41
(B) Bio regulator spray																		
Thiourea 0.2 % two spray	40.94	41.45	41.20	4686	5478	5082	6835	6848	6842	144.26	167.80	156.03	74684	87401	81043	3.60	4.20	3.90
Thiosalicylic acid 100 ppm two spray	41.18	41.69	41.44	4776	5647	5212	6966	7059	7013	145.75	172.97	159.36	76607	90837	83722	3.70	4.39	4.05
Control	40.29	40.91	40.60	3977	4723	4350	5728	5417	5573	121.25	144.47	132.86	61828	72844	67336	3.25	3.84	3.55
SEm±	0.21	0.17	0.17	122	114	109	156	141	136	3.73	3.52	3.33	2409	2254	2145	0.12	0.11	0.10
CD (P=0.05)	0.60	0.47	0.50	348	327	314	444	402	394	10.66	10.06	9.63	6873	6432	6194	0.34	0.32	0.30

Fig.1 General view of experiment plot



This was probably due to proper utilization of all the available and terrestrial growth resources which may be better translocation of photosynthetic from source to sink. The higher number of leaves probably higher chlorophyll content under last irrigation scheduling and foliar spray of bio regulators made the crop photo-synthetically more active. The increased leaf area in wheat might be due to better absorption of nutrients as a result of more foraging roots which ultimately led to higher dry matter accumulation. The other reason of high dry matter accumulation in wheat may be due to the significant increase in morphological parameters which are responsible for the photosynthetic capacity of the plant thereby increasing the biological yield. Similar results indicated by Bhunia *et al.*, (2006) and Datta and Chatterjee (2006).

Pooled data (Table 2) shows that under last irrigation at late milk stage were recorded significantly the highest grain yield

(5345kg/ha) and straw yield (7093 kg/ha), which is found at par with early soft dough stage as compare to early milk, late soft dough stage and control. Under the last irrigation at late milk stage was recorded significantly the highest net return (₹ 86.5 thousand/ ha) and B: C ratio (4.27) as compare to early milk, late soft dough stage and control but it was found at par with early dough stage. These results are in close proximity with those of Bhunia *et al.*, (2006), Datta and Chatterjee (2006), Dhar *et al.*, (2011) and Mehta *et al.*, (2014).

Significantly higher grain yield (5212 kg/ha) and straw yield (7013 kg/ha) of wheat were recorded under foliar spray of thiosalicylic acid (100 ppm) in pooled analysis. The maximum net returns (₹ 83.7 thousand/ ha) and benefit cost ratio (4.05) were recorded under foliar spray of thiosalicylic acid (100 ppm), which is found at par with spray of thiourea (500 ppm) over control. These results are in close proximity with those of

Bhunja *et al.*, (2006), Datta and Chatterjee (2006), Dhar *et al.*, (2011) and Mehta *et al.*, (2014).

Efficiency indices for water use were estimated in terms of water use efficiency. Pooled data of two years indicated that higher water use efficiency were observed (157.20 kg/ha-cm) under last irrigation at late milk stage and (159.36 kg/ha-cm) foliar spray of thiosalicylic acid over control (Table 2). This was associated with higher harvest index as a result of good water supply in the post-anthesis period and increased transpiration under irrigated conditions. These results are in close proximity with those of Datta and Chatterjee (2006), Dhar *et al.*, (2011) and Mehta *et al.*, (2014). Proposals to alter plant growth for the conservation of water for later extraction during reproductive growth are being researched. Shorter season cultivar that completes their life-cycles and produces a high harvest index before the available water supply is exhausted is another approach. Wheat yields have been increased in a water-limited environment by developing lines with shorter growing seasons (Mehta *et al.*, 2014). Of course, irrigation schedules that assure adequate water during reproductive growth are a direct approach to maintaining high harvest indexes. Methods that allow more of the input water to be made available for transpiration would improve overall water use efficiencies. To increase crop biomass production, more water must be used in transpiration. For water-limited environments, a greater potential apparently exists for improving water use efficiency.

In conclusion, on the basis of our investigation it could be concluded that last irrigation at late milk stage and two foliar spray of thiosalicylic acid at 100 ppm in wheat crop, gave higher yields, net return, B:C ratio and water use efficiency. It was proposed to initiate further studies on

agronomic management of irrigation scheduling and bioregulator as it will be a promising higher remunerative crop of South East Rajasthan.

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