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Performance of wheat (*Triticum aestivum* L.) cultivars to foliar spray of bioregulators under timely and late sown conditions in western Rajasthan

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Abstract
A field experiment was conducted on sandy loam soil of the Instructional Farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner during consecutive two *rabi* seasons of 2012-13 and 2014-15 to study the performance of Wheat (*Triticum aestivum* L.) Cultivars to Foliar Spray of Bioregulators under Timely and Late Sown Conditions in Western Rajasthan. The results reveal that sowing the wheat cultivars on 20th November (timely) significantly increased growth parameters *viz.*, plant height, number of tillers m^{-1} row length, dry matter accumulation m^{-1} row length, chlorophyll content of leaves, leaf area index, membrane stability index, relative water content, CGR and RGR compared to 15th December (late sowing) wheat crop.

Keywords: *Triticum aestivum* L., foliar spray, bioregulators

Introduction

Wheat (*Triticum aestivum* L.) is one of the most important staple food crops of the world as well as India. It is cultivated under diverse growing conditions of soil and climate. In India, it is the second most important food crop after rice. It is an excellent health-building food containing approximately 78% carbohydrates, 12% protein, 2% fat and minerals each and considerable amount of vitamins (Kumar *et al.*, 2011) [6]. About 80 to 85% of wheat grains are ground into flour (*atta*) and consumed in the form of *chapaties*. Soft wheat is used for making *chapaties*, bread, cake, biscuits, pastry and other bakery products. Hard wheat is used for manufacturing *rawa*, *suji* and *sewaya*. In areas where rice is a staple food grain, wheat is eaten in the form of *puri* and *uppama*. It is also used for making flakes and sweet like *kheer* and *shira*. Wheat straw is used mainly as fodder for livestock. The average productivity of wheat in the state is almost at par with the national average but still far behind in hyper arid region of western Rajasthan. Among various factors for low productivity, late planting of wheat in major wheat growing north-western region of the country is common mainly due to the intensive cropping system, which often delays the sowing of wheat even up to the middle of January. This situation is also common in western part of the state where groundnut - wheat or cotton – wheat crop sequence is practiced. Higher productivity of wheat mainly depends on total biomass production and harvest index. Biomass potential of a genotype is achieved when growth and development phases match with congenial environment conditions. Among the climatic factors, temperature and photoperiod play a key role in determining duration of different phenophases, which affect the vegetative and reproductive development and yield consequently (Slafer and Ramson, 1994) [12]. The late sown wheat crop get exposed to higher temperature of above 35 °C during grain development period, which causes yield reduction by 270 kg ha^{-1} (Nagarajan and Rane, 2002) [8].

Material and Methods

A field experiment entitled "Performance of Wheat (*Triticum aestivum* L.) Cultivars to Foliar Spray of Bioregulators under Timely and Late Sown Conditions in Western Rajasthan" was conducted during *rabi* seasons 2012-13 and 2014-15 at Instructional Farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner. The location falls under agro climatic zone- 1c (Hyper arid partially irrigated north western plain) of Rajasthan. Bikaner receives average annual rainfall of about 250 mm, out of which 80 per cent is received in *kharif* season (July to September) by the southwest monsoon. During summer, the maximum temperature may go as high as 48 °C while in the winter it may fall as low as 0

°C. This region is prone to high wind velocity and soil erosion due to dust storms in summer. The soil of the experimental field was sandy loam in texture, poor in organic carbon, low in available nitrogen, medium in available phosphorous but high in available potassium and slightly alkaline in reaction. The experiment was laid out in split plot design with three replications, (a) date of sowing: (1) timely sowing (20th november), (2) late sowing (15December) and (B) wheat cultivars: (i) Raj- 4083 (ii) Raj- 3765 (iii) Raj - 4120 (iv)Raj-1482 were assigned to main plot treatments and the foliar spray of bioregulators: (Salicylic acid (200ppm), N-acetyl-L-cysteine (20ppm), Water spray (Control) were assigned to sub plot treatments in both the years. The schedule of pre and post sowing operations done during the crop seasons. At the time of final field preparation, basal dose of 60 Kg N, 40 Kg P_2O_5 and 20 kg K_2O ha^{-1} through Urea, DAP and MOP was drilled below the seed zone. Zinc sulphate (33%) @ 25 kg ha^{-1} was also drilled along with basal application of major nutrients. The remaining ½ dose of nitrogen *i.e.*, 60 kg N ha^{-1} was top dressed in two equal splits with the first and third irrigation. The seed rates used for timely and late sowing were 100 and 125 Kg ha^{-1}, respectively. Foliar spray of bioregulators *viz*., salicylic acid (200 ppm) and N-acetyl-L-Cysteine (20 ppm) and (control) water spray were applied twice first at tillering (45 DAS) and second at heading /flowering (75 DAS) stages. For determining the leaf area Index (LAI), leaves from five randomly selected plants at 55 and 85 DAS were taken and leaf area (cm^{-2}) was measured with the help of leaf area metre (model CL 203 area metre USA). In order to evaluate the effect of treatments on growth necessary periodically observation were recorded for each parameter as per methodology briefly described in the following paragraph:
The LAI was worked out with the following formula

$$\text{LAI} = \frac{\text{Total leaf area}}{\text{Total land area}}$$

Crop growth rate (CGR)
Crop growth rate (CGR) of plant for time ‘t’ is defined as the increase in dry weight of plant material from a unit area per unit time as CGR was calculated by the following formula (Radford, 1967) [15] and expressed as g m^{-1} day^{-1}.

$$\text{CGR } (\text{g m}^{-1}\text{ day}^{-1}) = \frac{W_2 - W_1}{t_2 - t_1}$$

Where,
w_1= Total dry weight of plant at time t_1
w_2 = Total dry weight of plant at time t_2
t_1 = Time at first observation
t_2 = Time at second observation

Relative growth rate
Relative growth rate (RGR) of a plant at an instant for time interval ‘t’ is defined as increase in dry weight of plant per unit of material present per unit of time. The mean relative growth rate (RGR) of the crop was calculated by the following formula (Radford, (1967) [15].

$$\text{RGR } (\text{g g}^{-1}\text{ day}^{-1}) = \frac{\text{Log } W_2 - \text{Log } W_1}{t_2 - t_1}$$

Where,
W_1 = Total dry weight of plant at time t_1
W_2 = Total dry weight of plant at time t_2
t_1 = Time at first observation
t_2 Time at second observation

The statistical analysis of the data on growth characters, yield attributes, yield and quality parameters were done by using the analysis of variance technique. Significance of the differences between treatment effects was tested by 'F' test

Results and Discussion
Data (Table1) revealed that timely sowing of wheat (20th November) significantly increased plant height, leaf area index, crop growth rate, relative growth rate, dry matter accumulation and total tillers per metre row length at harvest over late sowing (15th December). Timely sowing results in maximum total tillers per metre row length which was 15.33 per cent higher over late sowing (86.06). The increase in wheat growth and vigour of the crop in case timely sowing seems to be on account of exposure of plants to favourable climatic condition particularly the temperature. While under late sowing prevalence of low temperature at early stage and high temperature above 25 ^{0}C at terminal phase of the crop adversely affected the growth and development of wheat crop. In the present study, increased number of tillers under timely sowing, compared to late sowing seems to be on account of congenial climatic conditions resulted increased availability of adequate metabolites as evidenced from increased dry matter accumulation (Table1). At the same time, better tillering might have helped the plants to improve their photosynthetic efficiency by providing optimum ground coverage *i.e*., (LAI) (Table2). Further, revealed that timely sowing recorded significantly higher LAI, crop growth rate and relative crop growth rate compared to late sowing of wheat (Table 2). The overall improvement in all above cited growth indices might have contributed to higher biomass accumulation at different growth stages and finally at harvest in case timely sowing. The better growth and development under timely sowing compared to late sowing as evident in the present study are in close agreement with the findings of Yadav (2005) [14] and Tripathi *et al*., (2012) [13] who reported higher growth of wheat crop in terms of number of tillers, dry matter accumulation, and crop growth rate under timely sowing. Several researchers at different locations Haryana (Kumar *et al*., 2000) [5] and at Birsa (Alam *et al*., 2013) [1] also reported almost similar in respect of findings growth parameters of wheat under timely sown condition.
The four wheat cultivars showed non-significant variations in plant height during both the years and on pooled data basis. Raj 4120 recorded significantly higher growth parameters as compared to other cultivars. The wheat cultivar Raj 1482 recorded significantly less leaf area index at 85 DAS as compared to Raj 4083, Raj 3765 and Raj 4120. Wheat cultivar namely Raj 4083, Raj 3765 and Raj 4120 were recorded 10.02, 11.07 and 11.40 per cent higher total tillers per metre row length over cultivar Raj 1482 (85.69), respectively. It is an established fact that yield potential of a crop/ cultivar is an outcome of interaction of genetic, environmental and agronomic manipulations. Since, all wheat cultivars were grown under identical agronomic management practices and environmental conditions in timely sowing or late sowing however, the observed variation in overall growth in different cultivars seems to be to their genetic milieu. The significant increase in biomass production in wheat cultivar Raj 4120

could be ascribed due to its higher tillering potential (Table 2), which might have facilitated faster canopy development (*i.e*., leaf area index) (Table 2). Relative growth rate during (30-60, 60-90 and 90 to harvest) over Raj 4083, Raj 3765 and Raj 1482 (Table 2). Thus the improvement in these growth characters might have led to higher interception and absorption of solar energy, there by resulting more photosynthesis and conversion of solar energy to greater dry matter accumulation (Table 2).

It is established fact that for realizing growth potential of a plant to the fullest extent, its life cycle should match with the growing season and timing of its major growth stages must be coincide with required sequence of climatic conditions. The shorter duration of vegetative period of wheat cultivar Raj 4120 has inherent capabilities, matched its vegetative growth with optimum temperature available under prevailing climatic conditions. Thus, climate might have helped the plants to efficiently utilize prevailing solar radiation. Whereas, the longer duration of other wheat cultivars faced adverse climatic conditions, especially at maturity stage which coincided high temperature above 25 ^{0}C resulting in to sub optimal grain filling and forced maturity. The marked variations in growth and development among different cultivars have been noticed by Sharma (2000) [11] and Prabhakar *et al*. (2003) [10] in wheat as well.

Data (Table1 and 2) further show that foliar spray of N-acetyl-L- cysteine (20 ppm) at 45 and 75 DAS significantly increased plant height at harvest, growth indices(leaf area index, crop growth rate, relative growth rate) and dry matter accumulation over foliar spray of salicylic acid (200 ppm) and water spray (control) during both the years and pooled data basis. Foliar sprays of bioregulators *viz*., N-acetyl-L- cysteine (20 ppm) and Salicylic acid (200 ppm) at 45 and 75 DAS significantly increased the plant height of wheat at maturity (Table 1) dry matter accumulation at later growth stages and at maturity (Table 1) Dry matter accumulation at early growth stage (30 DAS) though did not due to foliar sprays of bioregulators treatments because sprays treatments was given at 45 and 75 DAS. Leaf area index recorded at 85 DAS significantly increased by foliar sprays of bioregulators (Table 2). Thus these favorable influences of salicylic acid brought significant improvement in the plant height, dry matter accumulation per metre row length and effective tillers m^{-1} row length altogether resulted in higher biomass (biological) yield during both the years. Amin *et al*., (2008) [2] reported that salicylic acid at 100 mg L^{-1} was the most effective in increasing growth parameters, whereas, growth characters of wheat plants significantly decreased by increasing salicylic acid concentration up to 400 mg L^{-1} at milky and softy- dough stages. Ali and Mahinoud, (2013) [3] reported that the salicylic acid at 150 ppm concentration was more pronounced than other concentrations as well as the control. The highest values of plant height and branches per plant (76.7 cm and 5.2 branches per plant in first season and 79.30 cm and 6.1 branch per plant in second season) were registered at concentration of 150 ppm salicylic acid. These results may be due to the role of salicylic acid in enhancing some physiological and biochemical aspects (Maity and Bera, 2009) [7]. The stimulation effect of salicylic acid on plant growth was confirmed by EI-Shraiy and Hegazi, (2009) [4] on pea plant and Nagasubramaniam *et al*., (2007) [9] who reported that application of 100 ppm of salicylic acid to baby corn increased plant height, leaf area, and growth rate.

Table 1: Effect of sowing dates, wheat cultivars and bioregulators spray on plant stand and plant height (cm), dry matter accumulation per metre row length (g)

Treatment	Plant stand per metre row length at harvest			Plant height at harvest (cm)			Dry matter accumulation per metre row length (g)		
	2012-13	2014-15	Pooled	2012-13	2014-15	Pooled	2012-13	2014-15	Pooled
A. Sowing dates									
Timely Sowing (20th November)	22.87	22.50	22.69	85.53	83.58	84.59	219.56	206.73	213.14
Late Sowing (15th December)	23.13	22.74	22.94	76.19	72.59	74.39	190.34	178.82	184.58
S.Em±	0.21	0.18	0.14	1.54	1.76	1.17	2.63	2.61	1.85
CD at 5%	NS	NS	NS	4.67	5.34	3.39	8.42	8.34	5.50
B. Wheat cultivars									
Raj 4083	22.77	22.40	22.58	82.29	79.24	80.77	208.30	196.21	202.25
Raj 3765	22.92	22.55	22.73	82.64	79.99	81.31	209.04	195.21	202.13
Raj 4120	23.12	22.74	22.93	82.47	80.23	81.35	210.90	198.66	204.78
Raj 1482	23.20	22.80	23.00	76.03	72.87	74.45	191.56	181.02	186.29
S.Em±	0.30	0.26	0.20	2.18	2.49	2.10	2.99	2.96	2.10
CD at 5%	NS	NS	NS	NS	NS	NS	9.06	8.96	6.08
C. Bioregulators spray*									
Salicylic acid (200 ppm)	23.03	22.65	22.84	80.98	77.60	79.29	204.57	191.68	198.12
N- acetyl- L- cysteine (20 ppm)	22.93	22.55	22.74	83.24	80.84	82.04	212.58	200.48	206.53
Water spray (Control)	23.05	22.66	22.86	78.36	75.81	77.08	197.70	186.17	191.93
S.Em±	0.24	0.19	0.15	0.79	0.52	0.47	0.78	0.90	0.60
CD at 5%	NS	NS	NS	2.24	1.48	1.33	2.24	2.60	1.68

*Foliar spray at 45 and 75 DAS, NS, Non- significant

Table 2: Effect of sowing dates, wheat cultivars and bioregulators spray on chlorophyll content of leaves and leaf area Index

Treatment	Crop growth rate Relative growth rate (g m^{-1} day^{-1}) (g^{-1} g^{-1} day^{-1})						Total tillers per metre Leaf area index row length at harvest					
	60-90 DAS			60-90 DAS						85 DAS		
	2012-13	2014-15	Pooled	2012-13	2014-15	Pooled	2012-13	2014-15	Pooled	2012-13	2014-15	Pooled
A. Sowing dates												
Timely Sowing (20th November)	3.61	3.41	3.51	2.15	2.13	2.14	102	96.28	99.25	3.97	3.85	3.91
Late Sowing (15th December)	3.13	2.92	3.03	2.09	2.07	2.08	88.6	83.49	86.06	3.50	3.39	3.45
S.Em±	0.07	0.09	0.06	0.08	0.01	0.007	2.03	2.10	1.46	0.04	0.04	0.03
CD at 5%	0.22	0.29	0.17	0.026	0.03	0.02	6.16	6.37	4.23	0.12	0.12	0.08
B. Wheat cultivars												
Raj 4083	3.42	3.23	3.32	2.14	2.11	2.12	97.1	91.47	94.28	3.79	3.68	3.74
Raj 3765	3.46	3.20	3.33	2.14	2.10	2.12	98.0	92.33	95.17	3.82	3.71	3.77
Raj 4120	3.37	3.20	3.28	2.13	2.10	2.12	98.3	92.61	95.46	3.83	3.72	3.78
Raj 1482	3.22	3.05	3.14	2.15	2.08	2.09	88.2	83.13	85.69	3.49	3.38	3.43
S.Em±	0.10	0.13	0.08	0.01	0.01	0.01	2.87	2.97	2.06	0.05	0.06	0.04
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	5.98	0.17	0.18	0.11
C. Bioregulators spray*												
Salicylic acid (200 ppm)	3.40	3.16	3.28	2.13	2.09	2.11	95.0	89.57	92.33	3.72	3.61	3.67
N- acetyl- L- cysteine (20 ppm)	3.41	3.25	3.33	2.13	2.11	2.12	99.0	93.31	96.18	3.86	3.74	3.80
Water spray (Control)	3.30	3.10	3.20	2.12	2.09	2.10	92.1	86.77	89.44	3.62	3.51	3.57
S.Em±	0.03	0.02	0.02	0.00	0.00	0.002	0.73	0.56	0.46	0.01	0.01	0.01
CD at 5%	0.10	0.06	0.06	0.01	0.00	0.006	2.10	1.62	1.30	0.03	0.03	0.02

*Foliar spray at 45 and 75 DAS, NS, Non- significant

References

1. Alam P, Kumar S, Ali N, Manjhi RP, Kumari N, Lakra RK, *et al*. Performance of wheat varieties under different sowing dates in Jharkhand. Journal of Wheat Research. 2013;5(2):61-64.
2. Amin AA, Rashad El-Sh M, Fatma AEG. Changes in morphological, physiological and reproductive characters of wheat plants as affected by foliar application with salicylic acid and ascorbic acid. Australian Journal of Basic and Applied Sciences. 2008;2(2):252-261.
3. Ali EA, Mahmoud AM. Effect of foliar spray by different salicylic acid and zinc concentrations on seed yield and yield components of mungbean in sandy soil. Asian Journal of Crop Science. 2013;5(1):33-40.
4. EI- Shraiy AM, Hegazi AM. Effect of acetylsalicylic acid, indole- 3 bytric acid and gibberellic acid on plant growth and yield of pea (*Pisum sativum* L.). Australian Journal of Basic Applied Science. 2009;3:3514-3523.
5. Kumar P, Hiremath SM, Deshmukh PS. Influence of growth regulator on dry matter accumulation and yield of soyabean genotypes. (In) Proceeding of National seminar on Plant Physiology, 30 December 1999 to 1 January 2000, Udaipur; c2000. p. 119-122.
6. Kumar P, Yadav RK, Gollen B, Kumar S, Verma RK, Yadav S. utritional contents and medicinal properties of wheat. Life Science and Medicine Research. Volume LSMR-22; c2011.
7. Maity U, Bera AK. Effect of exogenous application of brassinolide and salicylic acid on certain physiological and biochemical aspects d green gram (*Vigna radiate* L.). Indian Journal of Agricultural Research. 2009;43:194-199.
8. Nagarajan S, Rane J. Physiological trails associated with yield performance of spring wheat (*Triticum aestivum* L.) under late conditions. Indian Journal of Agricultural Science. 2002;28:135-140.
9. Nagasubramaniam A, Pathmanabhan G, Mallika V. Studies on improving productions potential of baby corn with foliar spray of plant growth regulators. Annual Plant Physiological. 2007;21:154-157.
10. Prabhakar BN, Halephati AS, Pujari BT, Desai BK. Pattern of dry matter accumulation in wheat genotypes as influenced by sowing dates. Karnataka Journal of Agricultural Sciences. 2003;16(1):26-30.
11. Sharma K, Ram N, Singh M. Effect of sowing time on radiation use efficancy of wheat cultivars. Journal of Agronomy Meteorology. 2000;2(2):166-169.
12. Slafer GA, Ramson HM. Sensitivily of wheat phasic development to major environment factors: a re-examination of some assumptions made by physiologists and modelers. Australian Journal of Plant Physiology. 1994;21:393-426.
13. Tripathi NS, Mundra SL, Bandi B. Phenology and productivity of wheat as influenced by thermal regimes. Extended Summaries Vol. 2:3rd International Agronomy Congress, 2012, New Delhi, India; c2012.
14. Yadav LR. Effect of bioregulators on productivity of wheat (*Triticum aestivum* L.) varieties under normal and late sown conditions. Ph.D. Thesis, Rajasthan Agricultural University, Bikaner; c2005.
15. Radford PJ. Growth analysis formulae-their use and abuse 1. Crop science. 1967 May;7(3):171-175.